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A Qualitative Study of African American Women in Engineering Technology Programs in Community Colleges

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A QUALITATIVE STUDY OF AFRICAN AMERICAN WOMEN IN ENGINEERING TECHNOLOGY PROGRAMS IN COMMUNITY COLLEGES

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Educational Leadership

by
Jacquelyn Blakley
May 2016

Accepted by:
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ABSTRACT

This study examined the experiences of African American women in engineering technology programs in community colleges. There is a lack of representation of African American women in engineering technology programs throughout higher education, especially in community/technical colleges. There is also lack of representation of African American women in careers related to engineering. The enrollment for African American women students in engineering technology programs is minimal compared to the overall student enrollment in the programs. Previous research focuses on minorities in engineering programs in higher education but does not focus specifically on African American women in engineering technology programs in community colleges.

The purpose of the study was to generate an interpretation related to the social and institutional support associated with the community college. The research method was used to obtain data from students so that they could share their personal and academic experiences prior to attending the community colleges and while enrolled in the community colleges. The theories supporting the study included Tinto’s theory of student departure and the “prove-them-wrong” syndrome. The research questions associated with the study were: What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina and what are the experiences of women while they are enrolled in engineering technology programs in technical colleges in South Carolina? Utilizing interpretive research, the researcher used semi-structured interviews to gather data from the participants. The participants provided detailed and informative data concerning their experiences prior to enrolling in the
engineering technology programs and while enrolled in the engineering technology programs. The findings revealed six themes. Two themes emerged from the factors that influence women to major in engineering technology programs: family influence encouraged participants to be successful; and prior experiences from previous jobs, military, and other educational experiences played a part in participant’s determination to succeed. Four themes emerged from the second research question: positive experiences with instructors and students that encourage students to remain enrolled in college; negative experiences with instructors and students that cause students to question whether they should remain enrolled in college; preparation, academically and socially, impacted the students’ perception of the college experience; and students felt a sense of isolation, which caused them not to participate in college activities. The implications of the findings are discussed. Recommendations are provided for additional research associated with African American women in engineering technology programs in the southeastern states and research to include a follow up study on the existing participant pool.
DEDICATION

This dissertation is dedicated to my family. Without God and them, I would not have succeeded. To my husband Milt, and my children, Sterlin, Briana and Jamal, you have been my anchor. I realize that there have been some long days and nights, but thank you so much for your love, patience and understanding.
ACKNOWLEDGMENTS

I would like to take the time to acknowledge all who have supported me throughout this process. First, I give all honor and praises to God for giving me the knowledge and ability to succeed in this endeavor. Without him, none of this would have been possible. To my family, my loving husband, Milton, you have been there for me, and you have been patient and understanding. Thanks so much for everything. To my wonderful children, you challenged me and encouraged me to continue. Because of your tenacity and successes, I was motivated to continue and set that positive example. To my mother and sister, thanks for always being there to support me, encourage me and help me do things when I was in class or studying. To my aunts, you have supported me in more ways than you can imagine. You have always been there for me and you didn’t give up on me. You always pushed me to keep going and I appreciate that so much. To my Pastor, Dr. Ronnie Williams, you set the example, encouraged me, and so many times had messages that I thought were just for me. It was all confirmation that this process was all in God’s hands. To my “special” cousins, other family and friends, you have truly been there for me. So many of you have prayed for me, listened to me, encouraged me, helped me and supported me in more ways than you know. To my friend, Vanessa, you are awesome. Thanks so much for your patience and your professionalism in helping with this document. To the Generostee Baptist Church family, you are my rock. To my work family, you have supported me and challenged me, and for this I say thank you. Thank you may seem so small, but it is coming from the depths of my heart. I appreciate what everyone has done.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE PAGE</td>
<td>i</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>iv</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>I. CHAPTER ONE</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>5</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>9</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>10</td>
</tr>
<tr>
<td>Conceptual Framework for the Study</td>
<td>12</td>
</tr>
<tr>
<td>Research Questions</td>
<td>13</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>13</td>
</tr>
<tr>
<td>Design and Methodology</td>
<td>14</td>
</tr>
<tr>
<td>Delimitations</td>
<td>16</td>
</tr>
<tr>
<td>Assumptions of the Study</td>
<td>17</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>18</td>
</tr>
<tr>
<td>Organization of the Study</td>
<td>19</td>
</tr>
<tr>
<td>II. CHAPTER TWO</td>
<td>21</td>
</tr>
<tr>
<td>Overview</td>
<td>21</td>
</tr>
<tr>
<td>Gaps in Engineering</td>
<td>22</td>
</tr>
<tr>
<td>Engineering Workforce Development in the Community College</td>
<td>24</td>
</tr>
<tr>
<td>Barriers for Women in STEM</td>
<td>26</td>
</tr>
<tr>
<td>Women of Color in Engineering</td>
<td>31</td>
</tr>
<tr>
<td>Research on Women</td>
<td>32</td>
</tr>
<tr>
<td>African American Women in Engineering</td>
<td>35</td>
</tr>
</tbody>
</table>
Table of Contents (Continued)

The Role of Community Colleges .......................................................... 36
Summary .............................................................................................. 37

III. CHAPTER THREE ............................................................................. 39

Overview ............................................................................................ 39
Research Design .................................................................................. 39
Research Questions ............................................................................. 42
Research Setting .................................................................................. 42
Participants ......................................................................................... 42
Role of the Researcher ......................................................................... 44
Instrument Used .................................................................................. 44
Interview Questions ............................................................................. 45
Data Collection .................................................................................... 47
Data Analysis ....................................................................................... 49
Ethical Considerations ........................................................................ 51
Summary ............................................................................................ 52

IV. CHAPTER FOUR ................................................................................ 54

Data Analysis ....................................................................................... 54
Description of the Participants ............................................................. 55
Interview Analysis – Participant 1 ....................................................... 55
Interview Analysis – Participant 2 ....................................................... 59
Interview Analysis – Participant 3 ....................................................... 64
Interview Analysis – Participant 4 ....................................................... 68
Interview Analysis – Participant 5 ....................................................... 71
Interview Analysis – Participant 6 ....................................................... 72
Interview Analysis – Participant 7 ....................................................... 79
Themes ............................................................................................... 85
Research Questions ............................................................................. 96
Summary ........................................................................................... 99

V. CHAPTER FIVE .................................................................................. 100

Summary, Findings, Recommendations
and Implications ................................................................................ 100
Summary ............................................................................................ 100
Summary of Design and Theoretical Perspective ............................... 100
Discussion of Major Findings .............................................................. 102
Recommendations .............................................................................. 110
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitations</td>
<td>113</td>
</tr>
<tr>
<td>Recommendations for Future Research</td>
<td>115</td>
</tr>
<tr>
<td>Summary</td>
<td>116</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>119</td>
</tr>
<tr>
<td>A: IRB</td>
<td>120</td>
</tr>
<tr>
<td>B: Research Site Letter</td>
<td>121</td>
</tr>
<tr>
<td>C: Sample Recruitment Letter or Email</td>
<td>122</td>
</tr>
<tr>
<td>D: Informed Consent</td>
<td>123</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>125</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Participant Characteristics</td>
<td>86</td>
</tr>
<tr>
<td>4.2 Research Questions</td>
<td>88</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>12</td>
</tr>
</tbody>
</table>

1.1 Conceptual Framework for the Study

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CHAPTER ONE

INTRODUCTION

African American women are a large part of the population of the college enrollment in the United States (National Science Foundation [NSF], 2015). More than 11 million students are presently enrolled in community colleges in the United States, which represents 45% of the college population nationally (Strayhorn & Johnson, 2014). The intent for most of the students who enroll in community colleges is to transfer to a four-year college, but most do not transfer (Strayhorn & Johnson, 2014). Of the 81% of first-time community college students, most intend to obtain a bachelor’s degree, but less than 12% reach that goal (Strayhorn & Johnson, 2014). Racialized gaps exist in community college student degree completion and African-Americans have the lowest completion of all races (Strayhorn & Johnson, 2014). Although there have been gains in enrollment related to ethnic and racial diversity, degree attainment for these individuals has remained about the same (Strayhorn & Johnson, 2014). According to Cohen and Brower (2008), “In 2004, minority students constituted 36.5% of all community college enrollments nationwide” (p. 53). This increase in enrollment was up from 20 percent in 1975 (National Center for Education Statistics [NCES] Digest, 2005). Community colleges enroll more than 57% of female students and 38% of minority students in the student population pool (NCES, 2003). Enrollments among African Americans at community colleges are increasing faster than any other postsecondary sector (Lewis & Middleton, 2003). Although African American students are enrolling at higher numbers, many fail to persist through the programs. For all racial and ethnic groups, the total
number of bachelor’s degrees earned, the number of science & engineering (S&E) bachelor’s degrees earned, and the number of bachelor’s degrees in most S&E fields have increased since 2000 (NSF, 2015). Community colleges, more than any other higher education institution, are responsible for educating students from diverse and racial backgrounds (Laden, 2004).

From 1990 to 2000, full and part-time enrollment at community colleges increased from 5.2 million to 5.9 million students (NSF, 2004). Along with this overall increase of students, underrepresented minority enrollment increased 65 percent (NSF, 2004). In 2008, 35% of all college students attended a community college at some point during their higher education experience, and women outnumbered men in community college attendance in comparison to those who attended four-year institutions (Provasnik & Planty, 2008). Of all bachelor degrees awarded from 2009-2010, 57% were conferred to women and 62% of associates degrees were conferred to women during this same time period (Aud et al., 2012).

Although community college education is increasing in importance, little is known about women’s pathways through engineering technology programs at community colleges (Calcagno, Crosta, Bailey & Jenkins, 2007). The lack of information related to engineering education in community colleges is partly attributed to the lack of attention that researchers give community colleges as an important source for developing and promoting engineering education and careers (Calcagno et al., 2007). Enrollment among women in engineering degrees has increased over the last 20 years, but it is still substantially lower than the enrollment of men in engineering at all degree levels. Since
1993, the proportion of women in masters and doctorates levels has increased more than any other degree levels in engineering (NSF, 2015). Despite gains in enrollment, the gap between minority enrollment and Whites remains large.

Underrepresented students are less likely to graduate from high school, enroll in college and earn a college degree (NSF, 2015). Since 1993, the share of underrepresented students with bachelors and master’s degrees in engineering has increased, but the proportion of these students with doctorate degrees has flattened. (NSF, 2015). Underrepresented minority groups tend to earn a higher proportion of associate’s degrees than other degrees (Ong, Wright, Espinosa and Orfield, 2011). The science and engineering (S&E) bachelor’s degree is the most prevalent among all students. Degrees awarded in this area rose from “400,000 in 2000 to more than 550,000 in 2011” (National Science Board [NSB], 2014, p 2-25). Although the percentage of underrepresented minority groups earning bachelor’s degrees has increased, there still exists a gap. In 2011, “the percentage of the population ages 25-29 with bachelor’s or higher degrees was 20% for Blacks and 39% for Whites” (NSB, 2014, p. 2-26). Since 2000, the proportion of underrepresented students’ degrees in engineering has been flat. “From 1984 to 2004, both the absolute number and proportion of all under-represented minority groups increased while overall U.S. freshman enrollment in engineering declined” (Trenor et al., 2008, p. 449). Underrepresented minority women earned more than half of the degrees in science and engineering in relation to those degrees that were awarded to others in their respective racial and ethnic groups (NSF, 2015). But, in order for students to succeed
and earn degrees in engineering or any other program, they must be retained in the program (Lichtenstein, Chen, Smith & Maldonado, 2014).

African American women face the challenge of being a female in a male-dominated field and being an underrepresented minority in a STEM discipline (Jackson, Starobin & Laanan, 2013). The challenges are compounded when gender and race become two of the major factors of consideration (Jackson, Starobin, & Laanan, 2013). The stereotype that STEM is associated with men is one of the main reasons that there is gender disparity in STEM participation (O’Brien et al., 2014). Much of the research that has investigated the underrepresentation of women in STEM has included European American women or studies that fail to identify the ethnic background of participants (Diekman, Clark, Johnson, Brown & Steinberg, 2011). African American women are underrepresented in STEM degrees relative to European women, but they are also underrepresented in all degree areas relative to European women (O’Brien et al., 2014).

African American women can make a significant contribution to society and help the United States to compete successfully in the global economy, but in order for this to happen, they must be educated to get the jobs that are available. African American women continue to be severely underrepresented in engineering programs in higher education and in engineering career fields (NSF, 2015). Despite this fact, little research has been done to investigate why African American females have limited enrollment in engineering technology programs in technical colleges and why African American women fail to persist in engineering career paths. Much of the previous literature is related to overall underrepresented student enrollment in science, technology,
engineering and math (STEM) related fields and fails to specifically address the issues of African American women and community or technical colleges (Espinosa, 2011). Surprisingly, scholarly work that intersects gender and race/ethnicity is slim in both quantity and empirical rigor, in light of literature that has emerged from the civil rights and feminists movements (Espinosa, 2011).

**Statement of the Problem**

African Americans remain underrepresented in engineering majors and careers in comparison to their U.S. population representation (Barton, 2003). In 2004, the U.S. Census Bureau predicted that demographics would shift and estimated that African Americans would be one of the fastest growing portions of the American population (Barton, 2003). The growth was estimated to equate to 45 percent, which compared to an only one percent increase in the White population (Barton, 2003). The increase in the African American population is needed to keep up with engineering demands. Along with the increase in persons from diverse ethnic backgrounds is the need to “understand their perceptions of the field, educational experiences, and perceived barriers and supports relating to engineering education and career plans” (Trenor et al., 2008, p. 449). Stereotypes exist that suggest that women do not belong in STEM programs, which includes engineering. With this stereotypical attitude, it helps to explain why men still dominate the STEM fields (Warren et al., 2013). More than 20 years has passed since STEM fields began recruiting women and the number of women who have enrolled into STEM programs has declined (Warren et. al, 2013). Agencies such as the National Science Board and the National Academy of Engineering have recognized that
community colleges can take on the role of increasing workforce competency (Starobin & Laanan, 2008). Community colleges help serve the purpose for this type of education. Programs are now in place through the National Science Foundation that support implementation strategies to lead to an increase in the number of community college students who pursue STEM (Starobin & Laanan, 2008). These programs ultimately encourage development and participation for traditionally underrepresented student populations which include: “low income, ethnic and racial minorities, persons with disabilities, and women” (Starobin & Laanan, 2008, p. 38).

   Enrollment in science areas has increased relative to overall higher education enrollment, but engineering enrollment as a whole has decreased based on data from 1993-2007 (Trenor et al., 2008). Since the 1980s, little progress has been made in recruiting and maintaining women and minorities in engineering technology programs, although there has been an increase in the number of women and underrepresented minorities enrolled in undergraduate programs (Trenor et al., 2008). In the workforce, as well as all postsecondary academic levels, women are underrepresented in many science fields and engineering (Trenor et al., 2008). Many of the obstacles that were present for women and underrepresented minorities fifty years ago are still present today (Trenor et al., 2008). Retention is one result of those obstacles.

   Retention is a serious issue in community colleges (Ong, Wright, Espinosa, & Orfield, 2011). Retention, overall, at community colleges is a major goal. Economically, it is better to keep students that you already have, rather than continuously recruit new students. “Improving recruitment and retention in STEM fields is a critical challenge
facing the nation” (Ong et al., 2011, p. 173). U.S. educators and policy makers should not only foster learning pathways for those interested in pursuing education and careers in STEM, but educators should reach out to those who may be capable of excelling in STEM, but may not have shown that interest. At almost every step in the STEM pipeline, women are represented more than men (O’Brien et al., 2015). African American women, in particular, represent an untapped potential that could serve to bridge the gap to provide the workforce for sustaining the economic vitality of the U.S. (Ong et al., 2011).

The United States population is now of a racial, ethnic/minoritized background, but these diverse individuals are poorly represented in STEM and overrepresented in community colleges (Ong et al., 2011). In order for the United States to successfully compete in the global economy, a diverse workforce is needed (Ong et al., 2011). Women and men of different ethnicities are needed to fill the gap (Ong et al., 2011). The United States’ reputation of having the most prepared workforce in STEM is being challenged because of the lack of those who are prepared to enter the workforce and assume the demand in the workforce (Starobin & Laanan, 2008). The United States needs to prepare workers and to accomplish this goal, there is a need to educate women and underrepresented students. Community colleges can serve as a stepping stone to the STEM-related fields (Starobin & Laanan, 2008). With this substantial percentage of racial and ethnic minorities and women, this pool of students in community colleges can serve as a potential group to fill the nation’s science, technology, engineering and mathematics (STEM) workforce needs (Starobin & Laanan, 2008).
A gender gap exists in the career and academic achievement for men and women in engineering (Hanson, 2012; Jackson & Laanan, 2011). Although women are advancing and have earned more doctoral degrees than ever before, especially in fields such as biology, women are still underrepresented in engineering and computer science (Heilbronner, 2013). Studies show that young boys and girls who have a talent in STEM seem to engage in it at an early age, but along the way, women fail to perform as well on assessments related to mathematics. In the workforce, women represent half of the workforce but only 25% of the STEM workforce (Heilbronner, 2013). Women are not as likely to enroll-full-time as undergraduates. Underrepresented minorities are less likely to enroll as undergraduates than whites and Asians, according to a 2013 report on from the National Science Foundation. Among all racial/ethnic groups, women are enrolling in college at greater numbers than men. Of the employed scientists and engineers, minority women are only about 1 in 10 of those individuals (NSF, 2011). The composition of undergraduate enrollment is changing in the U.S. and reflects that there is a growth in the number of undergraduate students where minorities are an increasing fraction and whites are a decreasing fraction (NSF, 2011). Blacks and other ethnic minority groups are less likely to attend college or graduate, but when they do persist, the degrees that they choose are similar to those of whites (NSF, 2011).

