A STUDY OF UNDERREPRESENTED INDIVIDUALS WHO UTILIZED COMMUNITY COLLEGES AS PATHWAYS TO GAIN ADMISSION INTO ENGINEERING SCHOOLS AT FOUR-YEAR UNIVERSITIES

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A Dissertation

by

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I certify that this student has met the requirements for format contained in the University format manual, and that this dissertation is suitable for shelving in the library and credit is to be awarded for the dissertation.

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Date
DEDICATION

I dedicate this dissertation to my late father who was always an advocate for education and an exemplar for hard work. I also dedicate this work to my illiterate grandmother who was one of the greatest teachers in my life. I dedicate this dissertation to my mother, my aunt, and siblings, Sahar, Samar, Sana, Yousef, and Samir who have always believed in me and supported me. I also dedicate this dissertation to my beautiful wife Dalia, daughters Serene Petra and Lameese Jerash, and son Jad Jordan who have always inspired me and supported me especially during the years of my doctoral studies. I also dedicate this dissertation to all future engineers who will transform the world into a better place to live.
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Abstract

of

A STUDY OF UNDERREPRESENTED INDIVIDUALS WHO UTILIZED COMMUNITY COLLEGES AS PATHWAYS TO GAIN ADMISSION INTO ENGINEERING SCHOOLS AT FOUR-YEAR UNIVERSITIES:

By

Samer Musa Batarseh

In 2008, about 4% of all undergraduate degrees awarded in the United States were in engineering compared to 31% in China and about 19% throughout Asia (National Science Foundation, 2012). Based on current graduation rates, the United States is still expected to experience shortages in university graduates with engineering degrees (Sinkele & Mupinga, 2011). According to the National Foundation of American Policy (2010), in the 10 years between 2000 and 2010, American companies hired 890,100 scientists and engineers through the usage of H-1B visas.

According to the National Science Foundation (2013), “Women, persons with disabilities, and three racial/ethnic groups—African Americans, Latinos, and American Indians— are considered underrepresented in science and engineering” (p. 2). According to the U.S. Census (2010), within the labor market for engineers with four-year university degrees, African Americans make up 3.2% of the workforce while making up 12% of the total population. Latinos/as make up 4.7% of the workforce while making up 16% of the total population. White females make up 7.5% of the workforce while making up 32% of the U.S. (U.S. Census, 2010).
Many female and underrepresented minority students often opt for community colleges as gateways to higher education. Open access, closeness to work and family, and affordable fees make community colleges ideal options for all especially minority students (Tsapogas, 2004).

To meet the demands of the labor market and maintain a global leadership position in innovative technologies, the United States can tap into underrepresented groups in engineering within the American populations to solve the problem of the shortage of engineers within the American labor market (Frehill, Di Fabio, & Hill, 2008).

This qualitative study was based on personal interviews with 14 successful individuals from underrepresented groups in engineering. Using semi-structured interviews this qualitative study sought to understand the perceptions and experiences of participants. Data were collected from participants using demographic surveys and semi-structured individual interview questions. The sample of participants included 14 individuals from underrepresented groups in engineering who had first attended a community college prior to obtaining entry into a four-year college engineering program. This study explored the lived experiences of three African American males, three White females, and five Latinos, and three Latinos who were successful in using community colleges as pathways to gain admission into engineering schools at four-year universities.

This qualitative study was influenced by the cultural capital model (Bourdieu, 1986) and the anti-deficit achievement model (Harper, 2010).
The study sought to find answer to the following research questions: 1) what helped these successful individuals choose community colleges as pathways towards engineering majors? 2) What helped the participants complete the transfer journey from community colleges to engineering schools at four-year universities? and 3) What long-term academic and career goals were shaped by the community college experience?

Based on the findings of this study, the participants chose community colleges as pathways based on low cost, location, experimenting with higher education, peer pressure, and remediation. The factors that helped the participants complete the transfer journey from community colleges to engineering schools at four-year universities were achieving the rite of passage to higher education while staying at home, receiving support from passionate instructors, having rigorous curriculum, learning new pedagogies, completing internships, and joining campus clubs. The community college experience had a big impact on the academic and career plans of participants who stated they wanted to work as engineers, pursue graduate studies, undertake entrepreneurship, and pay back to their community through volunteering and mentoring.

Based on the findings in this study, prior to the community college stage, parents should take the responsibility of supporting, influencing, and planning children’s STEM plans early in life and communicate their plans to teachers and administrators. New community college students should be prepared for the rigor of science and math courses at community colleges by taking the necessary courses in high school. During the community college stage, future engineers should get involved in math, science, and
engineering clubs, seek advice from academic counselors, learn multitasking and time management skills, join study groups, and complete available challenging courses before transferring. At the post community college stage, students should get involved in engineering societies and clubs, complete engineering internships, and seek anti-deficit agents or mentors.

From a transformational leadership perspective, this study recommends that K-12 leaders plant the engineering seeds early among young students. The study calls for better collaboration among parents, students, leaders in K-12 institutions, community colleges, four-year university systems, and engineering sector employers. The study recommends better understanding of the challenges, strengths, wants, and needs of underrepresented groups in engineering. The study also recommends community college leaders create awareness about community colleges as viable and feasible pathways for bachelor’s degrees in engineering, improving student services including counseling and advising for engineering transfer students, and create more academic clubs and activities on community college campuses.

From a public policy perspective, this study recommends establishing mandates and incentives to create tangible collaboration among high schools, community colleges, and four-year universities. Also, the study recommends influencing policymakers through emphasizing the economic value of community colleges and the high return on investment (ROI) of using community colleges as pathways. Also, the study
recommends highlighting the voting power of underrepresented groups and the need to transform the current funding model for California community colleges.

From a data-based decision making perspective, the study recommends better uses for using current demographic data to properly plan for future academic plans and the use of historical data to improve student services. Based on the findings of this study, when understood and utilized properly by students and parents, the community college system could provide the necessary dispositions to provide underrepresented students with anti-deficit support and cultural capital to access higher education and succeed in earning high ROI degrees like engineering.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dedication</td>
<td>v</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>vi</td>
</tr>
<tr>
<td>Curriculum Vitae</td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xvi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>xviii</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>3</td>
</tr>
<tr>
<td>Nature of the Study</td>
<td>6</td>
</tr>
<tr>
<td>Operational Definitions</td>
<td>8</td>
</tr>
<tr>
<td>Assumptions, Limitations, and Scope</td>
<td>10</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>11</td>
</tr>
<tr>
<td>Conclusion</td>
<td>12</td>
</tr>
<tr>
<td>2. LITERATURE REVIEW</td>
<td>13</td>
</tr>
<tr>
<td>Introduction</td>
<td>13</td>
</tr>
<tr>
<td>Modern History of STEM in the United States</td>
<td>15</td>
</tr>
<tr>
<td>Importance of STEM for the United States</td>
<td>16</td>
</tr>
<tr>
<td>Community Colleges’ Role in the Master Plan</td>
<td>17</td>
</tr>
<tr>
<td>Community Colleges as Pathways for Underrepresented Students</td>
<td>19</td>
</tr>
</tbody>
</table>
Community College Funding Model .................................................................20
The Economic Impact of the Community College System ..........................22
Profiles of Latino/as in Engineering .................................................................23
Profiles of African Americans in Engineering .............................................26
Profiles of Women in Engineering .................................................................27
Profiles of White Females in Engineering ....................................................29
The Choice of STEM Fields by Underrepresented Students .......................30
Engineering Statistics in the United States versus Other Nations ...............30
Support and Success ........................................................................................31
Transfer and Graduation Data ........................................................................35
Community Cultural Wealth ........................................................................37
Role of Leadership at Community Colleges ...............................................38
Transfer Skills ................................................................................................43
Theoretical Frameworks ................................................................................43
Conclusions ......................................................................................................54