STEM occupations will increase by 22% between 2004 and 2014, according to the Bureau of Labor Statistics (Terrel, 2007). The ethnic make-up of the workforce is rapidly changing and underrepresented groups will increase to almost half of the workforce by 2050 (Cole and Espinoza, 2008; May & Chubin, 2003). The need for
engineers is particularly rising. Women and minorities make up a large portion of the labor pool that can assist with the need for more engineers, but women and minorities receive fewer degrees than white men (Anderson et al., 2006; Brown et al., 2005; Cole & Espinoza, 2008; French et al., 2005; Johnson, 2007; Kissinger et al., 2009; Marra et al., 2009; Tate & Linn, 2005). Continued research that focuses on women and underrepresented students in engineering is critical to the growth of engineering and other STEM programs.

**Purpose of the Study**

The purpose of the study was to investigate the experiences of African American women enrolled in engineering technology programs in technical colleges in South Carolina. Specifically, the study sought to investigate the positive experiences and challenges that these women faced prior to enrolling in technical college engineering technology programs and experiences and challenges while enrolled in the engineering technology programs. The study focused on the pre-college experiences of the African American women, to include their family backgrounds and K-12 education. The second focus was on the experiences of the women while they were enrolled in the engineering technology programs to include their academic experiences, social experiences, extra-curricular activities and any other obstacles that they may have faced. And, finally, the emphasis was on the post-education plans of the students, to include plans after graduation and plans 5 to 10 years in the future.

The purpose of this study was to generate an interpretation at the substantive level related to the social and institutional support associated with the community college
To learn more about the student experiences, semi-structured interviews were conducted with enrolled students in engineering technology programs in South Carolina technical college programs.

**Theoretical Framework**

The theoretical framework for the study incorporated Tinto’s theory (1993) of student departure as well as the “prove-them-wrong syndrome” to help explain the experiences of African American women prior to enrolling in community college engineering technology programs and their experiences while enrolled in community college engineering technology programs. Tinto’s model was developed to explain retention and explains that students depart from institutions without completing degrees because of the nature of their interactions with the college or university. The students and college administrators define success in different ways. The students do not necessarily consider departure as a failure. Tinto (1987)

claimed that students enter higher education with unique and individual characteristics ranging from socioeconomic circumstances, family support, clarity of purpose for higher education, and cultural and social values (p. 17).

Tinto’s model encompasses the linkages of academic integration and social integration. The association with Tinto’s model (1993) and African American women in engineering technology programs in technical colleges is that it helps to explain what determines whether these students stay in or drop out of colleges, and especially whether the students remain in the engineering technology programs. This framework allows for an
explanation of the lack of African American women in engineering technology programs in technical programs in South Carolina.

In a study by Moore, Madison-Colmore and Smith (2003), “the “prove-them-wrong syndrome” was offered as the core theoretical framework for understanding and explaining the phenomenon of persistence for African American males” (p. 66). When individuals are threatened with a negative stereotype, the individuals work to disprove the stereotype. Several of the African American female participants referenced that they wanted to succeed in spite of others saying that they would not succeed. The prove-them-wrong syndrome is also evident in social and academic domains where the African Americans are scarcely represented and may feel that they experience or have experienced negative perceptions. Although the “prove-them-wrong” syndrome was based on an African American male population, it is applicable to African American women as well.
Conceptual Framework for the Study

The conceptual framework for the study included Tinto’s theory of student departure and the “prove-them-wrong syndrome,” the research questions, the setting, the interviews and the methodology. A visual depiction of the conceptual framework is shown in Figure 1 below.

Figure 1.1: Conceptual Framework for the Study

The conceptual framework for the study illustrates the exploration of African American women in engineering technology programs in community colleges as it relates to their pre-college experiences, their experiences while enrolled in engineering technology programs and their post-education plans. The components of the conceptual framework of study (pre-college experiences, experiences while enrolled in engineering technology programs and post-education plans) were explored in terms of Tinto’s theory.
of student departure and the “prove-them-wrong syndrome.” Both theories were
grounded in practice by using interpretive research.

**Research Questions**

The major questions guiding this study were:

1. What are the main factors that influence women to major in engineering
technology programs in technical colleges in South Carolina?
2. What are the experiences of women while they are enrolled in engineering
technology programs in technical colleges in South Carolina?

This qualitative study examined the experiences of women enrolled in
engineering technology programs in technical colleges in South Carolina.

**Definition of Terms**

The following definitions or classifications were used in the study to help provide
clarification.

1. *STEM was* defined as Science, Technology, Engineering and Math education
majors and career fields (Lichtenstein, Chen, Smith & Maldonado, 2014).
2. *Minorities in STEM* were defined as those women or people of color who remain
underrepresented in STEM (Terenzini, Lattuca, Ro & Knight, 2014).
3. *Underrepresented populations* were defined as women and people of color.
4. *People of color (Ethnic Minority)* were defined as American Indian/Alaska
Natives, Blacks, Hispanics, and Pacific Islanders (Tate & Linn, 2005; Rice &
Alfred, 2014).
5. *African Americans and Blacks* were used interchangeably throughout the document.

6. *Community college* was defined as “any institution regionally accredited to award the associate in arts or the associate in science as its highest degree” (Cohen & Brawer, 2003, p.5).

7. *Two-year or Associate Degree* was defined as a degree that should “attest that its students have become familiar with general areas of knowledge and have gained competency in analytical, communication, quantitative and synthesizing skills” (Cohen & Brawer, 2003, p. 373).

8. *Double-bind* was defined as women of color as scientists experience oppression and discrimination based on their race or ethnicity and gender, resulting in women of color being the least recognized and valued, and the most invisible and marginalized, among underrepresented groups in STEM (Malcolm, Hall & Brown, 1976).

9. *Engineering Technology Programs* was defined as programs that prepare students for 21st century manufacturing. Skills learned include: how to interface programs, troubleshoot, and optimize complex systems and equipment (TCTC, 2015).

**Design & Methodology**

The interpretative research method and procedures utilized in this study were those based on the work of Klein & Myers (1999), which stated that

“the foundation assumption for interpretive research is that knowledge is gained, or at least filtered, through social constructions such as language, consciousness,
and shared meanings. In addition to the emphasis on the socially constructed nature of reality, interpretive research acknowledges the intimate relationship between the researcher and what is being explored, and the situational constraints shaping this process. In terms of methodology, interpretive research does not predefine dependent or independent variables, does not set out to test hypotheses, but aims to produce an understanding of the social context of the phenomenon and the process whereby the phenomenon influences and is influenced by the social context” (Rowlands, 2005, p. 81).

The interpretative research method was utilized to obtain data from students regarding their personal and academic experiences prior to attending the community college and while attending the community college. These experiences included those associated with family, socio-economic status, academic preparation, employment and other factors that could affect their decision to attend college and/or their persistence while in college. Participants provided demographic information and other pertinent information and participated in interviews. The interviews were coded and provided the basis for emergent theories on student retention. The institutional setting for this study was technical colleges in South Carolina with student populations ranging from less than 800 students per institution to more than 7000 per institution. The participants in the study were African American associate degree seeking female engineering technology students enrolled at the institutions.
Delimitations

When race and gender are discussed, sometimes one’s personal experiences can hinder forward thinking related to recognizing that there are issues and implementing strategies to handle the issues (Hanson, 2012). There are those who may have preconceived opinions about higher education, community colleges, and African American women students, and this can hinder progress with moving ideas forward (Ong et al., 2011). It is critical to present background information concerning African American women students in particular so that the reader can better understand hidden challenges (Ong et al., 2011).

This study is only about African American women enrolled in community college engineering technology programs. Men were excluded from this study because the number of women enrolled in engineering technology programs in community colleges is minimal compared to the number of women enrolled overall in community colleges and the number of women enrolled in engineering bachelor’s degree programs as well. The United States system has failed to adequately prepare students for STEM programs (Terenzini et al., 2014). This failure has had an enormous effect on underrepresented groups that include people of color, women, and women of color (Espinosa, 2011). Women of color earn less than 7 percent of engineering degrees (Espinosa, 2011).

The delimitations utilized by the researcher were determined to better interpret and understand the experiences of African American women in engineering technology programs in community colleges and how those experiences, past and present, affect the academic choices and success of those students. The researcher only desired participants
in South Carolina technical colleges. No students from private institutions were allowed
the opportunity to participate. Also, no students in states other than South Carolina were
interviewed.

The researcher believed that interviewing those students face-to-face provided a
sense of trust and communication to allow the interviewees to feel comfortable and
express themselves without feeling threatened. The sample was intended to include
various technical colleges throughout the South Carolina Technical College system, and
the intent was to have a broad range of African American female students by age and
geographic locations in South Carolina. Based on the population of African American
women in the state of South Carolina, the students enrolled in engineering technology
programs in technical colleges are not a representative sample of the entire population.

Assumptions of the Study

The researcher assumed the research participants were all students at one of the
sixteen technical colleges in South Carolina. These students were also enrolled in one of
the engineering technology programs. Other assumptions were as follows: (1) students
responded to the questions honestly and accurately, (2) the women understood the
questions and answered them openly as the questions related to their personal
experiences, (3) the data collected measured the same knowledge, skills and experiences
of the African American women in the same way, and (4) the interpretation of the data
accurately reflected the experiences of the respondents. Anonymity and confidentiality
will be preserved. Participants were given the option to complete the interview and had
the option to discontinue the interview at any time without consequence.
Significance of the Study

Although there is extant work on the topic of underrepresented students in STEM fields (Hagedorn & Purnamasari, 2012; and Jackson, Starobin & Laanan, 2013), this study will make an important contribution to the literature as it is focused on African American women in engineering technology programs in South Carolina technical colleges. The study of African American women in South Carolina technical colleges enrolled in engineering technology programs is significant because information was gathered that can provide knowledge to improve a number of things related to technical/community colleges and the engineering technology programs. First, learning from the experiences of the African American women, information can be shared with the sixteen technical colleges concerning the students’ perceptions of the pros and cons of enrolling and persisting in the engineering technology programs. The institutions can try to incorporate strategies to improve the learning experiences.

Second, the study will add to the research being conducted concerning African American women students in higher education, especially those in the engineering areas. It will respond to the gap in literature concerning African American women in engineering technology programs and especially those in technical colleges. African American women tend to get grouped in the category with all women in general, women of color or with all students of color, but African American women face double issues related to race and gender (Johnson, 2011).

Investigating the experiences of African American women in engineering in technical colleges will also respond to the need for the U.S. to keep up with global
competition by educating more individuals to work in the STEM areas, particularly in the engineering areas. Community/technical colleges are the avenues for training to increase workforce competency in many of the technical programs (Teacher Advisory Council, 2012).

This study created new knowledge because of the focus on South Carolina technical colleges. Because of the focus on this specific area, similar technical colleges in the Southeast, especially, can build on the study. Prior research has not specifically addressed African American women in engineering technology programs in community colleges, but has mainly focused on underrepresented minority students in general. Tinto’s theory (1993) of departure and the prove-them-wrong syndrome contribute to the investigation of the African American women and what motivates them to stay in college.

**Organization of the Study**

The study contains five chapters. Chapter One includes the introduction, statement of the problem, purpose of the study, theoretical framework, and conceptual framework. Also included in Chapter One are the following: research questions, research methods, definition of terms, delimitations, and significance of the study.

Chapter Two contains a review of the existing literature related to the study. Interpretative research theories, Tinto’s theory of student retention and the prove-them-wrong syndrome are presented. Other literature regarding community colleges and African American women in engineering is also covered.

Chapter Three presents the study’s research design and methodology. An overview of interpretative research is provided. The specific interpretative research
theory approach and procedures utilized in the study are discussed, and methodological
decisions are explained.

Chapter Four, the findings include a presentation of the findings from the study.
The chapter includes an analysis of the participants’ demographics and other
characteristics, emerging themes resulting from the interviews, and the interpretation of
findings by the researcher.

Finally, in Chapter Five, is a summary of the major findings from the study. The
chapter includes discussions of the interpretative research theory and recommendations
for future research are also presented.
CHAPTER TWO

LITERATURE REVIEW

Overview

The purpose of this chapter is to present a review of the literature relevant to the research study. The study drew from existing research and theories related to student retention. Further, this chapter presents the rationale for conducting research on African American women enrolled in engineering technology programs in community/technical colleges. Generally, the literature review focused on positive experiences and challenges that African American women, other women and other people of color in engineering face in community colleges. Related studies on familial, social and educational experiences that affect African American women throughout their careers in pursuing an associate degree in engineering are presented.

Educational researchers have studied retention of students in STEM fields in higher education (Tate & Linn, 2005). However, much of the previous research of women in STEM fields failed to fully capture the experiences of women of color (Tate & Linn, 2005), especially African American women in the field of engineering. The underrepresentation of research of women of color in STEM fields is due in part to the low participation of the women in the respective fields (Goodman Research Group, 2002, Margolis & Fisher, 2002, Seymour & Hewitt, 1997). In 2004, the National Science Foundation reported that although there had been a growth in the diversity of students who intended to major in engineering, underrepresented students were leaving engineering at a high rate (Tate & Linn 2005).
Tinto’s theory of academic and social integration (Tinto 1975, 1987, 1993) provided a basis for an overall understanding of the attrition in higher education. Also, “research in STEM fields identifies multiple complex influences on participation and persistence” (Tate & Linn, 2005, p. 483). When studying African American women in engineering, the intersection of race and gender should be addressed (Tate & Linn, 2005). A study at a science camp by Jayaratne, Thomas, and Trautmann (2003) revealed that non-minority girls and minority girls had different aspirations. Non-minority girls had a higher self-concept and were more interested in science than the minority girls. Tate and Linn (2003) highlighted the need for looking through several lenses when seeking to understand the diversity of African American women students’ lives and academic experiences.

**Gaps in Engineering**

Malcolm, Hall and Brown’s (1975) report “The Double Bind: The Price of Being a Minority Woman in Science” provided the foundation from which the study of African American Women in engineering technology programs was developed. Bunker et al, (2011) also supported the fact that there are gaps that exist in engineering education and employment. This gap includes all students, not just underrepresented students. The need for engineering graduates outweighs the number of students entering the workforce (Bunker et al., 2011). Many factors encourage students to major in engineering, but once the students start in this major area, retention becomes an issue (Hanson, 2012). Although “The Double Bind” was written approximately 40 years ago, many of its principles and foundations remain the same. Mainly, there is a shortage of women in engineering
education and engineering occupations in the United States. Although this has been more than 40 years, Ong et al., (1975) were correct with stating that “the current underrepresentation of women of color in STEM fields represents an unconscionable underutilization of our nation’s human capital and raises concerns of equity in the U.S. educational and employment systems” (p. 172).

In 2012, Hagedorn and Purnamasari supported the fact that there are predicted workforce shortages in STEM fields and that this shortage could have a catastrophic impact on the U.S. economy. Hagedorn and Purnamasari (2012) noted that if the United States continues to lose its dominant position in global innovation, industries will be located in other parts of the world that can provide the necessary resources needed. Researchers agree that there is a need to increase those educated in the STEM fields, but many do not agree on the impact that STEM education is having on the global economy (Hagedorn & Purnamasari, 2012). Some feel that the requests to increase the number of STEM workers is warranted and others feel that the “panic” may be overstated (Hagedorn & Purnamasari, 2012). In either case, previous research has laid the background for the issue to be further investigated. Issues related to the engineering workforce and engineering education need to be addressed.

Traditionally, women and underrepresented students have not participated in the STEM fields. Women receive nearly half of the baccalaureate degrees awarded in most industrialized countries, but women are still underrepresented in STEM fields (Jackson & Laanan, 2011). Starobin & Laanan (2008) highlighted the role of community colleges in developing women and minorities in STEM fields. According to Starobin and Laanan
(2008), at the time of the study, the nation’s community colleges enrolled over 10 million credit and non-credit students. Of this number, more than 57 percent were female and 38 percent were minority students. Community colleges serve as a stepping stone for underrepresented students (Hagedorn & Purnamasari, 2012). Previous studies also showed that minorities and young women high school students were as likely as young men to express an interest in STEM degrees (Hurtado, Eagan, & Chang, 2010; Riegle-Crum & King, 2010; Staniec, 2004; Varma & Hahn, 2007). Young women prove to be just as qualified for the STEM programs as well. According to Ong, Wright, Espinosa & Orfield (2011), “The current underrepresentation of women of color in STEM fields represents an unconscionable underutilization of our nation’s human capital and raises concerns of equity in the United States educational and employment systems” (p.172).

The United States lags behind many developed countries as it relates to quantity and quality of K-12 STEM education (Ong et al., 2011). Untapped human capital exists with women and racial ethnic minorities, especially women of color (Ong et al., 2011). This group can provide the workforce needed to help sustain the U.S.’s economic vitality (Ong et al., 2011).

**Engineering Workforce Development and the Community College**

The STEM workforce grew an astronomical 669% from 1950-2000 (Jackson & Laanan, 2011). Although there was large growth in the STEM field, in order for the United States to compete in the global economy, American colleges and universities must increase the enrollment of students who traditionally have not enrolled in STEM academic programs and courses even more (Jackson & Laanan, 2011). As a result, “the
Obama administration put forth several initiatives designed to assist in increasing the strength of community colleges’ and education’s focus on STEM” (Jackson & Laanan, 2011, p. 40).

However, until these efforts produce fruit, there are still significant gaps by gender and ethnicity in the United States in relation to STEM degree holding and employment patterns (Hagedorn & Purnamaseri, 2012). Additionally, access to quality education varies and students in the lower socioeconomic status tiers tend to experience poorer quality schooling, have limited or no access to advance placement courses and many of the teachers are underprepared or unprepared (Hagedorn & Purnamaseri, 2012). Also, contributing to the shortage of those employed in STEM fields, there is a shortage of trained STEM teachers at the K-12 level (Hagedorn & Purnamaseri, 2012).

Trenor et al. (2008) stated, for the U.S. to remain competitive in today’s global economy, it is essential to attract and retain more women, from all backgrounds, in the field of engineering. However, few studies have investigated ethnically diverse female engineering student populations in order to better understand their educational experiences and academic decisions related to engineering (p. 450). Pascarella (2006) stated, we can no longer plan an effective research agenda based on the assumption that our undergraduate student population is made up of White undergraduates from middle or upper-middle class homes, ages 18-22, attending four year institutions full time, living on campus, not working, and having few family responsibilities (p. 512).

The focus in higher education now is to include underrepresented students and females.
Barriers for Women in STEM

Hanson (2012) addressed why there were barriers for women majoring in STEM fields. Many females fail to enter the engineering fields because of the myths associated with females in engineering (Hanson, 2012). One myth states that girls are not as interested in science as boys are, but in fact, boys and girls begin with equal interests in science (Hanson, 2012). A second myth is that interventions that seek to increase girls’ interest in STEM are not as attractive to boys, but in actuality, what works to increase the interest for girls, works to increase the interest for boys as well (Hanson, 2012). A third myth is that parents can’t really influence a student if the student is not interested in science, but research shows that parent support is important and can contribute to a girl’s interest in STEM (Hanson, 2012). A fourth myth is that teachers of STEM are not biased towards males, but research reveals that teachers communicate with girls more than boys (Hanson, 2012). And finally, there is the myth that “changing the STEM curriculum at the college level might water down important coursework” (Hanson, 2012, p. 117).

Research found that women with “B”s in STEM classes are dissatisfied and more apt to drop out, but men with “C”s tend to persist (Hanson, 2012). Women tend to be more critical of themselves and expect higher results than the males in engineering, based on prior studies.

In elementary, middle and high schools, males and females enroll in and take math and science courses at about the same rate (Hill, Corbett, & Rose, 2010). And, upon leaving high school the numbers of females who are interested in pursuing degrees related to science and engineering are similar (Hill, Corbett, & Rose, 2010). But
somewhere along the way, through higher education, there tends to be a gap between the number of females who complete degrees in science and engineering majors (Hill, Corbett, & Rose, 2010). By graduation, men dramatically outnumber women in the science and engineering fields and when it comes to those enrolling in graduate school and those transitioning to the engineering work field, the gap becomes even greater (Hill, Corbett, & Rose, 2010).

Many differences exist between the learning styles and abilities between girls and boys. According to Hill, Corbett & Rose (2010), “One of the largest gender differences in cognitive abilities is found in the area of spatial skills, with boys and men consistently outperforming girls and women. Spatial skills are considered by many people to be important for success in engineering and other scientific fields” (p. 27). Many things were found to help or hinder women in the STEM field. Those that hindered included the following: lack of support of family, lack of social and academic support, and the belief in the stereotype that men are better in math than women (Starobin & Laanan, 2008). The positive experiences are related to academic preparation in math and science (Starobin & Laanan, 2008). The negative experiences have been related to structural and cultural academic factors, some as simple as chilly classrooms (Jackson & Laanan, 2011). A key factor with women when deciding to major in engineering was the fact that they had to accept being considered a “geek” (Jackson & Laanan, 2011). Joy & Marco-Bujosa (2013) stated,

Even though the women in community college engineering felt that they were “different” from other women in their identity and capacity for work in advanced
mathematics, physics, engineering, and computer science – and men felt that
women in their programs were highly capable and like “one of the guys” –
women, unlike men, felt they still had to prove their academic strengths and
capacity for long focused work to be fully accepted by the men they studied with
(p. 10).

In the past, males outperformed females in science and mathematics, but now
standardized test results show that females now score as high as their male counterparts
(Hagedorn & Purnamasari, 2012). Females are enrolling at the same levels of males in
these courses and earning higher grades (Hagedorn & Purnamasari, 2012). Women are
currently in the lead, enrolling in higher numbers to colleges compared to males.
Although females are very competitive, there still remains a gender gap for participation
in many of the STEM fields (Hagedorn & Purnamasari, 2012). There still exists a racial
achievement gap in math and science. In 2007, the scores of minority high school
students lagged behind Whites and Asians. African American students tend to “have less
access to Advanced Placement courses that can give students an edge in STEM”
(Lichtenstein et al., 2013, p. 317). After high school, many students take courses at a
two-year community college and this population is likely to include members of
underrepresented populations in engineering (Lichtenstein et al., 2013). Women make up
a smaller percentage of those earning degrees in engineering compared to those earning
degrees overall (Lichtenstein et al., 2013).

Because of a domination of the White male in the STEM fields, it is difficult for
women to enter the STEM fields (Jackson & Laanan, 2011). But, the demographics of the
United States are in a transformation. White men, which have been the traditional source of STEM professionals, are a declining share of the population (U.S. Census Bureau, 2011). The majority of population growth has come from non-Whites, particularly Latinos. With the growing population, women outnumber men with those attending college (College Board, 2010). However, the education system in the United States undereducates and underutilizes women of color. Ong et al., (2011) stated, “The daunting magnitude of their underrepresentation in advanced STEM areas represents serious equity concerns that connect with important historical and contemporary issues of social justice in the U.S. education and employment systems” (p. 175).

If the United States were to achieve equity in STEM fields, rather than allowing women to fall through the cracks when it comes to STEM education, there would be many benefits (Bement, 2009). Bement (2009) declared, “Minority women’s unique backgrounds, cultural traditions, perspectives, and experiences could bring dramatically new approaches to scientific discovery and innovation and could be leveraged to help solve the complex technological problems of our time” (p.1). Considering the benefits of equity and justice, along with the country’s demographic shifts and national move to further scientific innovation and competitiveness, there is a growing importance of recruiting and supporting women of color in STEM education (Bement, 2009). Research on minority women in STEM has been excluded from research agendas because many times this research is grouped by women in STEM or minorities in STEM, but not minority women in STEM.
Community colleges have helped increase the representation of females and underrepresented students in the STEM programs over the last few decades (Starobin & Laanan, 2008). Community colleges can be the solution to the lack of diversity in the engineering profession and undergraduate education. According to Terenzini et al., (2014), “The socioeconomic, racial/ethnic, and cultural heterogeneity of community college student bodies make those institutions potentially fruitful recruiting grounds for engineering schools seeking to increase the racial/ethnic and cultural diversity of their undergraduate programs” (p. 9). “America’s Overlooked Engineers” (Terenzini et al., 2014), a study which focused on community colleges and diversity in engineering education, suggested the following implications:

1. When community college students come to college, they come with personal and educational challenges. These challenges include risk factors such as weaker academic preparation, attending college later and other demands on their time that is not related to academics.

2. Based on the knowledge of the community college students, one should not conclude that investing in these students would be a mistake. From 2005-2007, 44% of the engineering graduates had community college experiences.

3. Three major challenges exist for community college students, the anticipated institutions and the engineering communities: the students must learn to balance their studies with family obligations and employment, the access to state financial aid, federal financial aid and other forms of support can be limited, especially for part-time students.
4. To recruit community college students effectively requires a myriad of strategies, not just forming articulation agreements (Terezini et al., 2014).

Findings by the NSF (2013), showed that four barriers exist for women entering and completing community college engineering programs. These barriers include, not having the knowledge to understand what engineering careers entail, the pathways that are harder for women to find and navigate in engineering technology programs, the challenges of “being geek” and “being female” and, the male dominated culture that is intimidating (NSF, 2013).

Those in academics should be aware of these implications and attempt to address them early in the educational careers of students, especially the potentially “overlooked engineers” (Terezini et al., 2014). Community colleges can help to bridge the racial/ethnic imbalance in engineering education. No evidence exists that proves that engineers who begin their education at a community college perform any less than the engineers who took the traditional route of attending a four-year college directly out of high school (Terenzini et al., 2014).

**Women of Color in Engineering**

The U.S. education system has failed to adequately prepare students interested in and capable of pursuing STEM fields (National Academies Press, 2010). This failure has particularly affected underrepresented students, especially people of color, women, and women of color (National Academies Press, 2010). Despite this fact, the intersection of gender and race/ethnicity in STEM fields is slim in scholarly work (Espinosa, 2011). In the 2010 Census Bureau, women of color represented 20% of the population aged 15-24,
but only 12 percent of the total STEM bachelor’s degrees awarded. White women received the degree at two times this rate (U.S. Census Bureau, 2011). Espinosa (2011), conducted a study on the concept of intersectionality that focused on gender, race, ethnicity and academic field which built on the literature streams of women in science, women and minorities in STEM, and women of color in STEM. The conclusion of the Espinosa (2011) study emphasized that institutions should explore gender and racial climates that exist within science and engineering schools and remove barriers that adversely affect women of color. In turn, they should employ evidence-based practices that will help all women succeed, regardless of background (Espinosa, 2011). Espinosa (2011) suggested that the Obama administration’s commitment to both scientific advancement and postsecondary completion for youth and adult student populations is an enormous opportunity for the STEM community to advance innovation as well as widen the educational and career STEM pipeline.

**Research on Women**

According to Johnson (2012), treating women as a homogeneous group obscures important racial and ethnic differences among women in STEM. The important issue is to address intersecting identities among women. Scholars have examined the underrepresentation of women in STEM for over 30 years, but most of the research did not focus attention on racial and ethnic diversity among women, which suggests that all women in STEM share the same experiences (Johnson, 2012). Research on women of color in STEM includes research on African Americans, Asian Americans and Latina women, as well as women from other racial and ethnic groups (Johnson, 2012). Because
of the number of women of color who attend colleges and universities, 34 percent of all female undergraduates are women and 26 percent of all bachelor’s degrees are awarded to women, a need exists to broaden research to include more than “White” subjects (Johnson, 2012).

According to the National Science Foundation (2004), even though there has been growth in the diversity of students planning to major in engineering, underrepresented ethnic minority students, which includes African American females, tend to leave engineering at a higher rate than Whites. Research findings revealed that influences on participation and persistence include the following examples:

- Women persist in STEM fields when they feel welcome, have access to role models and mentors and form bonds with other women in STEM (Seymour and Hewitt, 1997; Goodman Research Group, 2002),
- Women persist when they encounter supportive interactions with technology (Bennett et al., 1999),
- Women are more likely to persist in the computer science field when they can reject the field’s dominant culture (Margolis and Fisher, 2002),
- Self-confidence is a major factor in the persistence of underrepresented groups (Goodman Research Group, 2002; Linn and Kessel, 1996),
- Women and ethnic minority students pursuing STEM majors deal with differences in ethnic cultural values and socialization, stereotypes, isolation, perceptions of racism, and inadequate program support (Seymour and Hewitt, 1997; Margolis and Fisher, 2002; Tate & Linn, 2005).
When looking at women separately from other ethnic minorities, the intersection of race and gender is neglected (Hanson, 2012). When race and gender intersect, different experiences are informed (Hooks, 1981). Previous studies reveal that there are different experiences for women of color and White females (Johnson, 2011). Tate and Linn (2005) suggested, “As members of multiple social categories, women of color’s identification with ideological systems can be attributed to race, gender, or both, depending on social context and may conflict” (p. 484). The identities that students adopt or relate to can shape ideas of what people hope to become or expect to become. Identity can have an effect that is negative or positive on academic performance. Many African Americans have a fear of being treated stereotypically and this can add pressure to cause the students to perform at a lower level academically. This, in turn, can cause students to distance themselves from academia (Steele, 1997).

In a study by Tate and Linn (2008), three student identities emerged and were analyzed when investigating women of color engineering students. Tate and Linn (2008) said students develop these identities “to navigate academic environments and build comfortable communities” (Tate & Linn, 2008, p. 484). These identities included Academic Identity, Social Identity and Intellectual Identity. Academic Identity deals with academic activities and successes and is usually associated with grades. Social Identity is the view of self in society and how others in society views the individual. And, Intellectual Identity is associated with the desire to perform in the field of interest and the way to engage with those in that field (Tate & Linn, 2008). Although this
research focused on women of color in engineering, there is still more definitive research to be conducted specifically on African American women in engineering.

**African American Women in Engineering**

There is limited research on African American women in engineering. Much of the literature is related to underrepresented students or women in general (Johnson, 2011). Both of these categories include African American women, but the stories of African American women fail to get directly recognized (Burlew, 1982). Burlew (1982), focused a study on Black females and the nontraditional career component. Burlew’s focus was on the relationship that the students had with family role models, the environment and career choice expectations. The nontraditional fields typically identified with those in the STEM areas. Burlew (1982) concluded that African American women earned less than men and were needed in larger numbers in the STEM fields.

In a study conducted by Rice and Alfred (2014), the purpose was to understand the career experiences of African American engineers and examine the factors that served as a support system for African American female engineers. A holistic view of the students’ experiences was the focus of the study. Findings revealed that there were factors at the “individual level, family structure, K-12, higher education and professional workplace settings” (Rice & Alfred, 2014, p 43). At the individual level, self-image and determination and persistence were present. Also included on a macro-level was support from family and friends; teacher and counselor assistance; pre-college programs,
university resources; the minority network; mentors in the workplace; managerial support; and company structure (Rice & Alfred, 2014).

Preliminary research also reveals that young African American women are interested in science and tend to engage in science during the high school years (Hanson & Palmer-Johnson, 2000). African American women, despite their interest in science, encounter racism and sexism and remain underrepresented in science programs and occupations (Hanson, 2004). Although previous research may suggest that a double jeopardy exists for African American women because some have argued that women do less well in science and minority women do less well in science than those of the majority group (Clewell & Anderson, 1991; Vining-Brown, 1994).

African American women need support throughout the entire process with their education. Rice and Alfred (2014) stated, “Oftentimes, the engineering community focuses on one area of the pipeline to positively impact change and increase participation in STEM. This approach misses the mark” (p. 48). Joy and Marco-Bujosa (2013) also noted, “Despite the increased importance of community colleges in preparing individuals for further engineering educational and occupational pursuits, little is known about women’s (and men’s) pathways through community college engineering technology programs (p. 2).

**The Role of Community Colleges**

As is evident in previous literature, community colleges serve a significant proportion of underrepresented minorities in science, technology, engineering and mathematics (STEM) fields, with 44% African American students (Leggett-Robinson,
Mooring & Villa, 2015, p. 12). The history of community colleges shows that they enroll large numbers of women students as well. The students are also non-traditionally aged and many tend to be displaced workers. Community colleges have the challenge of deciding whether they should direct more students to the STEM area. Many students are not aware of the opportunities in the STEM area (Hagedorn & Purnamasari, 2012). Community colleges and those in K-12 schools should take advantage of opportunities to educate students about STEM fields and the types of training and careers available. The majority of jobs will require training beyond high school, but not necessarily a bachelor’s degree, and community colleges provide this access (Hagedorn & Purnamasari, 2012). Many students cannot afford to attend a university, but they can afford to attend a community college that can help the individual who struggled in high school, who was disinterested in education, who was a displaced worker or a single parent who must balance family, school and work (Hagedorn & Purnamasari, 2012).

**Summary**

The literature referenced above denotes that the focus on engineering is very important. The importance of an engineering concentration begins at the K-12 level and extends through the baccalaureate level. Because community colleges are where many of the students go who are needed to fill the gap in the STEM area, those in the community colleges must find a way to address the “gap” issue. The majority of the jobs in the future will not be on the baccalaureate level but on the associate degree level. Many of these jobs will be in the STEM areas and at this time, the United States is not prepared to fill the gap in the STEM area. In order to fill this gap, the type of students enrolling in
the STEM area needs to increase to include women and underrepresented students. The responsibility to help fill the gap is the responsibility of high school administrators and those at colleges and universities. Several reasons exist for the lack of success in STEM programs, such as students not being prepared academically, but other reasons exist as well. Awareness is critical.

Previous research studies have revealed that there are gaps in engineering associated with the lack of enrollment or completion of underrepresented students. Because the need for engineering graduates outweighs the number of students entering the workforce, there is a focus to educate minority students in STEM programs. Things that hinder women in the STEM field include lack of family, social and academic support and the belief that men are better than women in math. A study by Espinosa (2011) also suggested that institutions should explore gender and racial climates and remove barriers that affect women of color. Findings also revealed that there are factors that serve as a support system for African American female engineers throughout the learning and career process.

Understanding the perception of engineering and challenges for women enrolled in technical colleges is one way to attempt to address the issue. Perceptions can be reality and if there are poor perceptions of engineering education and careers, students will not enroll.
CHAPTER THREE

Overview

The purpose of this chapter is to present the research design, data collection and data analysis procedures required by the research method to address this study of African American women in engineering technology programs in technical colleges in South Carolina. The interpretive qualitative research design and the methodological steps used are addressed. The following topics are presented: (1) research designs, (2) research questions, (3) setting, (4) data sources, (5) data collection, and (6) data analysis.

 Particularly, this study focused, on experiences of African American women prior to enrolling in engineering technology programs at technical colleges and the experiences of these women while enrolled in engineering technology programs in technical colleges. Interviews were conducted and the interview summaries were analyzed. The role of the researcher is also included in this chapter.

Research Design

Knowledge is gained or filtered through social constructions when interpretive research is employed. The researcher has an intimate relationship with what is being explored and the social construct shaping the process (Rowlands, 2005). Interpretive research, also referred to interpretive phenomenological analysis (IPA), was used as the research methodology. The primary goal for the researcher in IPA is to determine how individuals make meaning of their experiences. Studies focus on how people perceive and talk about events, rather than categorizing phenomena based on certain criteria (Pietkiewica & Smith, 2014). The researcher attempts to understand and comprehend
what it is like to walk in the shoes of the interviewee. And through interpretive study, make meaning of the study by translating it. The process is two-fold, meaning that the participant attempts to make meaning of their experiences and the researcher tries to decode the meaning to make sense of what the participant shared (Smith & Osborne, 2008). The researcher is attempting to understand the experience from the participant’s perspective, but also the researcher is delving deeper to question what is actually happening and asking questions such as: What is the person really trying to say? Is there more to what the person said than was intended? What can the researcher derive from what was said and possibly what was implied?