3. METHODOLOGY ........................................................................................56

Introduction ....................................................................................................56
Research Design ...............................................................................................56
Research Questions ........................................................................................58
Setting and Sample ........................................................................................59
Instrumentation and Material ........................................................................60
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demographics and Personal Characteristics</td>
<td>74</td>
</tr>
<tr>
<td>2. Savannah’s Characteristics</td>
<td>77</td>
</tr>
<tr>
<td>3. Sally’s Characteristics</td>
<td>78</td>
</tr>
<tr>
<td>4. Ladonna’s Characteristics</td>
<td>79</td>
</tr>
<tr>
<td>5. Dan’s Characteristics</td>
<td>80</td>
</tr>
<tr>
<td>6. Janis’s Characteristics</td>
<td>81</td>
</tr>
<tr>
<td>7. Anita’s Characteristics</td>
<td>82</td>
</tr>
<tr>
<td>8. Leon’s Characteristics</td>
<td>83</td>
</tr>
<tr>
<td>9. Carlita’s Characteristics</td>
<td>84</td>
</tr>
<tr>
<td>10. Cassandra’s Characteristics</td>
<td>85</td>
</tr>
<tr>
<td>11. Juan’s Characteristics</td>
<td>87</td>
</tr>
<tr>
<td>12. Camellia’s Characteristics</td>
<td>88</td>
</tr>
<tr>
<td>13. Stan’s Characteristics</td>
<td>89</td>
</tr>
<tr>
<td>14. Adam’s Characteristics</td>
<td>90</td>
</tr>
<tr>
<td>15. Kevin’s Characteristics</td>
<td>91</td>
</tr>
<tr>
<td>16. Codes</td>
<td>93</td>
</tr>
<tr>
<td>17. Academic and Career Aspirations</td>
<td>141</td>
</tr>
<tr>
<td>18. Answers to Research Question One</td>
<td>156</td>
</tr>
<tr>
<td>19. Answers to Research Question Two</td>
<td>168</td>
</tr>
</tbody>
</table>
20. Answers to Research Question Three ................................................................. 171

21. Summary of Recommendations for Parents and Students:

   Pre-community College Stage .............................................................................. 179

22. Summary of Recommendations for Parents and Students: Community

   College Stage ......................................................................................................... 182

23. Summary of Recommendations for Parents and Students: Post

   Community College Stage .................................................................................... 185

24. Summary of Transformational Leadership Implications .................................. 192

25. Summary of Policy Implications ...................................................................... 199

26. Summary of Data-based Decision Making Implications ................................... 202
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cross-sectional map of the two theoretical frameworks</td>
<td>14</td>
</tr>
<tr>
<td>2. Overview of California’s public education systems 2010-2011</td>
<td>18</td>
</tr>
<tr>
<td>3. Cost per credit at California community colleges</td>
<td>21</td>
</tr>
<tr>
<td>4. Annual cost to attend a community college</td>
<td>22</td>
</tr>
<tr>
<td>5. Overview of underrepresented groups in engineering</td>
<td>24</td>
</tr>
<tr>
<td>6. Major models of leadership theories</td>
<td>41</td>
</tr>
<tr>
<td>7. Cultural Capital Model (Bourdieu, 1986)</td>
<td>46</td>
</tr>
<tr>
<td>8. Anti-Deficit Achievement Model (Harper, 2010)</td>
<td>51</td>
</tr>
<tr>
<td>11. The Community College Transformation and Aspiration Model (CCTAM)</td>
<td>175</td>
</tr>
</tbody>
</table>
Chapter 1

INTRODUCTION

In the past few decades, there have been many initiatives at different branches and levels of state and federal government to increase the numbers of American students pursuing university majors related to science, technology, engineering, and math (STEM). Nonetheless, based on current graduation rates, the United States is still expected to experience shortages in university graduates with engineering degrees (Sinkele & Mupinga, 2011).

According to the U.S. Citizenship and Immigration Services (USCIS) (2013), “U.S. businesses use the H-1B program to employ foreign workers in specialty occupations that require theoretical or technical expertise in specialized fields such as engineering and computer programming” (para. 2). The United States grants 65,000 H-1B visas annually in addition to 20,000 extra visas for master’s exceptions. According to the National Foundation of American Policy (2010), between 2000 and 2010 American companies hired 890,100 engineers on H-1B visas. Based on a study by the National Science Foundation (NSF; 2012), the median salary for engineers in the U.S. is $73,290. Therefore, in the first decade of the 21st century, American businesses have paid an estimated $65 billion in salaries to non-American engineers in the United States. The estimated total cost could be much higher when accounting for relocation costs, medical coverage, and other benefits.
In his State of the Union address, President Obama emphasized that approximately 50% of all new professions in the next decade will require post-secondary education, and yet, 25% of precollege students are not completing high school graduation requirements (The White House, 2011). According to a report by the President’s Council of Advisors on Science and Technology (2012):

Economic forecasts point to a need for producing, over the next decade, approximately 1 million more college graduates in science, technology, engineering, and math (STEM) fields than expected under current assumptions. Fewer than 40 percent of students who enter college intending to major in a STEM field complete a STEM degree. Merely increasing the retention of STEM majors from 40 percent to 50 percent would generate three-quarters of the targeted 1 million additional STEM degrees over the next decade. (p. 2)

Moreover, there are numerous research and policy reports signifying the need to foster science, technology, engineering, and math (STEM) education to sustain the United States’ competitive position within the global economy (Anderson & Kim, 2006; Chen & Weko, 2009; Dowd, Malcolm, & Bensimon, 2009; National Academy of Science [NAS], 2006). The impact of the lack of focus on STEM fields and the shortage of college graduates in STEM fields have attracted the attention of the White House. According to President Obama, the United States is facing challenges in:

Reaffirming and strengthening America’s role as the world’s engine of scientific discovery and technological innovation. Leadership tomorrow depends on how we educate our students today, especially in those fields that hold the promise of producing future innovations and innovators. That’s why education in math and science is so important. (Obama, 2009, para. 3)

In 2010, the White House reconfirmed the U.S.’s commitment to increasing the pipeline of STEM graduates. President Obama announced plans to expand the “Educate
to Innovate” program to focus on improving science, technology, engineering, and math (STEM) education in the United States (The White House, 2010).

Engineering can be a challenging area of study due to the fact it requires skills from multiple other disciplines such as math and science and also personal attributes such as creativity and innovation. Nonetheless, to meet the demands of the labor market and maintain a global leadership position in innovative technologies, the United States should capitalize on the strength of having a diverse population by exploring ways to help citizens from all ethnic backgrounds and genders access and succeed in STEM fields especially engineering.

**Problem Statement**

The United States is falling behind other nations in STEM and needs to maintain a leadership position in science and technology. More STEM graduates are needed to keep the economy growing. The National Action Council for Minorities in Engineering suggests, “The solution to America’s competitiveness problem is to activate the hidden workforce of young men and women who have traditionally been underrepresented in STEM careers” (Frehill, Di Fabio, & Hill, 2008, p. 3). Anderson and Kim (2006) provided further evidence that students of color lag in persistence and four-year degree completion in the STEM disciplines, while Dowd et al. (2009) pointed to the importance of developing Latina and Latino students in STEM fields. In the United States, about 4% of all undergraduate degrees awarded in 2008 were in engineering. This compares with 31% in China and about 19% throughout Asia (NSF, 2012). In the United States, STEM
jobs could provide high salaries to females and minorities. Half the workers in science and engineering occupations earned $73,290 or more in 2010, more than double the median earnings ($33,840) of the total U.S. workforce (NSF, 2012). Despite the potential for high salaries, the number of Americans pursuing careers in science and math in the U.S. continues to decrease (Hill, Corbett, & Rose, 2010). Moreover, many women and students of color shy away from pursuing four-year degrees in engineering (Seymour & Hewitt, 1997; Singh, Allen, Scheckler, & Darlington, 2007).