The philosophical foundation of interpretive research is guided deliberately by researchers. A preplanned series of questions are used as a narrative to generate discussion (McQueen & Zimmerman, 2006). During and after the initial questions, additional questions are asked as needed. There are a number of components of the interpretive research method (McQueen & Zimmerman, 2006). Five components were used for this study of African American women in engineering.

First, the research issue was addressed. The research issue was identified through investigating present issues in engineering in technical colleges, four-year colleges and the engineering career field. Because there is a growing need to meet demands in engineering, there is a need to educate more individuals in the engineering technology programs, especially women. Data from the 16 technical colleges revealed that there was a deficit of African American women enrolled in two-year engineering technology programs in the state of South Carolina. This analysis of data matched the summary of
data obtained from researching engineering program enrollment across the nation.

Second, the participants were selected intentionally from a pool of students who met the criteria specified, African American women enrolled in engineering technology programs. The participants were not randomly selected. After selection of the participants, third, the interviews were conducted. The interview questions were prepared prior to the interview, but some spontaneous questions were asked of participants as follow-up. The preference was to interview the students face-to-face and to audio record the interview, but some students were interviewed via telephone due to scheduling and location challenges. All students were audio recorded. The fourth component was analyzing the narrative of the students and, finally, the fifth component was reporting findings.

Because the goal of interpretive research is interpretation rather than finding facts, the researcher approached this method with few, if any, preconceived notions (McQueen & Zimmerman, 2006). Although the researcher was familiar with identifying as an African American female, the researcher was not familiar with STEM majors, especially not those in engineering majors in community colleges. As such, the researcher remained neutral in the analysis. This kind of research lends itself to being subject to interpretation. The researcher shaped the outcome by the selection of the interviewees, having the ability to recognize patterns in the narrative and, eventually, controlled how the findings were reported.
Research Questions

The primary questions provided direction for the study. Primary questions were:

1. What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?
2. What are the experiences of women while they are enrolled in engineering technology programs in technical colleges in South Carolina?

Research Setting

The research setting included interviewing students in the engineering technology programs in the technical colleges in South Carolina. There are 16 technical colleges in the South Carolina Technical College system. The 16 colleges are responsible for educating South Carolinians to live and work in South Carolina, to make quality higher education accessible and, to prepare students for high demand, high wage jobs (SC Technical College System, 2015). The engineering program was selected because there is a known lack of enrollment of African American women in this program and also because there is a growing demand for jobs in the engineering area.

Participants

Each of the 16 technical colleges were given an invitation for their college to participate in the study. Each college was asked for female African American students’ names in the engineering technology programs. Information was requested on each student to include name, classification, and major within the engineering technology program. Other information requested for each student included email address, home address, and telephone numbers. Initially, there was a response from 7 of the 16
technical colleges. The colleges included Tri-County Technical College, Greenville Technical College, Spartanburg Community College, Midlands Technical College, Aiken Technical College, Northeastern Technical College and York Technical College. Although all seven colleges responded, all did not agree to participate. Some of the colleges provided names and contact information to the researcher so that the researcher could contact the students and ask the students to participate. Some college representatives sent the request to the faculty in the engineering technology programs and asked for student participation. Other colleges sent the request to students and asked that the students contact the researcher to participate.

The technical colleges were chosen based on the perceived ease of interviewing the participants face-to-face and the established contacts at those locations. After this group was contacted, one college responded immediately and provided names and contacts of the African American women enrolled in the engineering technology programs. After receiving the list from the chosen technical college, the students were contacted via their college email addresses and/or they were contacted via telephone. A letter of invitation was sent via the college email address (see Appendix B). Initially, approximately half of the participants who were contacted responded. All but one of the respondents agreed to the interview. Of the interviews scheduled, at least three of the respondents either were a no-show or called to reschedule.

Because of the small percentage of respondents, the researcher contacted the remaining colleges that were initially not contacted previously and the researcher also sent reminder emails to the college representatives who failed to respond to the first
request. Unfortunately, some college administrators never responded and there were also some college personnel who continued to contact students but never provided student contact information to the researcher. Overall, the researcher contacted approximately 20 students, 16 responded and seven participated in the interviews, although nine were scheduled for interviews. The majors of the students included Mechatronics, Electrical Engineering, Manufacturing Management and Leadership, and Chemical Engineering. Four of the students were from the upstate area, one was from the Midlands area, one was from the lower part of the state and one was from the Piedmont area. Three of the students who were scheduled to participate in the interviews either canceled or failed to show up at the scheduled time and did not reschedule the appointment.

**Role of the Researcher**

The researcher acquired approval to conduct the study, prior to collecting data for the study. Documentation of the IRB approval is included in Appendix A.

The researcher’s biological tie with the students, of being an African American female, provided a link to the students who were interviewed. Also the researcher’s 16 years of experience working at a community college provided a foundation for research and for understanding the experiences of the African American women.

**Instrument Used**

After consideration of the research questions and the setting, the researcher decided to use semi-structured interviews to conduct the study. The interviews included open-ended questions so that the interviewees could feel comfortable to provide detailed responses.
Interview Questions

Demographic Questions

1. Where are you from originally, and where did you attend high school?

2. What major/degree program are you in? What is your academic classification?

Academic Preparation

3. What is the educational background of your mother, father and/or guardian?

4. What was your GPA from high school?

5. Do you feel that you are prepared for college at this time?

6. Why did you enroll at this particular technical college? What is your ultimate goal once completing your program of study?

7. Did you attend college, prior to enrolling at this college? When and for how long?

8. Tell me about the education of your parents, siblings, caregivers, etc. How did the status of those individuals influence your decision to attend college?

Current Experiences

9. What has been one of the most positive academic or social experiences that you have encountered since enrolling?

10. Talk about your experiences as an engineering student?

11. Why did you decide to major in engineering?

12. Why did you choose this technical college?
13. How could this engineering program better meet the needs of engineering students, particularly African American women?

14. What has been one of the most negative academic or social experiences since enrolling?

15. Are you motivated to continue with your education? What motivates you to succeed?

16. Are you involved in any activities at your college?

17. Are there things within this college that impact you in a positive or negative way concerning whether you will persist with continuing your education?

18. Were you prepared academically for this college experience?

19. Were you prepared socially for this college experience?

20. If there have been obstacles related to you completing your education, can you describe those?

21. If you could plan the ideal college experience how would it compare to your actual college experience?

**Post-Education**

22. What are your plans after graduating with this degree?

23. How do you see yourself five or ten years from now?

The role of the researcher throughout this study was one of an outside observer. The researcher only communicated with the interviewees on one occasion, so the researcher was considered an outsider to the participants. The participants for this study included seven African American female engineering students who were interviewed,
three face-to-face and four via telephone. Interpretive research methods were used to collect and analyze data to develop themes. Identification of themes can provide information for other African American females who are interested in majoring in engineering technology programs in community colleges and can also provide information for those in community colleges who are attempting to recruit African American females in the engineering technology programs.

**Data Collection**

The next step was conducting the interviews. The decision on where to interview the participants and how to conduct the interviews was particularly critical. Also, the determination was made concerning whether the interview would be recorded or videotaped (McQueen & Zimmerman, 2006). Some interviewees, even though they were assured that the interview would be confidential, appeared to be shy or afraid when answering the questions, or this could have been the natural personality of the interviewee. Finally, the researcher chose the proper methods of storing the data for confidentiality. Each African American female was invited to participate in an interview that would last approximately one hour. The interview was set up at the convenience of the interviewee. Interview setup proved to be a difficult task with trying to set up places and times in which to meet the students. Interviews took place on the campuses where the interviewees attended classes, at other designated locations in the geographical areas that were convenient for the interviewees or over the telephone. Each student had the opportunity to select the days and times that were best for them. The interview questions addressed the issues of why the African American women chose to major in the
engineering technology programs, what their experiences were while enrolled in the engineering technology programs and what are their plans for jobs and careers once they graduate from the engineering program. The interview was audio recorded with permission of the interviewee.

The researcher recorded the interviews and also took notes during the interviews for the purpose of using this information later when coding the data. The interviews were conducted over a period of four months, beginning in October 2015 and ending in January 2016. The interviews were scheduled and conducted either face-to-face or by telephone. The negative with the telephone interviews was the fact that the researcher missed the opportunity to build rapport with the students and possibly have “small chat” prior to the beginning of the interview. With the face-to-face interviews the researcher felt a connection with the student because of the chance to meet and put a face with a name. Although face-to-face interviews were the preference of the researcher, being able to conduct telephone interviews allowed the researcher to reach students from far distances within a short period of time without the inconvenience of driving up to 4 or more hours. According to researchers, there is no indication of differences in results from telephone interviews compared to face-to-face interviews (Bampton & Cowton, 2002; Opednakker, 2006; Sturges & Hanrahan, 2004).

Some students called in advance to cancel the appointments and some failed to show up during the allotted time, but failed to contact the interviewer concerning the cancellation.
After the audio recording, the interviewer transcribed the data and coded the interviews. The interviewer analyzed data to look for comparisons among the responses from the students. After the initial coding, patterns were noted among the responses to form an analysis of the results.

**Data Analysis**

The transcribed data were then analyzed. The analysis of data looked for coherence and meaning. Returning to the data looking at different perspectives was a part of this process (Green, Camilli & Elmore, 2006). Analysis of data included the following steps: transcription, description, analysis, interpretation, and display. Since it was impossible to reproduce the full flavor of an oral presentation in a written format, with transcription, a decision needed to be made about whether the transcription conventions would include features of speech or if it should capture the dialect of the speaker (Green et al., 2006). According to Green et al., (2006) through descriptions, proper coding should be determined to appropriately fit the interview format (Green et al., 2006).

The analysis phase included looking for relations in the data. Looking for themes was relevant in this section of data analysis. The researcher identified dimensions of the data as related to other studies. Interpretation involved reviewing the interviews and drawing connections between the results from the participants. And finally, the researcher reported the findings from the study as suggested by McQueen & Zimmerman, 2006.
The transcribed protocols provided knowledge and insight about the participants. The coding categories were developed from the conceptual model, the interview questions and the key concepts brought to the study by the researcher. Data generated by the interviews and other documentation were examined and coded by focusing on the experiences of the African American women. This form of open coding (Strauss & Corbin, 1990) included reading the data and categorizing the data into concepts suggested by the data. The data were then organized into themes which linked them into common categories. The process known as axial coding “relies on a synthetic technique of making connections between subcategories to construct a more comprehensive scheme” (Orlikowski, 1993).

The data analysis process included, multiple readings and making notes, transforming notes into emergent themes and seeking relationships and clustering themes (Pietkiewicz & Smith, 2014). The multiple readings included listening to the audio recordings a number of times to transcribe the data. This process helped with recalling the atmosphere of the interview and remembering the setting of the interview. Also reading the transcribed notes a number of times, provided new insights from each review. Focusing on content, the way in which the students responded to the questions and the language that the participants used, are all relevant things to note during this process (Pietkiewicz & Smith, 2014).

The process of transforming notes into emergent themes was the second step in the analysis process. At this point, the notes from the interviews were the main focus. Although the notes focused on particular details from the transcript, the source material is
reflected. The aim was for the researcher to aim for a more psychological conceptualization (Pietkiewicz & Smith, 2014). Finally, there was the process of seeking relationships and clustering themes. After noting themes from each interview, these themes were compared and grouped according to conceptual similarities. A number of themes emerged, but after comparisons were made, some themes were dropped because they did not fit well or lacked strong supportive evidence (Pietkiewicz & Smith, 2014).

In writing up the analysis, each theme identified was described and included extracts from the interviews. The researcher also commented throughout the themes on the way that the analysis provided the final structure for the study, and the framework was controlled by the researcher. The researcher kept an open mind and analyzed the data without preconceived notions and ideas.

**Ethical Considerations**

The purpose of this study of African American women enrolled in engineering technology programs in community colleges was to give a voice and attention to the women in the field of study. Each woman was interviewed with a set of predetermined questions that sought to give them the opportunity to express themselves openly about their experiences in the engineering technology programs, especially as that experience related to their race and gender. One-on-one interviews were held privately and transcribed. Names of the individuals were not mentioned in the study and there is little chance that the students are identifiable based on the information presented. Effort was taken to protect the identity of the students to avoid negative repercussions in the future.
All interviews were scheduled in a uniform manner to meet the schedule demands of each student. At each interview, the protocol was followed and the standard questions were asked of each respondent. Some students were asked follow-up questions based on the answers given. The participants were given the opportunity to withdraw from the interview at any point and unfortunately, one participant ended the interview without stating that she was about to leave. The researcher tried to contact the student several times after the disconnection but did not receive a response.

The proper protocol was followed by the researcher receiving Internal Review Board approval for research compliance from the researcher’s institution. Also, the researcher received consent from the students who agreed to interview. A sample form is included in Appendix D.

**Summary**

This chapter presented the research procedures used throughout the qualitative study. The research included interviews of African American female students with majors in engineering technology at some of the 16 technical colleges in South Carolina. These majors were chosen because data revealed that there is a shortage of qualified workers to fill jobs in engineering. Numerous reports indicated that unless there is an intense focus on the improvement of science and mathematics preparation, there will be an insufficient number of U.S. citizens who can fill STEM-related jobs (Lowell & Salzman, 2007). The majors of the students included those from Mechatronics, Electrical Engineering, Manufacturing Management and Leadership, and Chemical Engineering. These are programs that are included in the Engineering Technology
divisions throughout the South Carolina Technical College System. The technical colleges are a part of a State system that is governed by the State System Office in Columbia, South Carolina.

Selection of the participants was intended to be based on attempting to select a diverse group of students to include different ages and classifications, such as first-time post-secondary, those returning to college after a period of working in the field, freshmen or sophomores. Although there was a diverse group of ages, due to the small size of the pool at each college and the number of students agreeing to interview, the researcher could not be as selective as was originally intended. Basically, anyone who agreed to the interview and followed through with selecting a date and time to meet was interviewed. This was in fact a very hard process because many of the technical college personnel failed to submit names of the African American students to interview, as was requested.

Finally, after analysis of the results from the interviews, the data revealed very concrete themes that can be used to share with other African American females, faculty, and administrators in community colleges.
CHAPTER FOUR

Data Analysis

The purpose of this chapter is to provide the analysis of the data collected from the interviews conducted on seven African American women in engineering technology programs in community colleges. The findings of the results were based on the primary and secondary questions of the study. Of the 16 technical colleges in the technical college system in this South Carolina, four colleges were represented in the study.

Based on the design of the study, all students were African American female students. Two of the students enrolled in the community colleges immediately out of high school. One of the students enrolled in the community college after serving in the military, three of the students enrolled after working in industry for over 30 years and one enrolled after only a few years of working in industry. The students ranged in age from approximately 20 years old to 47 years old. All of the students were employed at least part-time, with the majority of the students working full-time in a manufacturing environment on either rotating, evening or night shifts.

The researcher developed themes that were directly chosen from the words of the participants. Saldana (2009) stated that the “researcher strives for codes and categories after coding to become more refined” (p. 10). After rounds of coding, themes emerged in both secondary questions. In the first research question, “What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?”, the following themes emerged: family influence encouraged participants to be successful and prior experiences from previous jobs, military, and other
educational experiences played a part in participants’ determination to succeed. The themes that emerged from the second research question were: positive experiences with instructors and students that encouraged students to remain in college; negative experiences with instructors and students that cause students to question whether they should remain enrolled in college; preparation, academically and socially, impacted the students’ perception of the college experience; and, students felt a sense of isolation, which caused them to not participate in college activities. The chapter will include the descriptions of the participants and the identified themes.

**Description of the Participants**

A brief description is provided for each participant.

**Participant One**

Participant one was interviewed face-to-face. The interview was audio-recorded and later transcribed. Participant one was not a big talker. Initially, she basically answered the questions in as few words as possible. She did not seem overly excited about the participation. She almost seemed afraid of answering the questions thoroughly, possibly feeling that there may be repercussions based on the answers that she gave. Later during the interview, she began to elaborate more on the answers and seemed more comfortable with the process.

Participant one attended high school in a very rural area in the upstate. The high school was very small. This was the first semester for participant one and she was enrolled in the Mechatronics program. Participant one was raised by one parent, her mother. Both of her parents completed high school. At the time of the interview, her
father was deceased and her mother was still employed. Education was viewed as very important in her household. Her GPA in high school was a 2.6 and she felt that she was academically prepared for college at this time. Her reason for attending the particular institution of choice was location. She did attend college prior to enrolling in this degree, but she left because she really needed to work.

As far as her family background, she has three brothers and one sister. Only she and her baby brother graduated from high school. The other siblings did not complete high school. Participant one felt that education was important because she did not want to struggle like her mother did.

When asked about her experiences while enrolled in this degree, participant one feels that she has been treated fairly. She feels that this has been an overall positive experience. She feels that the course work so far is not difficult. She decided to major in engineering because she has always been good at math and science and pretty good with her hands and she felt that she could combine those strengths to “make some money”. When asked, what this program could offer that could better meet the needs of the students, she feels that they could try to recruit more African Americans, especially women. They could go in high schools and in neighborhoods to try to build an interest in the program. She felt that she has not had any negative experiences.

Participant one is motivated to succeed. She is not involved in any activities at the college. She also feels that she was prepared academically and socially for this college experience. She gets along well with her other classmates. One major obstacle
that she does face is the fact that she works full time and attends school full-time as well. She currently works in manufacturing.

Her ideal college experience would include better time management on her part. She feels that her college could make the college experience better by offering her program of study on the campus that is nearer to her home. She would also like it if the classes were scheduled closer together with time, but she also mentioned that because of the time gap, she does have the opportunity to complete homework assignments.

Participant one would like to get into ABC Company’s scholar program so that she can have stable employment once graduating. Five or ten years down the road, participant one would like to have a bachelor’s degree in engineering.

**Interview Analysis – Participant 1**

**Research Question 1 – Main factors that influence women to enroll**

**Demographic Questions**

Participant one was from the upstate in South Carolina and attended the local high school in that area. Her major program of study is Mechatronics and this is her first semester in the program.

**Academic Preparation Questions**

Participant one reported that she grew up with one parent. Although she did not grow up with her father, he was a part of her life. The father is deceased and her mother works in Quick Service. Her GPA from high school was a 2.6. When asked about the education of her parents and siblings, participant one responded by saying, “I have three brothers and one sister. Myself and my baby brother graduated from high school.” This
comment led the researcher to believe that the other siblings did not graduate from high school. She felt like it was important for her to attend college because she didn’t want to struggle. She decided to major in engineering because she was always good at math and science.

Research Question 2 – Experiences of women while enrolled

Participant one shared that she felt she had been treated fairly by her classmates and instructors, but she did not say anything further. When asked about her experience as an engineering student, she quickly said that “it has been a positive experience” and that it has not been that difficult. She felt that the experience would be better if “they would try to recruit more African Americans, especially women.”

She did not share any negative experiences. She felt motivated to succeed and said, “As I am getting into the program, I am really starting to like it.” She felt that she had a good relationship with people in her class and the only thing that she considered an obstacle was the fact that she worked full-time and was a full-time student. She works from 3pm – 11pm in manufacturing.

When asked about her ideal college experience, she stated that, “The only thing that I could think of is if they could offer these classes on the other campus, so it could be more convenient. And for the time for my second class to my third class on Mondays, Wednesdays and Fridays, I have like a two hour layover. But I also use that time to do homework so it kind of works out cause I really don’t have time to do it at night.”
Post Education

After graduating, “I really want to get into the XXX company scholar program. But if that doesn’t happen like right now, I am currently in the technician apprenticeship program where I work with the technicians on weekends.” Her pay is more on the weekends because it is time-and-a-half. Initially, to get into the XXX company scholar program, she was not qualified, but she planned to try again next year. In five to ten years, she wants to have a bachelor’s degree in engineering. She hopes to attend Clemson because it is closer.

Participant Two

Participant two was interviewed face-to-face. Participant two seemed open and willing to participate from the beginning of the interview. Participant two attended a small rural high school in the upstate. This was a mid-size high school. The major of participant two is general engineering and this participant is considered a sophomore at the college.

Participant two grew up in the household with both parents. Both parents of participant two graduated from a local university. The mother has a degree in business and she was unsure of the degree for her father. Currently her father works, but, her mother is disabled. When she was younger, her parents were very strict in regards to education. They encouraged her to follow her heart, which was not necessarily a command to attend college, but they wanted her to be successful. She was successful in high school with a 3.6 GPA and she was an honor graduate. She feels adequately prepared for college at this time. She chose to enroll at this particular institution because
it was closer to home. Once completing college, she wants to work at a place where she can “just do maintenance.” She was in the military before she enrolled in the engineering program at this institution. She also attended an online college prior to enrolling in the current technical college, and received a certificate.

The participant did not have sisters or brothers. She felt that the status of her parent’s education did not influence her decision to attend college at all. She felt that her experience in the military was the main influencer of her decision to attend college. She wanted to build on the knowledge that she obtained in the military.

Participant two spoke very highly of one of the instructors in the program. She feels that he has been a part of her most positive experience. She felt that it was a little weird being the only female and only African American in the class, but then after a while you get used to it. At the time of the interview, she was no longer the only African American female in the class. Participant two did elaborate to say that she felt she was not treated fairly, although later she said she felt the engineering program was doing a good job. When asked about her most negative experience since enrolling in the program, she made reference to an experience of another student that had an effect on her. The other African American female student was going through a tough time and one of the instructors brushed it off and did not show any affection. She also went on to say that there was another student of another race that was going through something mediocre and the instructor offered the student extra time to do whatever was needed. This student did not speak up in this instance, but she felt the circumstances were wrong.
and should have been handled differently. The African American student remained in the class, but she was hurt.

Participant two was motivated to graduate and continue because she wanted to have someone to be proud of her and she wanted to be proud of herself. She was not involved in any activities on the college campus and she has no desire to be. She felt that she was academically prepared for this college experience but socially, she was not as prepared as she thought she was. She said she was used to a lot of diversity, but in her particular major, there was not a lot of diversity. She stated that is was mainly one race and one gender and she was used to being around a number of races.

The major obstacles that participant two has faced are personal. Her mother was really sick last semester. The last month she had to quit school and take care of her mother. Participants two’s ideal college experience would consist of enrolling in college as soon as you graduate from high school. She would also choose all day and no night classes. She works full-time and that takes up a lot of her time.

After graduating with this associate’s degree, she plans to get a job in maintenance, doing something hands on and using her technical skills. In five to ten years, she plans to return to Hawaii. She used to live there while in the military and she desires to return.
Interview Analysis – Participant 2

Research Question 1 – Main factors that influence women to enroll

Demographic questions

Participant two is from upstate South Carolina and attended high school in the area. Her major is General Engineering and she is a sophomore.

Academic preparation questions

Participant two’s parent both graduated from Clemson University. Her mom graduated with a business degree and her father graduated with an engineering degree. At the present time, her mom is disabled and her dad helps take care of her mom. Her mother has been disabled since she was in high school, around six years. Her parents were very strict in regards to education. When asked if they encouraged her to go to college, she replied, “Yes, well they encouraged me to follow my heart, not necessarily go to college to be successful.” She was an honor graduate. She enrolled at that particular technical college because it was closer to home. She became interested in maintenance because, “I was in the military before I joined, I mean before I came here. I was a radio operator, so I was really into doing stuff like that.” She attended online college prior to enrolling for her engineering degree. It was another college and she graduated with a certificate.

Participant two does not feel that the status of her parents influenced her decision to attend college. She stated, “When I was in the military and working on all of that stuff, I just wanted to enhance my knowledge or whatever.”
Research Question 2 – Experiences of women while enrolled

One of the most positive experiences for participant two has been experiences with one of her instructors. She stated, “Just him in general, because if you ask him a question he actually goes in depth with you and he shows you how to do the things in class. And I was never that comfortable with people, but with him it is different.” When asked about her experience as an African American engineering student, she stated, “At first it felt a little weird because I was the only female and I was the only African American in the class. I didn’t really talk to that many people because, but then after you get used to it, it’s just like another day.” Currently, she is not the only African American in the classroom.

Her negative experiences focused on the experience of another student. She felt a teacher mistreated a student. She said, “I didn’t say nothing, but I was like, that was kind of wrong.” She said the student was hurt, but she is still in the program.

When asked about things that affect her in a positive or negative way at the college, she once again made reference to the same instructor. She really liked him. She felt academically prepared for college but felt that she was not as prepared for the social aspect. She expressed the following, “I thought I was. I am used to a lot of diversity and it’s not a lot of diversity in this major. It’s pretty one sided. It’s like only mainly one race and one gender. I am used to every race.”

She has also faced a major obstacle with her mother getting really sick last semester. She had to quit school the last month of the semester. “And pretty much every obstacle I have in school is related to my mom. She is better now.”
Her ideal college experience would include, “Do it as soon as you graduate high school because it is hard going to work and then going to school after working 12 hours a day. Make sure it’s what you want. I would do all day classes, no night classes.”

**Post Education**

Her future plans include getting a job in maintenance and doing something hands on and using her technical skills. In five or ten years, she wants to be in Hawaii. She previously lived there in the military and would love to return.

**Participant Three**

Participant three was interviewed face-to-face and she was very open and willing to elaborate on all answers. She was very comfortable from the beginning of the interview and seemed very excited to participate in the study. She attended a very small, rural high school that has since closed and is now a charter school. Her major is electrical engineering. Her classification is a freshman and she has been out of high school for a number of years. She started school a few semesters ago.

Both of participant three’s parents graduated from high school. Her father was in the military and her mother was a homemaker. She grew up in the home with both parents. She came from a family of 13. They moved around a lot when she was younger. Her father is from the town where they eventually settled. Her father is now deceased. Education was viewed as very important by both parents. Her mother was an avid reader, so the participant felt she inherited the love of reading from her mother. Participant three dropped out of high school after the death of her father. Later she obtained a GED.
Finally, she made the decision to attend college and major in engineering because of her love for building things.

The timing of when the researcher asked if the participant felt she was prepared for college, was the determinant for the answer. She stated if the researcher had asked that question two months ago, the answer would have been no, due to the health of her mother. That was the most important thing for her at that time. She enrolled at the college because of the convenient location and she likes to be able to see her instructors. Once she completes her degree, she wants to get a master’s degree.

Interview Analysis – Participant 3

Research Question 1 – Main factors that influence women to enroll

Demographic questions

Participant three is from upstate South Carolina and she attended high school in that area. Her major is electrical engineering and she is classified as a freshman.

Academic preparation questions

Both of participant three’s parents graduated from high school. Her father was in the military and her mother was a homemaker. She is one of 13 children. She grew up in the home with both parents. They moved around a lot and finally settled in the area because that was where her father was from originally. Her father was a big authority figure in the house. Her father is now deceased and so is her mother. Education was a must in her family. Unfortunately, this student dropped out of high school two months after her father died. She struggled with death of her mother and the death of her father really bad. She explained,
Unfortunately, I dropped out of high school. My father died. After he died, I dropped out of high school. I would go try and get my GED. I would go and I got ready and would take the pre-test and I would pass with flying colors and then when it was time to take the actual test, I wouldn’t go. Finally, I took it and passed it.

My mother was diagnosed with cancer. It was my responsibility to take care of her and my other siblings. So, I was thinking about, well I was taking care of my mom, maybe I can do something in the medical field. When her health started deteriorating, I couldn’t bear the thought of seeing someone else’s mother go through what I saw my mother go through. So I was like, you know, I always liked fixing things. So I just started in the engineering program.

Participant three went through a very traumatic experience and she felt that it could have been handled better by the administrators and faculty at the college. She thoroughly shared the experience with the researcher. Ultimately, she ended with the following comment, “I am not going to let anything stand in my way, because you can, there is a smart way about doing everything. You can’t go through a wall but you can always go around it.”

Participant two felt prepared for college at this time, but she said if that question had been asked two years, or even two months ago, the answer would have been different. This is her first time attending college. As far as she knows, all of her siblings graduated high school. Out of 13 children, only one other brother went to college.
Research Question 2 – Experiences of women while enrolled

One of the most positive experiences that participant three has experienced is that she has been offered some amazing jobs since enrolling in the engineering program, but they required certain things and she has not taken some of the required courses yet. She also has an instructor that she considers amazing. She stated, “I kind of surprised him (the instructor), and it tickled me because I don’t think they look for me to know a lot of this stuff. When I know more than some of the guys, and I am helping them, my instructor is like, good job, well done.”

She wants to major in engineering mainly because there is a shortage of Black female engineers. She said, “I want to eat, I want to live comfortably, I want to give back, I want to do something. I just don’t want to make all of this money and sit on it. I don’t care how long it takes me, I am going to do it.” She went on to say that she is especially challenged when people feel that she can’t do something.

When asked what would better meet the needs of African American engineering students, she said that she wishes there were more African American females in the classroom. She stated, “I really can’t explain what can make it better. The instructors are good and there is really nothing more that you can do, you know, reach out I guess. Just reach out.” Participant two, aside from the negative experience that she has had, answered yes three times when asked if she was motivated to continue with her education. She is motivated by her mother. She exclaimed, “I am so determined. I don’t care. If I fail a class, you better believe I am going to come, I’ll take it again, I’ll come back around. I’m so determined.”
Although she is currently not involved in campus activities, she would eventually like to be involved in a group. She feels that she is academically prepared for the college experience because of the challenges that she went through obtaining her GED. She also felt that, socially, she was prepared for the college experience. She referred to the classmates as kids, because she is much older than most of them. She said, “I am just trying to get my lesson, but for the most, they think I am their age.” Participant three would not change anything concerning her college experience. She felt that everything had been a learning process.

**Post Education**

Participant three’s goal after graduation is to find a company that will match what she wants to make. In 10 years, she wants to be a partner in a corporation. She also plans to educate more black female engineers with what she has been through.

**Participant Four**

Participant four is from a larger high school in the northern part of the state. Her major is engineering transfer. This is her third year at this technical college. Her mother has a bachelor’s and master’s degree in engineering and her father has a master’s degree as well. She grew up with both parents. At the present time, both parents are unemployed because her father had an accident and her mother helps to take care of him. Education has always been viewed as very important in the home. She had a very good GPA of 4.1 in high school and she graduated high school in 2013. She felt that she was prepared for college at this time.
She enrolled at a community college because she did not feel prepared to go to a university and she was also not financially supported to go to a university. Her ultimate goal is to obtain a PhD in engineering. As far as the education of her siblings, she has two brothers and a sister; two graduated college and one never finished college.

She feels that the people’s attitudes at her particular institution is one of the most positive things that she has experienced. She is the only female in the class and she is the only African American in the class. She decided to major in engineering because her mother was an engineer. Participant four is motivated to continue her education because she wants to be independent. She feels that the heavy workload is the negative thing about college. She feels that she was prepared for college and, so far, there have been no obstacles to her completing this degree.

After graduating from college she would like to work with an engineering firm and then take the PE exam to get her license.

**Interview Analysis – Participant 4**

**Research Question 1 – Main factors that influence women to enroll**

**Demographic Questions**

Participant four is from the middle part of South Carolina and attended high school in that location. She is currently an engineering transfer major and this is her third year enrolled in the technical college.

**Academic Preparation Questions**

The education background of the parents for participant four include a bachelors and master’s degree in architectural engineering for her mother and a master’s degree in
something for her father. She grew up with both parents. During the time of the interview, both parents were unemployed because her father had an accident and her mother was home taking care of him. Education was always considered very important in her household. Her mother would say, “You need to do your homework. You need to take it the next step forward so you can be better than we were.” Participant four did well in high school and maintained a 4.1 GPA. As a result, she feels very prepared for college. At the time of her high school graduation she did not feel prepared to go to a big university, neither was she financially supported to go to a big university. She felt that the status of her parents did not influence her decision to attend college. Two of her siblings graduated from college and one never finished college.

**Research Question 2 – Experiences of women while enrolled**

When asked about the positive experiences that she has encountered, she did not hesitate to say the people’s attitudes. She said it was very pleasant to get help from others. When discussing her experiences as an engineering student, she said it had been neutral. “Everybody gets along with everybody for right now. It’s not biased at all. Because I do have a female engineering teacher and I am the only female in the class with a bunch of males, it’s kind of even, so it’s neutral.” Participant four was the first participant to admit that she majored in engineering because of the influence of someone else, her mother. She wasn’t really sure of a way that the engineering program could better meet the needs of the students.

She commented that she has not had a negative experience since enrolling. She was motivated to continue with her education because as she mentioned, “I want to be on
my own and be able to support myself and my family, so, I have to get my education to be able to do that.” She is not involved in any activities at the college. The only negative thing about the college that she mentioned was related to the heavy work load.

**Post Education**

After graduation, she wants to work for an engineering firm and work for the recommended five years so that she can come back and take the PE exam. In five to ten years, she hopes to have a doctorate degree.

**Participant Five**

Participant five is enrolled in a technical college in the lower part of the state. She has been enrolled in a general engineering program and has been attending there for one year. Both parents graduated high school, but neither has an advanced degree. She grew up with both parents. Both parents are employed in manufacturing.

Her ultimate goal was to get a degree so that she could work in an office at the local manufacturing company rather than work in the plant. She currently has an apprenticeship at the local manufacturing plant and they are paying for her education.

Although this student agreed to participate, she seemed very preoccupied during the interview. She seemed to be eating and getting in and out of the car. After a few questions were asked, the call was disconnected. The researcher attempted to call back, but no calls were answered. The researcher also called back after a few weeks to try and reschedule the interview, but the participant failed to respond.
Interview Analysis – Participant 5

Research Question 1 – Main factors that influence women to enroll

Demographic Questions

Participant five is from the lower part of South Carolina and she attended high school in that area as well. Her major was general engineering and this was her first year in the engineering program.

Academic Preparation Questions

Both parents of participant five graduated from high school. She grew up with both parents. Both of her parents were employed at the time of the interview. When asked how education was viewed in her household, she stated, “It is important.” Her GPA from high school was a 2.5 and she graduated in 2013. When asked if she was prepared for college, she replied, “Yes.” Participant two commented, “I enrolled at this college because they are paying for it. I have an apprenticeship with this company and they are paying for everything. I want to get this degree so that I can work at this company in the office, not on the floor.”

She did not attend college prior to enrolling at this institution. Participant five has siblings, but she didn’t state how many. When asked about the status of their education and if they attended college she became quiet and eventually the call ended.

No other information is available for participant five.

Participant Six

Participant six attended high school in the middle part of the state. She worked in industry for over 30 years, but after a divorce she decided to enroll in a community
college. Initially, she attended the community college closest to her hometown, but after completing the basic general education courses, she enrolled in another community college that offered the program in which she was interested. She is now enrolled in Chemical Technology Engineering. She plans to receive a Chemistry Lab Tech Certification and also a degree in EGT.

Her mother was a high school graduate, but her father did not graduate. She grew up with one parent, which was her mother. Her mother was a manufacturing operator and her father was a painter. Growing up, higher education was not considered very important. Her mother did not know the importance of an education. But today, in her household, education is considered very important. She and her husband (although they are now divorced) raised their children to value education. Her daughter has a BSN in Nursing and her son has enough hours to complete an associate degree, although he has yet to apply for graduation. At first she did not feel prepared for college, but now she feels very prepared.

Initially, she enrolled at the technical college that was closest to her home. At this college, she enrolled in the general education courses. After those courses, she transferred to another technical college so that she could get Chemical Technology Engineering degree. Prior to attending the technical colleges, she attended colleges online, but soon found out that was not what she wanted.