According to NSF (2013), “Women, persons with disabilities, and three racial/ethnic groups – African Americans, Latinos, and American Indians – are considered underrepresented in science and engineering” (p. 2). According to the U.S. Census (2010), within the labor market for engineers with four-year university degrees, African Americans make up 3.2% of the workforce while making up 12% of the total population. Latino/as make up 4.7% of the workforce while making up 16% of the total population. White females make up 7.5% of the workforce while making up 32% of the U.S. population (U.S. Census, 2010).

The U.S. Commission on Civil Rights (2010) emphasized the vital role graduates of science, technology, engineering, and mathematics (STEM) fields can play in growing the U.S. economy and maintaining the nation’s position as a global leader in innovation and technology. Between 1994 and 2003, Latino/as made up 64% of the student increase in national public school enrollment, African Americans made up 23% of the increase, and Whites dropped by 1% (Fry, 2006). Based on current growth rates for the different
groups, people of color are expected to form the majority of the U.S. population by the year 2050. Thus, populations traditionally underrepresented in STEM fields offer a potential solution to satisfying this demand without overreliance on foreign-born workers (Coble & Allen, 2005; Passel & Cohn, 2008). Therefore, to meet the expected demand for engineers, sustain technological and economic leadership, and ensure equity for all citizens the U.S. can respond to this challenge immediately by preparing and encouraging underrepresented students to pursue college majors in STEM fields.

Community colleges are untapped higher education centers when it comes to their potential to fill the pipeline for STEM workers. Community colleges can serve as gateways for students of color, female students, low-income students, and single parents to higher education and consequently help the United States maintain its global economic presence, decrease the financial gap between underrepresented minorities (URM) and the rest of the population, and enhance equity by providing alternatives and better opportunities for underrepresented individuals. According to Tsapogas (2004), many female and underrepresented minority (URM) students opt for community colleges as gateways to higher education and are more likely to:

- Be first-generation college students.
- Encounter unfamiliar and uncomfortable environments.
- Have cultural obligations towards family.
- Experience the absence of trailblazers or role models.
Open access, closeness to work and family, and affordable fees make community colleges an ideal option for all, especially minority students (Tsapogas, 2004). Therefore, community colleges can be vital links in the educational journey of science and engineering graduates. According to Turner (1990):

The transitory nature of the community college setting affects all students…students with fewer family connections to higher education may be more adversely affected…Coming to community college is a major step for us Hispanics who usually do not continue their education past high school. This is why it is critical to nurture the Hispanics who do make it to community college. (pp. 17-18)

Community colleges are important higher education institutions for many students pursuing degrees in engineering. Open admissions, proximity to jobs and family, and low tuition and fees make community colleges attractive to a large number of students (Tsapogas, 2004). Proximity to community colleges can be a factor due to the high cultural value placed on being geographically close to family or a support network for some students. According to the National Survey of Recent College Graduates (NSRCG) 51% of the Hispanic graduates and 62% of the female graduates with children reported community college attendance (Tsapogas, 2004).

**Nature of the Study**

Having diverse demographics within higher education engineering schools can enrich and enhance the quality of education and the educational experience of all students. In 2010, Latinos composed 16% and African Americans composed 12% of the total U.S. population. In 2050, Latinos are expected to make up 30% and African
Americans 12% of the total U.S. population for a combined percentage of 42% (National Action Council for Minorities in Engineering, 2011).

According to the National Action Council for Minorities in Engineering (2011), compared to their numbers in the total populations, few African Americans, White females, Latino/as earn four-year degrees in the fields of science, technology, engineering, and math (STEM). Also, a science and engineering report by the National Science Board (2010) reported significant gaps in science and mathematics achievement for African American and Latino/a students compared to Whites and Asians.

This study documented and analyzed the perceptions and experiences of successful underrepresented individuals in engineering fields. This qualitative study was based on personal interviews with underrepresented engineering individuals successful in transferring from community colleges to four-year universities. Success was determined by the students’ abilities to use community colleges to transfer to engineering schools at four-year universities. Beneficiaries of this study can be future underrepresented students in engineering, parents, community college administrators, and K-12 administrators.

To address the problem, this study explored the experiences of African American males, White females, and Latino/a individuals who were successful in using community colleges as pathways to gain admission into engineering schools at four-year universities. The researcher was unable to locate African American females to participate in this study. The theoretical frameworks of the study, which include the cultural capital
framework (Bourdieu, 1986) and the anti-deficit achievement model (Harper, 2010) informed the following research questions:

1. What helped these underrepresented individuals choose community colleges as pathways toward engineering majors?
2. What helped these individuals complete the transfer journey from community colleges to engineering schools at four-year universities?
3. What long-term academic and career goals do these individuals have, and did their community college experience help shape their academic or career goals?

Operational Definitions

Scientific observations require understandable operational definitions of concepts being presented (Miller, 2005). The following terms are operationally defined as follows:

**African American**

A person having origins in any of the Black racial groups of Africa. It includes people who indicate their race as “Black, African American, or Negro” or report entries such as African American, Kenyan, Nigerian, or Haitian (U.S. Census Bureau, 2010).

**Asian**

A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam (U.S. Census Bureau, 2010).
First-generation college student
A student with neither parent holding a four-year college degree (Engle & Tinto, 2008)

Latina
A female person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish-speaking cultural descent regardless of race (U.S. Census Bureau, 2010)

Latino
A male person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish-speaking cultural descent regardless of race (U.S. Census Bureau, 2010)

Remediation
Coursework offered at a postsecondary institution that is below college-level work (Education Commission of the States, 2013)

STEM majors/disciplines
Mathematics, statistics, computer/information science, computer programming, electrical, chemical, mechanical, civil, or other engineering; engineering technology, or electronics. Natural resources, forestry, biological science (including zoology), biophysics, geography, interdisciplinary studies including biopsychology, environmental studies, physical sciences including chemistry, and physics (American Council on Education, 2006).
**Underrepresented minority (URM)**

This category comprises three racial/ethnic minority groups (Blacks, Hispanics, and American Indians) whose representation in science and engineering is smaller than their representation in the U.S. population (U.S. Census Bureau, 2010).

**White**

A person having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicate their race as “White” or report entries such as Irish, German, Italian, Lebanese, Arab, Moroccan, or Caucasian (U.S. Census Bureau, 2010).

**Assumptions, Limitations, and Scope**

This is a qualitative study based on the personal experiences and perceptions of certain individuals not representative of the whole population of engineering students. The sample population of the study included individuals who were successful transferees from community colleges. The participant numbers are as follows:

- 5 Latinas
- 3 African American Males
- 3 White Females
- 3 Latinos

**Geographic Area**

The study explored the experiences of those students who have used the community college system in California to gain admission to four-year universities in California. The study was limited to 14 participants.
Methods

The study used semi-structured interviews with open-ended questions to collect data and explore the experiences and perceptions of participants.

Significance of the Study

According to NSF (2012), there are recent indicators that the United States is lagging behind other nations in STEM fields. Some of these indicators can be summarized as follows:

- In 1999, the United States accounted for 38% of world research and development (R&D) activities. Within 10 years, the U.S. lost 18% of its world R&D share and dropped down to 31% in 2009.
- Since 1995, the growth in number of researchers has been most rapid in China (tripled) and South Korea (doubled). The United States growth was around 50%.
- Between 2004 and 2009, research and development (R&D) employment by U.S. multinational companies (MNCs) abroad nearly doubled while their domestic (R&D) employment increased by less than 5%.
- In the United States, about 4% of all bachelor's degrees awarded in 2008 were in engineering. This compares with 31% in China and about 19% throughout Asia.
In the last 10 years, the proportion of science and engineering bachelor’s degrees awarded to women has not grown measurably and has declined in computer sciences, mathematics, and engineering.

Half the workers in science and engineering occupations earned $73,290 or more in 2010, more than double the median earnings ($33,840) of the total U.S. workforce.