She has had a wonderful experience at one of the technical colleges because she felt that they provided the resources that she needed and were always there to help, but at the other technical college she felt that the resources were not available. She also felt that
there should be more African American women in the program because she is currently
the only one. The negative experiences include the types of courses that she is required
to take during a semester and the fact that it is sometimes hard to understand the
instructors.

Upon entering college, she did not feel that she was prepared academically or
socially for the experience. She was going through a divorce. Also in the classroom, the
students were not accepting and it was hard for her to find study partners, etc. Her ideal
college experience would include resources to help people who return back to school,
especially people of color. She seems very determined and motivated to continue her
education.

Interview Analysis – Participant 6

Research Question 1 – Main factors that influence women to enroll

Demographic Questions

Participant six is from the coastal area in the state in South Carolina. Eventually
she moved to the middle part of South Carolina. She attended college in middle South
Carolina. Her major is Chemical Technology Engineering. She will also receive a
certificate in Chem Lab Certification and a degree in EGT.

Academic Preparation

She described the educational background for her parents like this, “My mother
was a high school graduate and my father, and he went to 12th grade and didn’t graduate.”
She grew up with one parent and that was her mother. The occupation of her parents
were described as, “she was a manufacturing operator and he was a painter.” When
asked how education was viewed in her home, she started to explain the emphasis that she put on education for her children,

    Oh it is very much viewed, because, my kids, I got one that is graduating. She graduated with her BSN in nursing. And then, I have a son, he is at tech school. He has taken so many classes that they told him that he need to apply for graduation because he has basically got an associate of science degree and didn’t even know it.

My husband was also an educator in the home. My husband, we raised our kids in the home. I just got a divorce about a year ago and I decided about a year and a half ago to go back and complete my education. My husband, he went to school, he was a two-year engineering major at a technical college.

After listening to the answer related to the way that she valued education in her home as a mother, the researcher once again asked how it was viewed when she was growing up. Her response was, “Well, I don’t think my momma understood, because I don’t think she knew the importance of it. Because, you know, I don’t think that she, I think that her philosophy was you go to work and get a job and take care of your children.” Participant six then further explained the emphasis that her mother placed on a high school education, “Her philosophy was for high school…. She wasn’t going to send us an extra year. She said you can get it in 12 years or you don’t get it at all. So we had to go to high school and graduate, but as far as college, I don’t think they knew the importance of an education.”
Participant six was an average student in high school with a GPA of 2.0. She felt prepared for college now, but she didn’t when she graduated from high school. The reason participant six enrolled in this particular college was explained,

I enrolled at the first technical college to get all of my undergraduate courses, you know, some of my math and English and then I branched over to this program because I was interested in the lab tech program. I came down here to the program because it wasn’t going to take me but a year, because I had all of my, most of my undergrad from the other technical school.

She was interested in this major because she felt that it was dominated by the majority race. She also stated, “When you go to those positions in industry, they get a substantial amount of money. Then they work days, so to me that is more privileged, and they don’t work hard.” Her ultimate goal once completing the degree is to grow in a position. She said, “I just want to grow and be able to retire and be able to sustain. Whatever I get I want to be able to sustain and keep it. You know, if you go that skill, you basically can go anywhere and work.”

Participant six did take some online classes at a four year college prior to enrolling in the technical college. She expressed that, “I just touched the basics of doing a little bit, but it wasn’t what I wanted. In other words, I was going to get some type of degree, but it wasn’t for me. I have to be in a learning setting. I have to be in a classroom itself.” Participant six has two siblings. Both of them went to college and one graduated and has a doctorate in nursing. Based on the education of her parents and her siblings, these were her thoughts,
Well I saw my sister, I saw my daughter, I saw my husband, how much money her makes more than me. He didn’t work hard. I work hard as a manufacturing operator and I wasn’t going anywhere. Not even supervision, but with them, they seem like to me, it’s a way for them to get into leadership. It’s a road. It’s a way for them to get into leadership. It’s a way for them to move through the plant. So, I just thought, if I go back and I get my education then, I won’t have to work as much. You know working in manufacturing is extremely hard sometimes.

**Research Question 2 – Experiences of women while enrolled**

Participant six decided that one of the technical colleges that she attended warranted the positive comments. The positive thing about that technical college in particular is that it had a lot of resources. “They had like learning centers and stuff. Like for people who wanted to learn. For those who were having trouble with different things. They would get somebody in there to help you.” Her experiences at the second technical college were different. She felt she had no resources. She said they would tell you, “We don’t teach engineering math.” She continued by saying, “We didn’t have anybody that we could go to for help, but the teachers themselves.” She said basically 15 minutes was all that you could get with a teacher.

When asked how this program could better meet the needs of African American engineering students, she remarked, “To be honest with you, it’s none of us in it. It’s one other girl and she is in another program, but not this particular program.” She felt that the most negative experiences were related to the teachers. She felt that there was a language barrier with some of the instructors because they were not Americans.
Although there have been difficulties, participant six noted that she is still motivated to continue with her education. The motivation factors were expressed in the following way, “My grandchildren, my grandkids, my son’s children, I want them to see that in life, you got to get up. That no matter how old you are and the mistakes that you have made, you can still be successful, it’s within yourself.”

Like the other participants, participant six is not involved in any college activities. Responding to the question of whether there are things that impact her in a positive or negative way at the college, participant six said, “Most of the teachers are very discouraging. I am the only black in the class and she basically told me that she would help everybody get a job, but she told me that she probably wasn’t going to help me.”

She also felt she wasn’t as prepared academically or socially as she could have been. Socially, students were not accepting. She described her experiences in this way, “I could never find a study group, you know. And I think that if I would have had more comradery, I think I would have did very, very good, but since I didn’t, I haven’t.”

The ideal college experience for this participant is described as, I just feel like if a program was set up for people of my age to come back and be successful, that they could have programs, you know, other programs within programs and have it for us with resources. Like if we don’t remember something in chemistry, then you know to have those resources available for us because it has been so long. That’s my ideal.
Post Education

After graduating, the eye of this candidate is on working at the local river plant. In five or ten years, she plans to go back to school. She has a buzz for school now.

Participant Seven

Participant seven is originally from New Jersey and she attended high school in the upstate. Her major is Mechatronics and this is her last semester at the institution. She grew up with both parents until the age of five years old, at that time her parents were divorced and her mother moved them from a northern state to a southern state, where her mother was originally born. Her mother was a nurse and her father was a construction worker. Her mother received her degree from a local two-year college.

Growing up, her mother stressed the importance of an education, although she worked about sixteen hours a day. Participant seven and her siblings always had to complete their homework before doing any other activities after school. Now, this is the way that she raises her children. She makes sure that they complete their homework each day after coming home from school and getting a snack. She will ask them about their day at school and in return they inquire about her day at school as well. She feels that it is hard sometimes being a divorced mother of three.

In high school she had a GPA of 2.98. Initially she did not feel prepared for college, but as she has advanced through the courses, she now feels more capable of completing the program. Participant two did attend another technical college prior to enrolling in this technical college, but due to her working the night shift and driving a far distance, she decided to attend the technical college that was closer to home. As far as
she can remember, at least one of her siblings graduated from college. At first her mother did not support her college aspirations, but later on she started to support her more and encourage her to complete her education.

Since enrolling in the program, she feels that the students are awesome. They have encouraged her and they offer to help if she needs help. As an engineering student, she feels it is challenging and there are still some parts that she is afraid of, but overall it is okay. She feels that the program could help her and others by recognizing women more. Her one negative experience has been when an instructor told her that she would not pass his class. She did fail the class, but eventually learned the ways of the instructor and passed the second time. She is not involved in any activities on campus. She has had some family issues that have been obstacles in completing her education, but she is determined to finish her degree.

After graduating from college with the engineering degree, she wants to make the “big bucks.” She wants to progress with a company and do a little traveling. She has high ambitions to be successful with programming.

Interview Analysis – Participant 7

Research Question 1 – Main factors that influence women to enroll

Demographic Questions

Participant seven is originally from New Jersey but attended high school in upstate, South Carolina. Her major is Mechatronics and this is her fourth semester. She is classified as a sophomore.
Academic Preparation

Her mother was educated as a nurse and her father was a construction worker. Her mother was born in South Carolina and her father was from New York. She grew up with both parents until, at age 5, her parents were divorced. Her mother’s nursing degree is from a two-year college. Participant six also compared the value of education in the eye of her parents and the value of education for her as a parent. When she was a child, she describes it as this,

Well, my mother was a workaholic, she was always at work. She worked 16 hours ‘cause she worked on the cancer floor. I remember us coming from school, she would make sure we do our homework and make sure we do our studies before any other time. Afterwards we would have free time, we could play and do whatever we wanted to do outside or whatever. But she made sure that education played the first part when we hit that door inside.

As a parent she uses some of those rules. She said the following.
When they come in they get a snack or whatever if they want something to eat. They will do their homework and we will talk about whatever, their goals in school. Then they will ask me questions about my schooling and then they ask me what I learned today in school. It’s reverse. They play the role that I play on them. When I ask what they do in school, they do it to me too. It’s kind of cool.

Participant seven has been married and is now divorced. She has three children. Her GPA in high school was a 2.98. She felt prepared for college at this time, but she admitted that it has been a struggle. She expressed the challenges, “I graduated in 1992.
So to get a better education on life, so that I can better myself and better my kid’s life. I think that I have accomplished a lot since I have been at the technical college.” She was enrolled at another technical college, but she had to leave 3rd shift and drive a distance, so she decided to go to the school closest to her house.

Participant seven has five siblings, several more if you add the other siblings by her dad. All of her siblings graduated from high school and as far as she can recall, only one, a sister, graduated from college. Her mother was not very supportive at the beginning. She stated, “Well my mom was not too supportive from the beginning and she still isn’t a little bit. She’s kind of shaky, but I am almost finished so she like, well okay.” Because her mother made sure that they had an education and if they struggled she told them to ask for her. So now if she is struggling, she tries to ask for help. She felt like it is a challenge because she was not taught some of the things that she should have been taught and she feels others have an advantage because of this.

Research Question 2 – Experiences of women while enrolled

Of the most positive experience since enrolling, participant seven felt that the students were awesome. “Some of the students are like, they encourage you. They help you. They get involved. They say if you have any questions, here is my number, call me.” She also had supportive things to say concerning the instructors. She said, “I probably came into two instructors. They are encouraging as well. One teacher seemed a little hard and he frightened me a little bit. You know he made me very nervous, but he is always constantly asking me how I am doing.”
She described her experiences as an engineering student as challenging. The technology, voltage, etc. is all challenging. She majored in engineering because of the challenge. She also feels that, “Everything is going to be technology, all these three dimensional things that’s going on and none of the old stuff back in our days. All of the stuff is going to be computer operated and mechanical wise.”

When asked how the engineering program could better meet the needs of African American students, she said that there should be more for women. She expressed that women were not recognized for doing some of the things that they do. She then elaborated by saying, “None of them were recognized for that, but now being a woman of today’s society, we are being recognized for technology that’s coming out that we putting ourselves into so we know.”

Initially, she commented that there were no negative experiences, but then she recanted and said,

Well I would say that I have only had one negative word probably that someone said. And it was an instructor. You know my grades. At the time I was struggling on it and at the last minute I sort of caught up with how he work. So with me trying to catch up with my grades that negative I go was he said it doesn’t matter if you pull the grade up, you still gonna fail my class. That’s the only negative that I got. From that point on, it kind of made me a little disappointed, but I had the same instructor today so he is doing a new, he is teaching a new class.

She said that now the teacher has changed. At one time, he would tell them if you didn’t get the information that was written on the board, that was your fault, but now he will ask
if there are any additional questions and offer to see them after class or in his office. She commented by saying, “I am like okay, yea. I am like um-hmm, everybody changes.”

Participant seven is not involved in any campus activities. When responding to the question relating to things that impacted her in a positive or negative way, she said, the instructors have definitely been positive and supportive. She felt that she was prepared academically and socially for this college experience. Socially, she said that now she is comfortable sharing what she knows and has offered to help others with her new skills. She commented by saying, “I didn’t know that I could do that. I didn’t know that I could teach my boys how to change a socket, an electrical socket, you know and explain to them how that goes.”

Participant seven shared a few obstacles that she has faced since enrolling in college. First, she found out her father has cancer. She has just begun communicating with him after years of separation and now she has to deal with his illness. Her mom is not in good health. Her twin sister has been battling problems with her blood pressure. All of these things take time away from her focusing most of her attention on school. She explained the challenge in this way, “There is always something after school that takes more attention from me studying and doing my homework. I be late doing it. I work third shift so I can catch up then.” In the midst of all of this she said, “I do have an understanding family and my twin is very supportive. And she is like go ahead, go to school, finish this semester. Don’t let nothing stop you because you are too close.”
Her ideal college experience would include the ease of getting to class, finding a good parking space and “trying to get the materials that you need from the bookstore, making sure everything is good, making sure you got the right one.”

Post-Education

To answer the question concerning her plans after graduation, she replied, “Try to make them big bucks!!!! Find a company where I can progress, maybe do a little traveling, who knows.” In five to ten years, she wants to be very comfortable with a number of cars and houses. She can also envision, “Making programs or designing programs for the engineering, for technology, making my small little business. I can see myself sitting back working from home. From designing the programming for electrical classes or programming for a company of parts.”

Themes

The themes resulting from the analysis of all seven participants are detailed below. The findings are structured and organized by the research questions. Table 1 provides a list of the participants, their geographic area of location in South Carolina, their range in age, marital status, parental status, their parent’s education, and their current classification in college. The research questions include:

1. What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?

2. What are the experiences of women while they are enrolled in engineering technology programs in South Carolina technical colleges?
Table 4.1 Participant Characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Geographic Location (SC)</th>
<th>Age Range</th>
<th>Educational Classification</th>
<th>Marital Status</th>
<th>Major</th>
<th>Parents’ Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>Upstate, SC</td>
<td>&lt; 30</td>
<td>Freshman</td>
<td>Single</td>
<td>Mechatronics</td>
<td>Both-High School Graduate</td>
</tr>
<tr>
<td>Participant 2</td>
<td>Upstate, SC</td>
<td>&lt; 30</td>
<td>Sophomore</td>
<td>Single</td>
<td>General Engineering</td>
<td>Not sure</td>
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<tr>
<td>Participant 3</td>
<td>Upstate, SC</td>
<td>&gt; 30</td>
<td>Freshman</td>
<td>Married</td>
<td>Electrical Engineering</td>
<td>Both - High School Graduate</td>
</tr>
<tr>
<td>Participant 4</td>
<td>Midlands, SC</td>
<td>&lt; 30</td>
<td>Sophomore</td>
<td>Single</td>
<td>Engineering Transfer</td>
<td>High School Graduate College Graduate</td>
</tr>
<tr>
<td>Participant 5</td>
<td>Lower, SC</td>
<td>&lt; 30</td>
<td>Freshman</td>
<td>Single</td>
<td>General Engineering</td>
<td>Both-High School Graduate</td>
</tr>
<tr>
<td>Participant 6</td>
<td>Piedmont area, SC</td>
<td>&gt; 30</td>
<td>Sophomore</td>
<td>Divorced</td>
<td>Chemistry Technology</td>
<td>Both-High School Graduate</td>
</tr>
<tr>
<td>Participant 7</td>
<td>Upstate, SC</td>
<td>&gt;30</td>
<td>Sophomore</td>
<td>Divorced</td>
<td>Mechatronics</td>
<td>College Graduate High School Graduate</td>
</tr>
</tbody>
</table>
An overall analysis of the results revealed how individuals make meaning from their experiences. Many of the commonalities are grouped in a category by the age of the women, while the other commonalities are across the board for all of the African American women. The African American women over 30 years of age tended to answer the questions in more detail and were not afraid to elaborate on issues, whether those issues were positive or negative. Those under 30 years of age were very short with their answers and did not elaborate when responding to questions, unless follow-up questions were asked. The younger African American female students grew up with both parents, were single and had parental support throughout the enrollment process. The students over 30 years of age, varied with whether they grew up with one or both parents, one was married and the others were single or divorced, and at least two of their mothers did not support them going back to school. The parents of this group sometimes did not understand the importance of them attempting to further their education. Things that were more important to these parents included providing support for their children, which included assuring that their children graduated from high school and obtained a job after graduation.

The participants were all enrolled in institutions that were located in South Carolina and there did not appear to be a noticeable difference with the responses from the participants who were located in the different regions of South Carolina. The only perceived difference was with a student from the lower part of South Carolina who seemed less interested in the interview and eventually hung up during the process.
The table below outlines the interview questions and details which interview questions are associated with the particular research question.

*Table 4.2 Research Questions*

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Interview Questions</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question 1</strong></td>
<td>What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?</td>
<td>1-8, 11,12</td>
</tr>
<tr>
<td><strong>Question 2</strong></td>
<td>What are the experiences of women while they are enrolled in engineering technology programs in South Carolina technical colleges?</td>
<td>9-10, 13-23</td>
</tr>
</tbody>
</table>
The first research question included a number of support questions. These questions addressed demographics and academic preparation. The themes associated with this question are

1. Family influence encouraged participants to be successful.
2. Prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed.

**Theme 1 – Family influence encouraged participants to be successful.**

The African American women over 30 tended to be less prepared for higher education than those under 30 years of age. The over 30 age group had GPAs in high school that were not as high as the GPAs of those under 30 years of age while they were in high school. Only one of the students over the age of 30 grew up in the house with both parents. The parents of the under 30 age group were more educated overall than the parents of the over 30 age group. All of the students were influenced in some way by family members. Some of them attended college because a sister or brother had attended and those individuals set examples. Others attended college because a sister or brother did not attend college and the student saw the struggle and wanted to do better. One of the students was encouraged to attend college because of the success of her daughter. Because of the more advanced education of the parents, the females under the age of 30 were more focused on what they wanted to do and why they wanted to do it. Their GPAs were higher and the major difference was the young age at which they started college. In addition, they were about to accomplish a major milestone in their life without going through some of the challenges that life presented the returning students.
A commonality among all of the participants is the fact that they are motivated by family and they had that intrinsic motivation to want to achieve and accomplish more. They all want to make someone proud of them, whether it is their parents or their children. Because of the education of many of the parents of the students over 30 years of age, several of the students indicated that they wanted to do better to have more opportunities. For example, the participant was asked, “How did the status of those individuals (parents and siblings) influence your decision to attend college? She replied, “I didn’t want to see myself struggle like my mom did.”