Conclusion

According to the data and literature discussed in this chapter, African Americans, Latino/as, and White females are underrepresented in engineering. Chapter 1 provided background on the necessity within the United States to maintain its global leadership position in technology and innovation, an overview of the problem statement regarding the underrepresentation of certain groups in engineering fields, the research questions addressing low completion rates, operational definitions, assumptions, limitations, and the significance of the study. Chapter 2 provides details on theoretical frameworks and a literature review.
Chapter 2

LITERATURE REVIEW

Introduction

This chapter provides the literature review that informed this study about underrepresented individuals who opted for community colleges as pathways into engineering school at four-year universities. The chapter starts with an overview of the importance of expanding the engineering pipeline in the United States. Then the chapter provides an overview of the public higher-education system in California and the roles of the different entities within the system. The chapter continues with demographic, general education, and engineering information about African Americans and Latino/as in the United States. The chapter moves on to present information on women in engineering and statistics on engineering in the United States versus other nations. The chapter then presents studies on the different reasons underrepresented students choose STEM fields as areas of study, on peer support and success, and on the community cultural wealth model.

Next, the chapter discusses the two theoretical frameworks for this study. The first theoretical framework is Bourdieu’s cultural capital, which states, “Academic success is directly dependent upon cultural capital and on the inclination to invest in the academic market” (Bourdieu, 1977, p. 504). The second theoretical frame is the anti-deficit achievement framework of Harper, which focuses on success indicators of African American students and the “institutional agents, policies, programs, and resources that
help Black men achieve desired educational outcomes” (Harper, 2010, p. 66). Figure 1 provides a Cross-sectional map of the two theoretical frameworks guiding this study and the different components contributing to each framework.

![Cross-sectional map of the two theoretical frameworks](image)

*Figure 1. Cross-sectional map of the two theoretical frameworks.*

In addition to the two theoretical frameworks guiding this study, other frameworks are presented in order to view the issues through multiple lenses and theories. Creswell (2009) defined theory as “an interrelated set of constructs or variables formed into propositions or hypotheses that specify the relationship among variables” (p. 51). Therefore, using multiple frameworks provided different logic, rationales, and
arguments to further investigate the use of community colleges as successful pathways for underrepresented engineering students.

**Modern History of STEM in the United States**

According to Drew (2011), during the height of the Cold War in 1957, the Soviet Union launched Sputnik, the first ever satellite to orbit the Earth, signaling a clear challenge to American technological leadership. As a response, the United States Congress enacted the “National Defense Education Act (NDEA) in 1958, which provided funding to advance math and science at all educational levels and provide financial incentives for students to pursue math and science majors” (Drew, p. 3). The Cold War and patriotism created a positive focus on STEM education. “In the years immediately following the launching of Sputnik, for example, school systems throughout the country focused their attention on gifted learners, and many schools developed programs to nurture their talents” (Kulik & Kulik, 1984, p. 409).

From a transformational leadership framework, President John F. Kennedy had the vision to understand the negative psychological impact of falling behind the Soviets’ technological advances. President Kennedy also had the foresight to understand national pride and the positive confidence booster the space program could generate. In May 1961, President Kennedy addressed the U.S. Congress and demanded an additional $7-9 billion in funding for space under “urgent national needs.” The additional funding resulted in landing a man on the moon just eight years later (John F. Kennedy Presidential Library and Museum, 2012). In recent years, the U.S. Congress passed the
America Competes Act of 2007, reauthorized three years later through the America Competes Reauthorization Act of 2010 with additional requirements to increase the number of underrepresented minorities in STEM fields (U.S. Congress, 2010).

**Importance of STEM for the United States**

As far back as the 19th century, John Dewey (1897) highlighted the importance of developing critical thinking and problem-solving skills for students. Over a century later, a Harvard University study reaffirmed the importance of Dewey’s recommendations as a solution to improve STEM education in the United States with an estimate of 16 years or more to observe positive changes (Chedid, 2005). Recently, the standards of mathematics and science education in American schools have been under scrutiny and many extensive research reports such as Before It’s Too Late (Glenn, 2000) and the Report of the Academic Competitiveness Council (U.S. Department of Education [DOE], 2007) have been published. These reports created a better understanding of alternatives to improve educational standards in the United States.

According to Newman (2011), there are three important reasons behind the emphasis on understanding and improving the science, technology, engineering, and mathematics (STEM) pipeline for all Americans. The first reason is the impact on the United States’ global position as a leader in technology, the second reason is related to the advantages of a diverse labor force, and the third reason is related to opportunity and equity for all (Newman, 2011). The findings of Newman’s (2011) mixed study on low
success rates for underrepresented individuals in engineering supported the findings of
the quantitative studies by NSF (2012).

Community Colleges’ Role in the Master Plan

California’s 1960 Master Plan for education transformed the higher education
system in the state. The Master Plan defined and detailed the roles and responsibilities of
the three major public segments within higher education. According to Douglass and
Greenspan (2002),

In the Spring of 1960, the California Legislature passed the Donahue Act placing
in statute a number of components of the California Master Plan for Higher
Education, a major effort to plan the future of the state’s pioneering system of
public higher education. (p. 1)

According to the California Master Plan for higher education survey team, the
charter of the community college system included open access in order to create
opportunities for all adults seeking higher education (Douglass & Greenspan, 2002, p. 1).
Nonetheless, the Master Plan did not specify any success metrics or goals beyond open
access. According to a study by Moore and Shulock (2010), “After six years, 70% of
degree-seeking students had not completed a certificate or degree, and had not transferred
to a university, with most of the non-completers having dropped out” (p. ii). Therefore,
due to the lack of success mandates within California’s Master Plan or any financial
incentives through budgeting, improving success rates for all students, and especially
underrepresented students, is more a function or responsibility of campus leadership.

The public higher-education system in California consists of the Community
College system, the California State University (CSU) system, and the University of
California (UC) system. The University of California system is designed to admit the top 12.5% of high-school graduates every year (University of California System, 2012). The California State University system is expected to admit around 33% of the top high school graduates annually (California State University, 2012). The remainder of high school graduates will either attend community colleges or other higher education institutions (California Community College Chancellor Office, 2012). An overview of California’s public education systems is provided in Figure 2.

Figure 2. Overview of California’s public education systems 2010-2011.

The California Community College system is the most cost-effective education system in the State of California. While the state revenue needed to support one full-time community college student is slightly more than $5,000 per year, that same student costs
approximately $7,500 in the K-12 system and $20,000 and $11,000, respectively, at UC and CSU (California Community College Chancellor's Office, 2012).

**Community Colleges as Pathways for Underrepresented Students**

For underrepresented students in engineering, community colleges could serve as cultural staging platforms. Due to their relatively low cost, course flexibility, locality, and open-access policies, community colleges have been an excellent higher-education alternative for a diverse population of higher education students (Tsapogas, 2004). Moreover, beyond cost and access advantages, community colleges can offer students of color the comfort of staying close to families, loved ones, and familiar environments while completing the first years of their higher-education journey (Tsapogas, 2004).

According to Tsapogas (2004), based on the 2001 National Survey of Recent College Graduates, around 40% of undergraduates and graduates in science and engineering have attended community colleges at some point on their educational path. These recent college graduates were more likely to be African American, Latino/a, or Native American. Moreover, Tsapogas (2004) also concluded science and engineering students who are married females and those who have children are more likely than male graduates to have attended community college.

Due to open access and flexibility in choosing a field of study, there is modest research addressing the decision of women to pursue undergraduate degrees in STEM fields by attending community colleges (Starobin & Laanan, 2005). However, according to Starobin and Laanan (2008), the diverse environment and culture on community
college campuses “may help female students focus on their engineering studies rather than being conscious of their gender” (p. 42). This study explored the perceptions and experiences of some women of color who chose community colleges to prepare them for engineering schools at four-year universities.

**Community College Funding Model**

Due to changes in demographics and labor market demand, and the prolonged economic recession affecting California, the “sacred triangle” of open access, low cost, and quality education is becoming harder to maintain. The current “Census Day” state funding model is based on the number of students enrolled and attending classes in the third week of a semester. Therefore, the current budgeting process does not offer any incentive for California community colleges to improve students’ educational outcomes such as completing courses, obtaining certificates, graduating, or transferring to four-year universities. The California community college system remains committed to the original mission of the Master Plan of providing open access to all adults. Using the Board of Governors (BOG) fee waiver program, low-income and disabled students are given access to higher education at no or low cost. In the past 30 years, there have been some modest increases in the cost per college credit for attending community colleges in California as shown in Figure 3.
However, the annual cost of attending a community college in California remains one of the lowest among all 50 states. As shown in Figure 4, California fees of $864 per year constitute around 29% of the national average cost to attend community college, which is $2,963 per year (College Board, 2010).
According to the American Association of Community Colleges (2011), the role of community colleges is to provide open access to postsecondary education, offer vocational training for immediate employment, prepare students to transfer to four-year universities, and offer non-credit courses for local community members. However, according to a report by Shulock, Moore, Offenstein, and Kirlin (2008), “the even lower rates of success that Latino students used to have are of great concern given their growing share of the student population and the State’s workforce” (p. 7). Therefore, the low success rate of underrepresented students at community colleges in the form of achieving
associates degrees and transferring to four-year universities can have economic implications on personal incomes and tax revenue beyond equal access to education. Kever (2009) also pointed out that decline in success rates for underrepresented students will lead to a decline in per capita income, which can negatively affect the economy. Moreover, according to Machin, Marie, & Vujić (2011), improving the educational attainment of a population can yield significant social benefits and can be a key policy tool in the drive to reduce crime.

According to data from the Foundation for California Community Colleges (2011), the California community college system has the potential to impact the state’s economy and the income of successful students.

- For every dollar California invests to get students in and through college, the State’s economy receives a three dollar net return on investment.
- Students receiving a degree or certificate from a community college see an 86% increase in their wages, from $25,600 to $45,571, three years after earning their degree.
- For every dollar spent on economic and workforce development programs at community colleges, there is a $12 increase in California’s business income and employee wages.
- A 2% increase in the share of the population with an associate’s degree, combined with a 1% increase in the share with a bachelor’s degree, results in 174,000 new jobs, $20 billion in additional economic input, and $1.2 billion more in state and local tax revenues annually.

Profiles of Latino/as in Engineering

According to the Pew Hispanic Center (Fry, 2006), the Latino/a population grew at a rate of 141% from 14.6 million to 35.3 million in the 20-year period between 1980 and 2000. Based on U.S. Census data (2010), between 2000 and 2010 the U.S. population increased by 27.3 million to 308.7 million. The Latino/a population increased
by 15.2 million, accounting for over half the growth in the U.S. population. The Latino/a population grew by 43%, rising from 35.3 million in 2000 to 50.5 million in 2010, composing around 16% of the total U.S. population.

Between 1994 and 2003, Latino/as have accounted for 64% of the students added to national public school enrollment. African Americans accounted for 23% of the increase and Asian Americans another 11%. Enrollment by Whites has decreased by 1% (Fry, 2006). Figure 5 shows percentages of URMs in the population and in engineering.

Source: U.S. Census (2010)

**Figure 5.** Overview of underrepresented groups in engineering.

Although Latino/as make up 16.3% of the U.S. population, they only make up 7.9% of undergraduate degree holders and 6.3% of the engineering workforce (U.S.
Census, 2010). Latino/as have made some good contributions to engineering in the United States, and many have served on multiple missions for the National Aeronautics and Space Administration (NASA, 2012). These are some of the better-known Latino/a astronauts:

- Franklin Chang-Díaz holds a Bachelor of Science in mechanical engineering from the University of Connecticut (1973) and a doctoral degree in applied plasma physics from the Massachusetts Institute of Technology (MIT) (1977).
- Carlos Noriega holds a Bachelor of Science degree in computer science from the University of Southern California (1981); a Master of Science degree in computer science; and a Master of Science degree in space systems operations from the Naval Postgraduate School (1990).
- Ellen Ochoa holds a Bachelor of Science degree in physics from San Diego State University (1980); a Master of Science degree (1981); and a Doctorate in electrical engineering from Stanford University (1985).

In 2009, Latino/as made up only 8.4% of graduates with engineering majors (National Action Council for Minorities in Engineering, 2011). Moreover, based on the U.S. Census data (2010), Latino/as make up 6.2% of the workforce with four-year engineering degrees. According to Robinson (2012), in a qualitative study conducted through two semi-structured interviews with seven Latina students at Arizona State University who successfully reached their fourth (senior) year in engineering, factors behind their success related to family expectations, seeking social justice, challenging
doubters, and a desire to become role models in their community. Robinson’s goal was
to explore success factors through the lived experiences of the participants. The
responses of the participants were based on intrinsic characteristics and environmental
factors. The study focused on family and individual factors and did not address
organizational agents such as institutional programs.

**Profiles of African Americans in Engineering**

Although African Americans make up 12.6% of the U.S. population, they only
make up 9.2% of undergraduate degree holders. Within four-year engineering
occupations, African Americans make up 3.2% of the workforce (U.S. Census, 2010).
According to Young (2005), one of the most significant problems facing science
education is the underrepresentation of African Americans in science-related fields.
Nonetheless, many African Americans are associated with engineering-related
achievements, and many African American astronauts served on multiple space missions
for the National Aeronautics and Space Administration (NASA, 2012). These are some
of the most famous African American astronauts:

- Robert Lawrence was named the first African American astronaut in 1967.
  He holds a Bachelor of Science in chemistry from Bradley University (1956)
- Guion Bluford received a Bachelor of Science degree in aerospace
  engineering from the Pennsylvania State University (1964), a Master of
  Science degree with distinction in aerospace engineering from the Air Force
  Institute of Technology (1974), a Doctor of Philosophy in aerospace
engineering with a minor in laser physics from the Air Force Institute of Technology (1978), and a Master’s in business administration from the University of Houston (1987)

- Ronald McNair received a Bachelor of Science degree in physics from North Carolina A&T State University (1971) and a Doctor of Philosophy in physics from the Massachusetts Institute of Technology (1976)

- Mae Jamison received a Bachelor of Science degree in chemical engineering from Stanford University (1977) and a Doctoral degree in medicine from Cornell University (1981)

At the multiple achievement levels of educational degrees, African Americans are still under their ideal percentages compared to their proportion in the U.S. total population. Moreover, in 2009, only 4.7% of graduates with engineering majors were African Americans compared to 12.6% in the total population (National Action Council for Minorities in Engineering, 2011). Also, within the engineering workforce, African Americans make up 3.2% of the total workforce with four-year engineering degrees (U.S. Census, 2010) (see Figure 5).

Profiles of Women in Engineering

According to data from NSF (2012), despite making up about half the population, women constituted 13% of the engineering workforce in 2008. Minority female engineering students at higher education institutions could be facing dual biases based on race and gender. According to Flores-Gonzalez (2002), individuals can hold multiple
identities, each having its own significance. Thus, community colleges could provide a good entry point for women of color who are pursuing engineering degrees due to the diverse and familiar environments of community colleges.