All participants were also motivated to attend the college that they are attending because of the proximity to their residences. Each of them stated that they chose the college of choice because was located conveniently and this was also related to work and family obligations.

**Theme 2 – Prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed.**

Although the specific question was not asked concerning employment, all students revealed that they were employed at the present time and the majority were working full-time jobs that were considered less than premium times to work. The work schedules of most of the students interfered with class and study time, but some of the participants had understandings with the instructors to accommodate the inconveniences. For example, one of the students missed classes each week, because of the rotating work schedule where one week she worked on Monday and the next week she was off on Monday, and so on. Not being able to work was not an option because they all needed to
work. They all considered that attending school and taking care of their families was a huge sacrifice. Participant number one attended college prior to enrolling in her current technical college but she quit because “I really needed to work.” Other comments were similar as it related to working and going to school.

Although some of the students did not have children of their own, they still felt obligated to take care of relatives, such as parents. Four of the seven participants were in the role as a caregiver to family members, and this provided a tremendous strain on the participant with other family obligations, work commitments and school assignments. One of the participant’s mother was disabled. Another participant was helping to take care of her father because he had an accident and her mother now has to stay at home and take care of him. Two of the other participants were single parents, one with two children and one with three children.

Prior to enrolling in the engineering degree, the females over 30 all had jobs that they felt were not rewarding them properly. One participant stated, “I was in manufacturing. Manufacturing going from job to job and I got tired of getting laid off.” Participant 7 stated, “All I can think about is those words, women can’t do that, you can’t do what I do, and then I am like, I can do more.”

The themes associated with the current experiences of those enrolled in the engineering programs include:

1. Positive experiences with instructors and students that encouraged students to remain enrolled in college.
2. Negative experiences with instructors and students that cause students to question whether they should remain enrolled in college.
3. Preparation, academically and socially, impacted the students’ perception of the college experience.
4. Students felt a sense of isolation, which caused them not to participate in college activities.

**Theme 1 – Positive experiences with instructors and students that encouraged students to remain enrolled in college.**

All of the participants shared that they have had some positive experiences while enrolled in the engineering program. These positive experiences were all related to student to student interactions or interactions with instructors. Participant one says the students are the most positive thing, and participant two specifically named one instructor. She stated, “Just him in general because if you ask him a question he actually goes in depth with you and he shows you how to do the things in class.” Participant three stated, “We all work good together. There is no animosity among any of my classmates and I. Even after school, if I need help with something, I’ve got a number to call with one of my classmates and we can get it done.”

**Theme 2 – Negative experiences with instructors and students that cause students to question whether they should remain enrolled in college.**

All of the female students over 30 years of age shared a negative experience that related to college personnel or resource issues. None of the students under 30 shared personal negative experiences. One person under 30 reported on a negative experience
associated with another African American female engineering technology student who was over 30. The negative experiences associated with the instructors were not directly associated with receiving bad grades but they were associated with general interaction with the instructor and the fact the instructors made reference to the student not succeeding or the instructor not treating the student fairly compared to the other students in the classroom. The majority of the participants are the only African American females in the classroom and the instructors were not of African American descent. This fact alone caused the students to be uncomfortable.

The negative experiences from the instructors ranged from: (1) The instructor failed to show compassion and concern for the African American student when she was dealing with a major crisis, but showing what was considered as extreme passion and concern for a Caucasian student who was experiencing an issue that the African American student felt was not as critical. The student commented by saying: “This one instructor that I have showed no type of sympathy. She did nothing.” (2) The instructor saying that the students will not pass the class and giving up on the student, and (3) Instructors misadvising students and teaching on a level where the students cannot understand, along with the fact that there is a language barriers between the instructor and the students.

**Theme 3 – Preparation, academically and socially, impacted the students’ perception of the college experience.**

Most of the students felt academically prepared for college. The students under 30 did not elaborate on their preparedness, but the students over provided more details.
One student over 30, who felt academically prepared for this experience, related it to the fact that she had been challenged earlier in life. She commented by saying,

I think going to school to get my GED, stopping, starting, stopping, it kind of set me back a little bit and I was kind of unsure, kinda, my faith kind of waived a little bit. Once I got into my classes, I realized that’s what I have worked for. I have worked in places that deal with stuff like that, so I kind of know it, so I am sure enough now of myself that I can do it. Another comment from a student over 30 was, No, I think I was emotionally when I first went, but not academically. But when I came back from A Tech to B Tech, I was.

The social experiences for the students were similar as well, but it seemed that the students under 30 were so accustomed to being in the minority that they did not feel that it was so different than other things that they had experienced. Comments related to social preparedness included:

“I thought I was. I am used to a lot of diversity and it’s not a lot of diversity in this major. It’s pretty one sided.”

“These kids, these kids here are something else.” “I love it. I love this school. Even when we go on breaks, I be like, man, I can’t wait to get back to school.”

“Social as in with others? When I learn something I say hey, look what I learned today in school this is cool. I didn’t know that I could do that.” “Yea, I am just awesome.”
Theme 4 – Students felt a sense of isolation, which caused them to not participate in college activities.

None of the students participated in any of their college’s activities besides attending class. When asked if they were involved in college activities, six of the seven participants said they did not and did not state that they had a desire to be involved. One participant said no, but she followed up with the statement,

Not as of yet. Not yet, I don’t want nothing to you know, to deter me from my classes. Maybe a little later on, I would love to do something, join a group or something, if I can find one, dealing with battered women or battered or neglected kids or homeless women. And I say those things because I experienced that myself. I used to work at a boarding school. I dealt with battered women. I have seen that. So those are groups that I would like to work with, you know.

When speaking on their experiences as engineering students, all of the students were a definite minority in the classroom. Only two of the students mentioned that there were other African American females in the classrooms, and those students attended the same college and were referencing each other. Some of the African American females were enrolled in classes with African American males. Comments included:

“At first it felt a little weird because I was the only female and I was the only African American in the class and I really didn’t talk to that many people because, but then after you get used to it, it’s just like another day.”

“I think it would be better if they would try to recruit more African Americans, especially women.”
“It’s not biased at all, because I do have a female engineering teacher and I am the only female in the class with a bunch of males, it’s kind of even, so it’s neutral.”

“It’s none of us in it. I have no African American women in that program. It’s one other girl and she is in another program but not this particular program.”

The feeling of isolation also relates to what the students felt the college could do to better meet the needs of engineering students, particularly African American women. They responded as follows:

“I think it would be better if they would try to recruit more African Americans, especially women.”

**Research Questions**

Each research question will be addressed.

**Research Question #1**

What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?

Based on the results from the interviews, family influence encouraged participants to be successful and prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed. These were the main factors to determine why the students decided to attend college and why they decided to major in engineering. The students under 30 years of age had at least one parent who had been educated beyond high school with a bachelor’s degree. The parents also had a major in or career in an engineering related field. The students recognized the success of the parent(s) and wanted to follow in those footsteps. Although the students mentioned
that the parents did not force them to major in engineering, the parents supported their choices.

The parent of the students over 30 years of age were not well educated beyond high school and some of the parents failed to complete high school. This lack of academic as well as career success served as a valuable lesson to the students. Due to challenges in life and previous experiences, these students decided that they wanted more out of life. They wanted better jobs and the jobs that provided more income with less physical labor. All of the students over 30 were employed in manufacturing and they realized that engineering was a field that could provide financial stability.

The students over 30 had been challenged with lower wages, losing jobs, depending on spouse support and family issues. Because of those experiences, they were determined to work hard and make a better life for themselves. Although different paths led them to the same major, the students were all determined to succeed.

**Research Question #2**

What are the experiences of women while they are enrolled in engineering technology programs in South Carolina technical colleges?

The themes derived from the question above are: Positive experiences with instructors and students that encourage students to remain enrolled in college; negative experiences with instructors with instructors and students that cause students to question whether they should remain enrolled in college; preparation, academically and socially, impacted the students’ perception of the college experience; and students felt a sense of isolation, which caused them not to participate in college activities. Although, it is true
that all students encounter positive and negative experiences while enrolled in degree programs. The positive and negative experiences for the African Americans were common in ways that may only affect this particular demographic. Most of these students were the only African Americans in their classroom or degree program. Some of them were the only woman in the classroom or degree program as well. If there were others, these students were still a definite minority. None of the students mentioned that they had African American instructors and only a few mentioned that they had female instructors.

The positive experiences all stemmed around student and instructor interaction. The participants felt a connection with the students. Some of the instructors also took a special interest in the welfare of the students and would try to make sure that everything was okay with the student and her experience. Only one of the students mentioned a positive experience with overall school support activities. At one college, programs were set up to show a special interest in those returning back to school.

Instructors had a strong impact on the perception from the students as it related to negative experiences. Many instructors failed to take an interest in the students and the students felt that the instructors did not care whether they succeeded or not. Students were told that the instructors would not recommend them for jobs and instructors told the students that there would be limits on the amount of money that they could make, even though the range for that degree program was a lot higher.
Summary

The researcher conducted interviews with seven African American females enrolled in engineering technology programs in South Carolina. The interviews were conducted in a face-to-face format and via telephone. After the audio recorded interviews were conducted the interviews were transcribed and coded to determine themes that emerged from the research question. The researcher determined that six themes were present throughout the study: (1) Family influence encouraged participants to be successful, (2) Prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed, (3) Positive experiences with instructors and students that encouraged students to remain enrolled in college, (4) Negative experiences with instructors and students that cause students to question whether they should remain enrolled in college, (5) Preparation, academically and socially, impacted the students’ perception of the college experience, (6) Students felt a sense of isolation, which caused them to not participate in college activities.
CHAPTER FIVE

Summary, Findings, Recommendations, and Implications

Summary

This chapter includes a discussion of the findings. First the purpose of the study and the research questions are restated. Following this discussion is a summary of the design, a summary of the participants, and an analysis of the themes as they are situated in the literature. Finally, the research questions are answered and implications for practice and future research are discussed.

The purpose of the study was to examine the experiences of African American women enrolled in community colleges majoring in engineering. The study sought to determine the answers to the questions, “What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?” and “What are the experiences of African American women while they are enrolled in engineering technology programs in South Carolina technical colleges?” The participants were African American women enrolled in technical colleges in South Carolina. The study was significant because it added to the literature base of African American women enrolled in community colleges with majors in engineering technology.

Summary of Design & Theoretical Perspective

The methodology for this study was qualitative using interpretive research. According to Pietkiewicz and Smith (2014), the collection of data usually occurs in naturalistic settings such as homes and schools. Through the analysis, the participants’ and researchers’ interpretations are considered during the process. Smith & Osborn
(2008) also emphasized that in the process of analyzing interpretive analysis, it can be described in terms of a double hermeneutic or one of dual interpretation. Participants in this instant first make meaning of their world, then the participants’ meanings are decoded by the researcher attempting to make sense of the participants’ meaning making.

The view that people socially and symbolically construct their own realities is through the paradigm of interpretive research (Rowlands, 2005). The interpretive research approach is consistent “with the epistemological and ontological assumptions that the world and reality are interpreted by people in the context of historical and social practices” (Rowlands, 2005, p. 83). It is best for the researcher to seek to understand individuals through their subjective meanings rather than through the researcher’s objective definitions. The understanding through this phenomena is a relationship developed between the interviewee and the researcher (Rowlands, 2005). The emphasis in this research study was on interpreting the experiences of African American women in engineering technology programs and what led to their decisions to attend college and major in those degree programs. The focus of the interpretation was from the responses to the questions, the tones of the responses and how it all related to the past experiences of the women.

The theories associated with the experiences of the African American women in engineering are Tinto’s theory of student departure and the “prove-them-wrong syndrome.” Tinto argued that students leave higher education because of their interactions with the college. The sources of the departure can be associated primarily with three areas to include academic problems, lack of integration socially and
intellectually with the culture of the college or a low level of commitment or involvement
with the college (Tinto, 1993). Moore et al., using the “prove-them-wrong syndrome”
argue that students persist in order to prove others wrong. When the students are faced
with negative stereotypes, they try hard to disprove the stereotypes and work to succeed
in spite of the perceptions of others. Colleges and students interpret failure in different
ways. Students may not consider it a failure to not complete a degree in the time frame
that the college considers successful completion. The students may transfer or return
later to obtain a degree (Tinto, 1993).

Discussion of Major Findings

This section of Chapter Five summarizes the findings that resulted from the case
study which addressed the two research questions. The first research question explored
the main factors that influence women to major in engineering technology programs in
technical colleges in South Carolina. The themes from this question are: family influence
encouraged participants to be successful and prior experiences from previous jobs,
military, and other educational experiences played a part in participants’ determination to
succeed. Further, the next research question explored the experiences of women while
they were enrolled in engineering technology programs in South Carolina technical
colleges. The themes from that question are: positive experiences with instructors and
students that encourage students to remain enrolled in college; negative experiences with
instructors and students that caused students to question whether they should remain
enrolled in college; preparation, academically and socially, impacted the students’
perception of the college experience; and students felt a sense of isolation, which caused
them to not participate in college activities. The themes from the research questions are summarized below.

Research Question 1: What are the main factors that influence women to major in engineering technology programs in technical colleges in South Carolina?

The first emerging theme was family influence encouraged participants to be successful. All of the students were influenced by family members in one way or the other. The younger students were influenced more positively by their parents and their parents’ educational status. The older students were influenced more by the parents’ emotional support rather than their parents’ successes academically. In both situations, the students were determined to excel and complete their degrees although they faced obstacles along the way. The motivation from family connects with previous research that builds on Tinto’s theory of student departure. Research has “examined relationships between cultural norms, motivational orientation, and college academic achievement and persistence” (Guiffrida, 2006, p. 452). Tinto claimed that students enter institutions with background characteristics such as family backgrounds, skills and prior schooling, and as a result those characteristics impact the levels of commitment for education completion (Guiffrida, 2006). Whether the family members were educated or non-educated, the impact of family involvement in the students’ lives had a definite impact on the decisions that the students made.

The results of the family related questions also reflect the results of a study by Hanson (2007). Like individuals in this study, the younger women did not perceive that their parents had a major influence on their decision to pursue the engineering technology
field. Although, two of them had parents in the engineering field, they said that the parents let them decide what they wanted to do, but they knew they would have their parents support. More than half of the students also mentioned the influence of the father. The remaining students answered questions about the father’s educational status and jobs, but failed to elaborate on the influence of the father. One father had been absent from the student’s life for 30 years, but recently had started to communicate with her over the last year.

Several of the students noted that their parents, mothers in particular, were concerned with their education, but that was limited to making sure that they received a high school diploma. Only one participant mentioned that her mother was not very supportive, “Well my mom was not too supportive from the beginning and she still isn’t a little bit. She is kind of shaky, but I am almost finished. So now she is like, well okay.” The mother felt like the student was doing too much. According to Ong et al. (2011), one of the most influential factors for encouraging women of color to complete a STEM degree is family and community support. This support includes encouragement, acceptance and educational expectations. The extent to this support also varies by cultural background and parental education level (Ong et al., 2011).

The second theme, prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed, impacted the decision that the students made to enter college and minimally impacted the choice of major. All of the students were employed full-time, which in turn, affected student attendance and performance. Some of the students missed a number of classes because of
work schedules. Some of them also missed classes due to family situations, but they were still determined to persist. The fact that the older students had struggled most of their working lives with low paying jobs, they decided that a major in engineering would reward them more for their efforts. Their perceptions were that engineers make a lot of money and they wanted jobs that provided the opportunity to make a lot of money to improve their lifestyle. One participant wanted to work to maintain a certain lifestyle after going through a divorce.

Two of the younger students mentioned that they felt they were good with their hands and this encouraged them to major in engineering. One participant stated, “I was in the military before, so I was really into stuff like that.” Another student emphasized, “I’ve always been good at math and science and I am pretty good with my hands, so I felt like I could get into something where I could make some money doing both.” Starobin and Laanan (2008), reflected on the experiences of female STEM students and reported that female students believe the stereotype that men are good in math and women are weak in that area. The younger students in this study realized that they had the potential to pursue the engineering field sooner, but the older students were encouraged to pursue the field because of life experiences. The older students also seemed to be motivated by the fact that there were those who told them that they could not make it in engineering. These students had the confident and self-esteem to enroll in the programs against the odds.

Second Research Question: What are the experiences of women while they are enrolled in engineering technology programs in South Carolina technical colleges?
Four themes emerged from the interview questions related to the above secondary question. The first theme is positive experiences with instructors and students that encouraged students to remain enrolled in college. One question asked was related to the positive experiences while the students had been enrolled in the engineering technology programs. All of the students shared stories of positive experiences while at the college. These experiences were all related to either the personality and interaction with the other students or the interaction with the instructors. Prior research has revealed that in order for institutions to retain students, the students must develop relationships. According to Tinto, the more that the students are integrated into the college, the greater the commitment to succeeding and completing the degree (Tinto, 1993).

Based on what the students considered good experiences, all of which were related to interactions with other students or instructors, colleges need to recognize the need to build on the social aspect of education. Only one student mentioned that the college offered services that helped her to adapt to college and learning. Students are more committed to completing their degrees if they are academically and/or socially integrated into the college (Guiffrida, 2006). A good example of a system that supports students in mathematics, engineering and science is a community college program in California, the Mathematics, Engineering, Science Achievement Community College program (MCCP). The program serves to “increase the number of educationally disadvantaged community college students in STEM, many of whom are lower-income and first-generation students” (Hill, Corbett, & Rose, p. 35). A large portion of African
American women students fit into those two criteria, so some or all of the components of the program can be applied to other community college programs across the nation.