Women tend to have an internal locus of control and tend to blame themselves when facing academic challenges related to success and failure. On the other hand, men tend to have an external locus of control and tend to blame curriculum, pedagogy, and instructors for their lack of success in courses (Seymour & Hewitt, 1997; Tobias, 1990). Powell (2005) conducted a qualitative study on 14 women who had either declared or intended to declare a computer science major in the School of Engineering and Applied Science at the University of Pennsylvania. The study concluded although the participants felt they were at the same level of proficiency in mathematics, they felt their male counterparts had more knowledge when it came to the field of computer science. The study concluded these perceptions caused participants to experience feelings of low self-assurance and eventually a loss of interest in computer science as a college major. The study confirmed the importance of establishing institutional programs for underrepresented students as presented in the anti-deficit achievement model by Harper (2010) and the study by Newman (2011). Powell’s study also confirmed the importance of having cultural capital, as presented in Bourdieu’s work (1986). One of the limitations of the study by Powell was that it did not investigate any female engineering students who were transferees from community colleges to see if community college experience can equip women with the necessary cultural capital to succeed at a four-year university.
Profiles of White Females in Engineering

White females make up around 32% of the U.S. population. Within four-year engineering occupations, White females make up 7.5% of the workforce (U.S. Census, 2010). Nonetheless, many White females are associated with engineering-related achievements and many served as astronauts on multiple space missions for the National Aeronautics and Space Administration (NASA, 2012). These are some of the most famous White female astronauts:

- Eileen Collins, who received an Associate in Science degree in mathematics/science from Corning Community College in 1976; a Bachelor of Arts degree in mathematics and economics from Syracuse University in 1978; a Master of Science degree in operations research from Stanford University in 1986; and a Master of Arts degree in space systems management from Webster University in 1989. Collins was a graduate of a community college who went on to be the first woman shuttle commander.

- Sally Ride who received from Stanford University a Bachelor of Science in physics, a Master of Science in 1975, and a Doctorate in physics in 1978.

At the multiple achievement levels of educational degrees, White females are still under their ideal percentages compared to their proportion in the total U.S. population. For example, White females compose around 32% of the U.S. population and make up only 7.5% of the engineering workforce with four-year engineering degrees (U.S. Census, 2010) (see Figure 5).
The Choice of STEM Fields by Underrepresented Students

According to Vryonides (2007), Bourdieu’s concept of cultural capital includes “language use, manners, tastes and orientations/dispositions reflecting the internalization of behavior, knowledge and habits during the socialization process” (p. 871). This interpretation, which encompasses vernaculars and outlook, could explain some of the challenges faced by African Americans and Latino/as in the new environments and cultures of higher-education institutions in their pursuit of engineering degrees.

Some minority students choose to study STEM fields for reasons that vary based on ethnic background (Hanson, 2004; Oakes, 1990; St. John, Hu, Simmons, Carter, & Weber, 2004; Trusty, 2002). For African American students, the factors impacting the choice to pursue studies in STEM fields are educational levels of parents, being first-generation college students, home ownership, AP courses, and SAT score. For Latino/as, the factors are self-concept, academic engagement, and gender (Trent, Nicholson, & McKillip, 2006a, b).

Engineering Statistics in the United States versus Other Nations

According to data from NSF (2012):

- In the United States, about 4% of all bachelor’s degrees awarded in 2008 were in engineering. This compares with 31% in China and about 19% throughout Asia.
In 1999, the United States accounted for 38% of world research and development (R&D) activities. Within 10 years, the U.S. lost 18% of its world R&D share and dropped down to 31% in 2009.

Since 1995, the growth in numbers of researchers has been most rapid in China (tripled) and in South Korea (doubled). The growth in the United States was around 50%.

Half the workers in science and engineering occupations earned $73,290 or more in 2010, more than double the median earnings ($33,840) of the total U.S. workforce.

Between 2004 and 2009, research and development (R&D) employment by U.S. multinational companies (MNCs) abroad nearly doubled while their domestic R&D employment increased by less than 5%.

Support and Success

Peer. According to Laanan (2004), there is little research aimed at understanding the experiences of community college transfer students. Granger (2011) conducted a qualitative study based on interviews with 11 African American students at a community college in Missouri. Granger (2011) emphasized the “significance of peer and faculty support on students’ decisions to persist” (p. 78). The study showed how community college support programs can increase the success rates as measured by the participants’ ability to complete a two-year pre-engineering program in three years or less and transfer to a four-year university. The findings of this study highlighted the importance of
organizational agents and affirmed the findings of the anti-deficient achievement model proposed by Harper (2010). The study did not address cultural capital, which might have contributed to the success of participants.

Granger’s (2011) work highlighted the importance of validation for minority students. According to the theory of validation, in addition to the pressure of academic work, minority students tend to experience self-doubt, concerns about lack of success, and feelings of being out of place. Leadership and faculty can positively validate students’ familiarity with the new college environment by assisting students in surmounting their feelings of inadequacy (Rendon, 1994). Moreover, improving social and academic integration could improve success rates at community colleges (Nora & Rendon, 1990). According to Rendon (1994), validation calls for academic leaders “to design activities that promote active learning and interpersonal growth among students, faculty, and staff” (p. 44). Therefore, validation can come from multiple agents in and outside classroom and even campuses and involves deliberate interaction of campus personnel, resources, and systems with students to provide membership and not just access.

Williams (2003) conducted a qualitative study based on 32 interviews with African American graduate students (16 males and 16 females) engaged in graduate work in STEM. The study concluded the participants had some shared experiences contributing to their success as STEM students. The first shared experience was a high level of participation in STEM. The second shared experience was positive personal
intervention by another person. The third shared experience was the perception STEM fields provided positive outcomes. The fourth shared experience was intrinsic qualities that primed them to be part of STEM fields. The study emphasized the importance of intra- and interpersonal characteristics, which can be mapped to cultural capital (Bourdieu, 1986). However, the study did not address the organizational support systems of the anti-deficit achievement framework (Harper, 2010).

**Institutional.** Transfer student capital is the practice of gaining the necessary skills to transfer and succeed at four-year universities (Laanan, Starobin, & Eggleston, 2010). Newman (2011) conducted a mixed-methods study using data from 657 African American engineering and computer science students and interviews with 70 individuals including 37 African American engineers/computer scientists, nine engineering or computer science faculty members, 16 administrators, and eight recent undergraduate degree recipients. The study concluded the organizational agents such as institutional programs at two predominantly White public research universities have contributed to the success of the 37 African American engineering students and the eight African American engineering degree recipients. The findings of the study confirmed Harper’s (2010) anti-deficit achievement model, which emphasized the importance of institutional “policies, programs, and resources that help Black men achieve desired educational outcomes” (p. 66). Both Newman (2011) and Harper (2010) highlighted the significance of sharing responsibility for success rather than focusing on the historical disadvantages of African Americans. The study by Newman (2011) highlighted the importance of the role of four-
year universities in providing institutional support and guidance to improve success rates for African American engineering students, but the study did not provide recommendations on methods or programs to increase the breadth of underrepresented engineers through the use of the community college system.

In a qualitative study by Cruz (2010), data were collected through semi-structured interviews with 22 Latino/a graduating seniors majoring in STEM disciplines at a Hispanic-Serving Institution (HSI) and a Predominantly-White Institution (PWI) in Texas. The goal of the study was to understand the persistence and resilience of Latino/a students operating in the double -jeopardy environments of higher education and STEM fields. Cruz (2010) concluded the participants were aware of their ethnic identity but felt the world of STEM was color blind as long as they understood the norms of STEM culture. The study also concluded participants derived sense of self through pride in their own cultural heritage. However, the study did not address organizational support for Latino/as at the two Texas universities attended by the 22 participants. Also, this study did not explain whether the same persistence and resilience outcomes would be found at Historically Black Colleges (HBC) and/or would be duplicated at more diverse institutions like community colleges.

In a qualitative study by Granger (2011), 11 African American engineering students who successfully transferred from River City Community College in Missouri to four-year universities expressed their desire to attain higher than average salaries and improve living standards for their families as the main reasons behind choosing
engineering majors. This desire is also supported by economic data provided by NSF (2012), which found half of workers in science and engineering occupations earned $73,290 or more in 2010 compared to the median earnings ($33,840) of the overall workforce in the United States.