The second theme was negative experiences with instructors and students that cause students to question whether they should remain enrolled in college. Although the under 30 group failed to report negative experiences, the over 30 age group reported a number of negative experiences. The negative experiences were mainly associated with instructor experiences, although one student’s negative experience was related to the school as a whole. None of the students mentioned that they had African American instructors. Based on the comments from some the participants, they felt a sense of racism and sexism during the courses. One comment from a participant was, “Maybe this is wrong, but this is how I feel. It really is a black and white issue.” Another comment made when asked about negative experiences was as follows, “The people who are teaching the program.” Hanson’s study, (2007), reported that African American women face sexism as well as racism as they pursue science fields. As a result, even if young African American women are interested in science in high school, eventually this interest fades. Other obstacles for African American women are the low expectations of teachers and the small numbers of minority women teachers and mentors (Hanson, 2007). Moore, Madison-Colmore and Smith (2003) reported that when society projects that there is inferiority because a person is Black, some students attempt the prove-them-wrong. The Black students will work hard to disprove perceptions and stereotypes.

The third theme was preparation, academically and socially, impacted the students’ perception of the college experience. Although only one of the students tied her
preparedness to how she learned in grade school, several of the other participants made reference to the fact that they were not as academically prepared as they could have been. The students’ grade point averages in high school ranged from, 2.0 to 3.7. Several of the participants made reference to the fact that they had been out of school a long time and they “didn’t learn these things in high school”, so to them it was like almost starting over. Because most community colleges have open-door admission, students have various levels of preparation. One question that was not asked of the participants, was if they needed developmental courses. Whether these students needed these courses or not, the perception from the interviews is that they have crossed that hurdle and they are currently enrolled in the engineering program courses. One student said that she took every opportunity at the first community college that she attended, to go to help sessions and to the tutoring center. She was disappointed, upon transfer to the other community college, that those services were no longer available.

To address the issue of preparedness, it is up to the community colleges to have programs in place to help all students. Positive and supportive academic environments can help foster the learning for students. African American women, in particular, need systems in place to help them overcome some of the obstacles that they face by being in the minority. According to Jackson (2010), women who are interested in STEM benefit from motivation and encouragement.

And finally, students felt a sense of isolation, which caused them to not participate in college activities. The sense of belonging is critical to students succeeding in education, especially higher education. All students need to feel like they belong, but
African American women in engineering can feel alone. Characteristics of students, the students’ status in college, the students’ efforts in participating in activities, students’ perceptions of their environment, and students’ perceptions of the gain they have made influence student performance (Johnson, 2011). Not only is engineering a male dominated field, it is a white male dominated field. When African American women students enter the classroom and see no one like them, there can be a feeling of isolation. A number of studies have reported that women of color in STEM have reported feeling excluded. What may seem simple to a majority student can seem like a challenge to the African American female in a white male dominated room. Students feel avoided when trying to decide where to sit in a classroom or when selecting partners for group assignments or informal study groups (Johnson, 2011). One student commented that she would ask if anyone wanted to study for the test and no one would study with her. The students would say, “No. I study better on my own” or “I have someone to study with.”

The isolation is more than a social issue. When information is shared by instructors with students in informal settings, the woman of color can miss out on valuable information about classroom work, laboratory work and possible scholarship and work opportunities. Employers also call on instructors for recommendations for employees. The instructors may lack relationships with the minority women and fail to recommend them because the social aspect of the relationships fails to exist. Participant six commented, “I had Dr. ____. She basically told me, (I am the only black in the program) she basically told me that she would help everybody get a job, but she told me that she probably wasn’t going to help me.” When asked why the instructor said that, the
participant commented, “I made a D in her class and she told me that I need that class.” The participant went on to say that the program requirements say that you must have a 2.0 to graduate but there is no mention that you must have a C or above in all classes. Based on the comments from this student, she felt that being the only black in the class influenced the instructor’s decision.

The prove-them-wrong syndrome is triggered in social and academic domains, especially in those fields where African Americans are not represented in large numbers (Moore, Madison-Colmore & Smith, 2003). Because of the psychological and sociological challenges in engineering, the students developed personality traits that encouraged the females to prove-them-wrong (Moore, Madison-Colmore & Smith, 2003). Students work harder to reach their goals and prove that they can be successful.

The African American women in the study shared some common experiences prior to enrolling in the community college engineering technology programs and they shared some common experiences while enrolled in engineering technology programs in South Carolina. The main characteristic that they all shared was the fact that they were black females and with those characteristics come certain behaviors. For several of them it was automatically assumed that they would perform poorly. Several of them were excluded from group “clicks.” Many of them faced the challenges of working, going to school and trying to provide for their families.

Recommendations

Based on previous research on African American women in higher education, especially those in STEM programs and the results of this study, a number of
recommendations can be made to a few audiences. The study can inform African Asian women enrolled in engineering technology programs; those interested in engineering technology programs; and, those contemplating attending college, but not sure of a major. The study can also inform faculty and staff in education (K-12 through higher education) of the challenges that the African American women face when enrolling in higher education.

African American women should continue to strive to succeed in engineering. African American women need to work together to help bring other people along. Rather than face the risk of being the only African American female in the program, students should enroll with a friend. These women should encourage others to accept the challenge to major in an engineering related field. Having a companion in the program could address the issue of not having a study partner and assist with the feeling of isolation. Prior to enrollment, these students should inquire about available resources. Communities and community colleges have resources available that can assist with some of the challenges that students face. Women need to be more aware of what is available and take advantage of the opportunities. Also, African American women should, prior to enrolling in college, conduct research to find out what major is best for them. Many females feel that engineering is a man’s job, but females succeed in engineering related fields as well.

K-12 schools and colleges need to address the issues that appear as obstacles that stand in the way of African American women enrolling in engineering programs and make changes to support the students. Community colleges should find ways to reduce
the barriers to graduation. More support services should be provided to assist the women who are mothers and the primary bread winners in their families.

Many factors affect the reasons that students fail to graduate. Many of the challenges include the fact that students are academically unprepared, they lack the financial resources necessary to live as well as pay for a college education, and the day-to-day responsibilities that include working and family impact their ability to study and/or attend school. African American women in engineering face these barriers, along with dealing with the issue of being a woman in a male dominated field and a minority.

As mentioned previously in the study, sometimes there were differences in opinions or concerns expressed from the participants, based on the age of the participants. The younger than 30 age group of African American women tended to be less vocal about negative issues. The older women voiced their concerns more about discrepancies and fairness issues in the classroom. The older group was more compelled to describe instances of perceived discrimination related to sex or race.

Only one of the colleges in the study was mentioned as having services to help with student needs. Also, none of the students were involved in extracurricular activities. Students should be strongly encouraged to participate in activities by the college.

Stereotypes can affect academic performance. Cultural biases affect how individuals treat each other. African Americans, in particular, face these prejudices every day. School personnel in K-12 and colleges should make a conscious effort to recognize these biases. Colleges need to cultivate a sense of belonging so the students who are currently enrolled will have the desire to stay, and also, so those students who are
interested in the institution will choose to attend. Success does not happen from simply recruiting women into engineering programs. The technical colleges must make a conscious effort to recruit, retain and graduate African American women of color, especially those in engineering programs.

In order to recruit and retain females in STEM fields, colleges should put structures in place to assist females so that they feel like they are a part of the institution. Positive and supportive academic environments are vital to the success and persistence of the students. Informal student interactions with faculty, staff, administrators and other students at the community colleges also play a vital role in the success of the students. Other strategies that community college personnel can use to influence how students perceive engineering include the college’s participation in the following activities:

- Share that engineering skills are learned and are not innate
- Create welcoming environments by sharing successes of other African Americans, particularly African American women
- Encourage a supportive environment in the classroom to include all students
- Encourage instructors to contact and support the students
- Encourage participation in extra-curricular activities
- Develop programs that specifically attract minority students.

**Limitations**

Given that the women were asked to participate in a synchronous interview, many of the participants found it difficult to schedule the interview because of other commitments such as family obligations, school commitments and work commitments.
The study could have been impacted because there is a chance that more students would have participated if they did not have other commitments. Also, some of the students may have felt rushed and failed to take the necessary time to answer the questions thoroughly.

Because some interviews were done via telephone and some were done face-to-face, the researcher missed the opportunity to compare non-verbal cues from some of the participants. Non-verbal cues provide additional information to the researcher because not only are the words heard but the expressions behind the words can give the words more meaning. Also, the time period for the study extended over approximately six months due to the response rate from the colleges while attempting to collect the names of students to interview, and the communication back and forth with the students to set up and conduct the interviews. The length of expired time may have impacted the study because the researcher could have forgotten some of the small intricate details of the earlier interviews.

Due to the nature of the job title of the researcher, some of the participants may have been fearful of repercussions if they answered openly and honestly, even though the researcher assured the participant of confidentiality. The position of dean appears to threaten some individuals and the participants in the study may have been afraid to answer openly and honestly.

The research is limited by the number of participants in the study. Over 20 students were contacted and only seven participated. Due to the type of study, interpretive research, interviewing seven students seemed appropriate, but if more
students had been contacted, more comparisons could have been made between the individuals and possibly between colleges.

The researcher felt that being female was an advantage because she could relate to some of the experiences of the participants. The participants could also sense that the researcher had a certain degree of understanding because of the shared gender as well as ethnicity. The gender issue probably impacted the study in a positive way because the students perhaps felt more comfortable with a researcher of the same race and ethnicity.

Readers should trust the results of the study, because of the limited threats to validity. One concern may be the interviews with the students. Because this is self-reported data, there is always the risk that the students were not being totally honest with the researcher. It was up to the researcher to make the students feel comfortable with the interview process so that the information would be truthful and the interviewer could trust the data. The interviewer would need to develop a sense of trust with the interviewees and vice versa.

**Recommendations for Future Research**

The following are recommendations for further research for African American women enrolled in engineering programs in community colleges:

1. Because the study was limited to African American women in engineering programs in community colleges in South Carolina, it is suggested that further studies include more colleges in the southeast such as other community colleges in South Carolina, and community colleges located in Georgia, North Carolina, Tennessee and Alabama.
2. More research should be done to include statistical data that compares the grades of the students with their interview responses.

3. More research should be done regarding mentors of the African American women in engineering.

4. More research should be done to compare socio-economic status of the women in engineering and how it relates to their experiences in the program.

5. In the future, the researcher will attempt a follow-up study of the participants to determine the extent to which Tinto’s theory adequately predicted their student retention outcomes. At this time, the research indicates that although the students are affected by many of the factors that cause them to depart from an institution, the students are predicted to complete the engineering degrees.

Summary

This chapter outlined the findings in the data which were summarized in the themes based on the research questions. The two themes from the first question included: (1) Family influence encouraged participants to be successful and (2) Prior experiences from previous jobs, military, and other educational experiences played a part in participants’ determination to succeed. The four themes from the second question included: (1) Positive experiences with instructors and students that encouraged students to remain enrolled in college, (2) Negative experiences with instructors and students that cause students to question whether they should remain enrolled in college, (3) Preparation, academically and socially, impacted the students’ perception of the college
experience, and (4) Students felt a sense of isolation, which caused them to not participate in college activities. The discussion of the findings included a thorough analysis of the information attributed to the themes. Finally, recommendations were included to provide information to groups that are related to the study. These groups include African American women interested in attending college but unsure of a major, African American women enrolled or planning to enroll in community college engineering technology programs, and K-12 through college faculty and staff who advise and instruct the African American girls/women.

The purpose of the study was to examine the experiences of African American women enrolled in community colleges majoring in engineering technology programs. The participants provided information to the researcher that enhances the literature on African American women in engineering programs but also contributes to the established literature of the experiences of women enrolled in community colleges. The goal of the study was met because the researcher was able to make recommendations for students and practitioners. The African American female student experience can be enhanced if secondary and higher education administrators recognize that the effort must be intentional to recruit and retain African American female students. The student experience must be different because the background of the student is so different. The classroom experience must be enhanced for inclusion of all students and instructors should be educated on diversity issues. When the students shared their experiences, it seemed that many of the encounters with instructors and students were not meant to be discriminatory or disrespectful, but those individuals were unaware of how those
interactions were perceived by the African American women. Education is key when dealing with diversity.

If South Carolina is to succeed with equipping business and industry with qualified workers, educators must find a way to educate all students regardless of gender or race.
Appendix A

IRB APPROVAL

Dear Dr. Flowers,

The Clemson University Office of Research Compliance reviewed the protocol identified above using exempt review procedures and a determination was made on August 18, 2015 that the proposed activities involving human participants qualify as Exempt under category B2 based on federal regulations 45 CFR 46. The approved consent script is attached. Your protocol will expire on May 31, 2016.

The expiration date indicated above was based on the completion date you entered on the IRB application. If an extension is necessary, the PI should submit an Exempt Protocol Extension Request form, http://www.clemson.edu/research/compliance/irb/forms.html, at least three weeks before the expiration date. Please refer to our website for more information on the extension procedures, http://www.clemson.edu/research/compliance/irb/guidance/reviewprocess.html.

No change in this approved research protocol can be initiated without the IRB’s approval. This includes any proposed revisions or amendments to the protocol or consent form. Any unanticipated problems involving risk to subjects, any complications, and/or any adverse events must be reported to the Office of Research Compliance immediately. All team members are required to review the Responsibilities of Principal Investigators and the Responsibilities of Research Team Members available at http://www.clemson.edu/research/compliance/irb/regulations.html.

The Clemson University IRB is committed to facilitating ethical research and protecting the rights of human subjects. Please contact us if you have any questions and use the IRB number and title in all communications regarding this study.

All the best,
Nalinee
Appendix B

July 1, 2015

Research Site Letter

To Whom It May Concern:

Dr. Lamont Flowers, principal investigator, and Jacquelyn Blakley, doctoral student at Clemson University, would like to request to conduct research with human subjects at your institution. The research is “A Qualitative Study of African American Women in Engineering Technology Programs at Community Colleges”.

We would like to obtain a list of all African American women enrolled in the engineering programs at your institution. Please submit this information to Jacquelyn Blakley, jlcarso@g.clemson.edu. Feel free to contact me at 864-245-8439. After this information is received, Jacquelyn will select the students to interview.

The purpose of the study is to learn more about the experiences of African American women in engineering programs in community colleges, specifically, in an attempt to better understand the challenges that these women faced prior to enrolling in the engineering programs and challenges that these women currently face while enrolled in the engineering programs. The intent is to learn more about what motivates the women and in turn, this information can be used to share with potential students, K-12 administrators and higher education administrators so that more African American women can be recruited, enrolled and graduated from the engineering programs.

Thanks in advance for your cooperation with this research study. If you have further questions or concerns, please contact one of the persons below.

Sincerely,

Dr. Lamont A. Flowers
Principal Investigator
Distinguished Professor and Executive Director
Clemson University

Jacquelyn Blakley
Doctoral Student
Educational Leadership
Clemson University
Appendix C

Sample Recruitment Letter or Email

Dear Madam,

My name is Jacquelyn Blakley and I am a doctoral student in the Educational Leadership program at Clemson University. I am writing to invite you to participate in my research study “A Qualitative Study of African American Women in Engineering Technology Programs at Community Colleges”. You're eligible to be in this study because you have been identified as an African American woman enrolled in an engineering program at your college. I obtained your contact information from a contact at your college.

If you decide to participate in this study, you will be asked to interview with me and answer questions related to your experiences prior to and while enrolled in the engineering program. I would like to audio record your interview so that I can use this to transcribe the interview. We will then use this information to analyze the responses and learn more about the experiences of African American women in community colleges.

Remember, this is completely voluntary. You can choose to be in the study or not. If you'd like to participate or have any questions about the study, please email or contact me at jlcarso@g.clemson.edu or call me at 864-245-8439.

Thank you very much.

Sincerely,

Jacquelyn Blakley
Appendix D

Information about Being in a Research Study
Clemson University

Title of the Research

Description of the Study and Your Part in It

Dr. Lamont A. Flowers, Principal Investigator, along with Jacquelyn Blakley, under the direction of the Principal Investigator is inviting you to take part in a research study. Dr. Lamont Flowers is a Professor at Clemson University. Jacquelyn Blakley is a student at Clemson University, running this study with the help of Dr. Lamont Flowers. The purpose of this research is to study African American women in Technical Colleges in South Carolinian Colleges majoring in engineering.

Your part in the study will be to (describe the procedures to be followed in easily understood language).

It will take you about (provide an estimate of the expected duration of the participant’s participation in the study) to be in this study.

Risks and Discomforts

We do not know of any risks or discomforts to you in this research study.

Possible Benefits

(Describe any benefits to the participant and to others that may reasonably be expected from the research.) OR We do not know of any way you would benefit directly from taking part in this study. If appropriate, add: However, this research may help us to understand (limit to a brief statement).

This research can provide benefits to the participants

Protection of Privacy and Confidentiality

(Describe the extent to which confidentiality of records identifying the participant will be maintained.) If appropriate, precede this description with: We will do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the
research team that you were in this study or what information we collected about you in particular.

**Choosing to Be in the Study**

You do not have to be in this study. You may choose not to take part and you may choose to stop taking part at any time. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study. (If you will be collecting data from students of any of the researchers, include the following statement: If you decide not to take part or to stop taking part in this study, it will not affect your grade in any way.)

**Contact Information**

If you have any questions or concerns about this study or if any problems arise, please contact (insert the Principal Investigator’s name here) at Clemson University at xxx-xxx-xxxx.

If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC’s toll-free number, 866-297-3071.

**Consent**

I have read this form and have been allowed to ask any questions I might have. I agree to take part in this study.

Participant’s signature: ___________________________ Date: __________________

A copy of this form will be given to you.
REFERENCES


130