**Transfer and Graduation Data**

According to data from the California Postsecondary Education Commission (2010), in 2010 52,241 students transferred from a California public community college to the California State University (CSU) and the University of California (UC) systems. For all four-year majors, 4.4% of all transferees were African Americans and 23.9% were Latinos/as. In 2010, the CSU system issued 5154 four-year engineering degrees, out of which 85 were for African Americans. The UC system issued 5425 engineering degrees, out of which 63 were for African Americans. Out of the graduating engineering classes for the UC and CSU systems, African Americans made up 2% of CSU engineering graduates and 1% of UC engineering graduates. For African Americans, the UC campuses with the most graduates were Berkeley, Los Angeles, and Irvine, with 17, 15, and eight graduates, respectively. For CSU, the top three campuses were San Jose, Long Beach, and Los Angeles with 17, 14, and 10 graduates, respectively. In comparing the transfer and graduation numbers for African Americans, they make up 2.9% of transferees from community colleges to four-year public engineering schools, though they only make up 1% of graduates.
In 2010, the CSU system issued 5154 four-year engineering degrees out of which 583 were for Latino/as. The UC system issued 5425 engineering degrees out of which 399 were for Latino/as. Latinos/as made up 11% of CSU engineering graduates and 7% of UC engineering graduates. The UC campuses with the most Latino/a graduates were Berkeley, San Diego, and Los Angeles, with 79, 74, and 65 graduates respectively. For CSU, the top three campuses were San Luis Obispo, Pomona, and San Jose, with 111, 99, and 72 graduates, respectively. When comparing transfer and graduation numbers, data reveal although Latino/as make up 18.8% of transferees from community colleges to four-year public engineering schools, they only make up 9% of graduates.

According to Stanton-Salazar (1997), social capital “focuses on the degree and quality of middle class forms of social support inherent in a young person’s interpersonal network” (p. 2). The impact of social networks can lead to economic and educational consequences. Stanton-Salazar (1997) explained these networks serve as “freeways” enabling individuals to be effective, efficient, and more mobile socially. Education can be an entry point for underrepresented individuals into this freeway system that can lead to equity, social justice, and economic influence (Stanton-Salazar, 1997). Thus, the low graduation rates from engineering schools for underrepresented students could be attributed to lack of social capital and the knowhow to navigate the complex network of ramps, exits, underpasses, and overpasses within the higher education “freeway” system.
Community Cultural Wealth

According to Yosso (2005), community cultural wealth comes in six different forms: aspiration, navigational, social, linguistic, familial, and resistant capital (Auerbach, 2001; Delgado Bernal, 1997, 2001; Orellana, Dorner, & Pulido, 2003; Solórzano & Delgado Bernal, 2001; Stanton-Salazar, 2001). These different forms of cultural wealth are collaborative forces that reinforce and build on one another.

1. Aspirational capital—includes resiliency to hope, dream, and achieve beyond the tangibles. “Aspirational capital is the ability to hold onto hope in the face of structured inequality and often without the means to make such dreams a reality” (Yasso, 2005, p. 77).

2. Linguistic capital—includes mental and communal skills gained through the use of unique vernaculars, styles, and languages (Orellana et al., 2003).

3. Familial capital—includes principles and values gained through intra- and inter-family relationships (Delgado-Gaitan, 2001, p. 54).

4. Social capital—includes the custom of “lifting as we climb” where minorities share gained knowledge with their social networks (Gaitan, 2001).

5. Navigational capital—includes dealing with and adapting to systems implemented by and for non-minorities (Solórzano & Villalpando, 1998).

6. Resistant capital—includes the abilities to resist discrimination and unfairness (Delgado Bernal, 1997; Freire, 1970; Giroux, 1983; Solórzano & Delgado Bernal, 2001).
The different forms of capital should not be viewed as disjointed or independent silos but rather as different but integrative assets that can help underrepresented students achieve their academic goals. Moreover, due to their proximity to home and diverse environments, community colleges can serve as stepping-stones or “bridges of capital” for minority individuals who otherwise would not have considered pursuing STEM-related fields through four-year universities (Laanan, 2001; Starobin, 2004).

Shain (2002) conducted a qualitative study through structured interviews with 12 African American women students. The purpose of the study was to explore success and persistence of African American engineering students at two engineering schools in the northeast. The study concluded having self-confidence and a future vision helped participants implement tactical and strategic goals. The study confirmed the importance of cultural capital as a success factor, as presented by Bourdieu (1986). The study did not address institutional agents as presented by Harper (2010) in the anti-deficit achievement model.

**Role of Leadership at Community Colleges**

Northouse (2004) defined leadership as “a process whereby an individual influences a group of individuals to achieve a common goal” (p. 3). According to Northouse (2004), there are four central characteristics of leadership as a concept and practice, which include the following: a) leadership is a process, b) leadership involves influence, c) leadership occurs, and d) leadership involves goal attainment. Therefore, leadership is both an art and a science. By 1990, as many as 65 different leadership
classification systems had been proposed. These systems have been developed as attempts to define the dimensions of leadership (Fleishman et al., 1991). The following is an overview of some of the widely accepted leadership models:

1. **Trait Models.** According to Carlyle (1840), for every era, superior leaders emerge as a result of their mental power, social class, heritage, and charisma to lead others. Trait theorists suggest that somehow leaders are born. Within this view of leadership, the leader is viewed as a hero, a savior, and a great being.

2. **Participative Models.** Lewin and Lippitt (1938) conducted research on autocratic and democratic leadership styles and found autocratic leaders provide more guidelines and directions to members but do so in increments. On the other hand, democratic leaders provide information on goals and tasks but do not micro-manage members. Laissez-faire was another style of participative leadership introduced by Lewin, Lippitt, and White (1939). Leaders using the laissez-faire style do not provide any guidance or directives, which can result in a lower sense of unity and quality of work.

3. **Contingency Models.** According to Fiedler (1964), leaders are more effective when they have a strong position of power, strong relationships with members in the organization, and when tasks are well defined and structured.

4. **Situational Models.** According to Hersey and Blanchard (1969), more effective leaders are more adaptive in their leadership style depending on the goals of the
organization and abilities of the members. Situational leadership includes styles like telling, selling, participating, and delegating.

5. Behavioral Models. According to Stogdill (1974), there is a relationship between leaders’ personalities and behavior and effective leadership. Some of the aspects examined by Stogdill (1974) were assertiveness, self-confidence, emotional intelligence, ethical conduct, and friendliness.

6. Transactional Models. According to Burns (1978), transactional leadership emphasizes exchange of benefits between leaders and members. Financial and non-financial rewards are provided by leaders in exchange for good performance by members.

7. Transformational Models. According to Bass (1985), transformational leaders empower others to define goals, improve skills, and maximize potential. Transformational leaders are able to achieve goals beyond expectation through motivating and inspiring members of the organization.

According to Burns (1978), “Leadership is one of the most observed and least understood phenomena on earth” (p. 2). Leadership at community colleges can play a major role in impacting equity and social justice. According to the cultural-ecological theory, leaders can develop policies to improve equity and inclusion of voluntary and involuntary minorities into the learning environment and remove any obstacle to their access and success (Ogbu & Simons, 1998). The end goal for access and success should be equity and social justice for all members of society. Equity is defined as the level of justice, fairness, and equality that can benefit all stakeholders (Bardach, 2009).

Leadership at community colleges can help promote equity, create an equal level of access and success, and help students in their transitions by changing borders into boundaries as explained in the multiple worlds theory (Phelan, Davidson, & Yu, 1998).
Kezar (2000) interviewed 30 college presidents to understand perceptions of leadership and equity. The study of “Pluralistic Leadership” at all levels within colleges concluded a) more than one leadership framework may exist on campuses, b) classical models of leadership fail to understand diversity, c) changes in college cultures are needed to promote diversity, and d) leadership values are largely influenced by circumstance and tradition. To improve access and success rates for underrepresented students in engineering, community college leadership should transform the current climate and culture at campuses to impact change. Leading colleges through classical management strategies might not be the best approach to change. Kotter (1996) distinguished management from leadership. Kotter defined management as “a set of processes that can keep a complicated system of people and technology running smoothly” and stated leadership “defines what the future should look like, aligns people with that vision, and inspires them to make it happen, despite the obstacles” (p. 25). Thus, management is needed to keep the day-to-day practices in operation while leadership envisions and creates new realities.

According to Kezar and Eckel (2005), changing the status quo to promote diversity is a slow process and can be risky for college presidents under constant pressure to utilize resources efficiently and effectively. The findings by Kezar and Eckel (2005) also aligned with the transformational leadership model and the ability of transformational leaders to create new visions and empower others to achieve goals beyond expectations (Bass, 1985).
Transfer Skills

More research is needed to understand the social and psychological lived experience of students who transfer from community colleges to four-year universities (Laanan, 2004). Human capital is defined as “the activities that influence future real income through the imbedding of resources in people” (Becker, 1962, p. 9). Transfer student capital is the process to gain the assets of familiarity with the new environment and the proficiency needed for successful transition from community colleges to four-year universities (Laanan, 2004). Transfer student capital is an assembly of multiple variables related to transition, persistence, and achievement at four-year universities (Laanan et al., 2010). Moreover, according to Cohen and Brawer (2008), almost half of all students enrolled in public higher education in the U.S. are enrolled at community colleges. Therefore, transfer student capital is of greater importance to decision makers seeking to improve the pipeline of transfer and graduation for low-income students, women, and students of color in engineering. Thus, the burden can be shared by institutions, who should create welcoming environments and remove micro-aggressions, and by students, who should gain the necessary social, cultural, technical, and transfer capital needed to transfer, persist, and graduate with four-year engineering degrees.

Theoretical Frameworks

Steele (2011) emphasized the importance of both the psychological factors (personal variables) and situational factors (institutional variables) for the success of minority students. Also, Hagedorn, Cypers, and Lester (2008) affirmed the successful
transfer journey from community college to a four-year university is impacted by multiple factors such as personal tactics, strategies, and resources, and also by institutional factors such as student services. Therefore, this study utilized two theoretical frameworks to address both individual and institutional factors impacting the successful transfer of underrepresented engineering students from community colleges to four-year universities.

Beyond financial resources, some underrepresented individuals might lack the needed non-financial capital to access or succeed in their pursuit of a college education, especially in fields as demanding as engineering. Academic capital is defined as “the social processes underlying family knowledge of educational options, strategies to pursue them, and career goals requiring a college education” (St. John, Hu, & Fisher, 2010, p. xiii). Cultural capital is defined as “the sense of group consciousness and collective identity” that functions as an asset “aimed at the advancement of an entire group” (Franklin, 2002, p. 177). Therefore, cultural capital can be as important as academic capital or financial capital in helping underrepresented students accomplish their educational goals. Also, cultural capital can play a major role in the decision-making process of pursuing higher education and more specifically engineering as a field of study. Knowing someone who is an engineer, or knowing something about engineering as a field of study or career, could influence underrepresented students to pursue engineering majors.
Education can impact individuals positively by “developing the necessary skills for both initiating and maintaining network relations” (Cochran, Larner, Riley, G’nnarsson, & Henderson, 1990, p. 303). Many underrepresented students start their higher education journey at a disadvantage due to lack of skills and knowledge to deal with the higher education culture within the United States. Thus, the majority of literature on underrepresented minorities in engineering focuses on the deficits and liabilities obstructing entry and success. Bourdieu (1986) concluded the cultural assets of an individual and the family compose a non-financial type of capital that can be as powerful as actual economic assets. Thus, cultural capital can be as important as financial capabilities for first-generation college students. The research by Harper (2010) focused on the organizational climates or “anti-deficit” agents rather than the barriers preventing underrepresented students from achieving their educational goals. Harper (2010) also highlighted the “institutional agents, policies, programs, and resources that help Black men achieve desired educational outcomes” (p. 66).

According to Bourdieu (1977), “Academic success is directly dependent upon cultural capital and on the inclination to invest in the academic market” (p. 504). Therefore, the knowledge and skills to utilize education as a long-term investment vehicle are paramount to the resiliency and success of underrepresented students in higher education. Yosso (2005) described Bourdieu’s cultural capital as “an accumulation of cultural knowledge, skills and abilities possessed and inherited by privileged groups in society” (p. 76). It is unclear whether Bourdieu believed the skills
held by privileged groups could be copied by the unprivileged or whether those seeking the skills should develop their own unique cultural skills.

According to Bourdieu (1986), in addition to economic capital there are two other types of capital an individual can have: social capital and cultural capital (see Figure 7).

*Figure 7. Cultural Capital Model (Bourdieu, 1986).*

Economic capital is the easiest to measure in terms of income, property, and wealth. Social capital is “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintances and recognition” (Bourdieu, 1986, p. 248). Therefore, the magnitude of social capital is dependent on the number and status of human contacts an individual might have within a certain society. Lin (2001) defined social capital as “resources embedded in social networks accessed and used by actors for actions” (p. 25). Also, Stanton-Salazar (1997), considered social capital “social freeways” allowing people to navigate the pathways of privilege and power (p. 4).
Cultural capital is a process to sustain and formalize status within society. Cultural capital comes in the form of objectified capital, embodied capital, and institutionalized capital (Bourdieu, 1986). The objectified form of cultural capital refers to cultural products and symbols associating an individual with a certain societal class or status. Objectified capital refers to the legal possession of cultural material and objects such as paintings and antiques. Embodied cultural capital refers to an individual’s ability to appreciate objectified capital such as paintings and antiques.

The embodied form of cultural capital is less visible than other forms of cultural capital. Also, unlike objectified capital, embodied cultural capital is not easily transferable from one individual to another and requires certain lived experiences and the development of specific tastes and preferences to appreciate cultural goods and services. Institutionalized cultural capital refers to the formal certifications and diplomas validating the possession of cultural capital. According to Bourdieu (1986), academically, cultural capital is “sanctioned by legally guaranteed qualifications, formally independent of the person of their bearer” (p. 247).

Bourdieu’s work also aligned with the cultural ecological theory of Ogbu (1986). According to Ogbu (1986), there are two different types of minority in the United States, voluntary and involuntary. The two types differ in their views on engaging with the majority. Involuntary minorities might develop resistance, which might create more difficulties in terms of language, culture, and identity, to the point of viewing academic success as “acting White,” which might lead to discarding education. The goal of
leadership at community colleges and four-year universities should be to create awareness and promote the universal social, economic, and cultural benefits of education.

The student attrition model by Bean (1980) suggested four major variables leading to students dropping out of college. These four variables are background, organization, environment, and attitude (Bean, 1980). The first variable is background: the challenges an educational institution might face when admitting students from certain backgrounds. This variable seems in agreement with the deficit model presented and the blaming of underrepresented students for any issues and challenges they might face in college (Valencia, 1997). The second is an organizational variable related to students’ interactions and experiences at the educational institution. This variable is in agreement with the anti-deficit achievement model where the offerings and services of an institution are viewed as major determinants of retention and success in underrepresented students (Harper, 2010). The third is an environmental variable related to the experience of students outside the educational institution. The fourth is outcome and is related to students’ attitudes toward education and institutions, which can be tied to Bourdieu’s cultural capital model.

Based on the dominant deficit theory of thinking, individual and family factors are the main causes for the lack of success of underrepresented students. In deficit theory, institutional and societal factors are not factored in as causes for failure or barriers to success (Valencia, 1997). The deficit model also views non-dominant cultures as
“deprived” cultures without any significant contribution to society (Valencia, 1997, p. 137).

On the other hand, Harper’s (2010) anti-deficit achievement framework focused on institutional success agents rather than pointing out deficiencies within underrepresented groups. Mapping Harper’s anti-deficit framework to Bourdieu’s cultural capital, the success of underrepresented students in engineering can be the combination of individual assets and institutional programs that can lead to success in dealing with the new educational environment. Therefore, underrepresented students can focus on success programs rather than on deficits and liabilities within their new frontiers in education.

Rendon, Jalomo, and Nora (2000) argued that to understand successful pathways, the focus should be on the positive variables for students rather than focus on attrition variables (Bean, 1980) or deficit models (Valencia, 1997). Rendon et al. (2000) explained:

Student(s) will elect to stay or leave college not so much because of theory, but because college and university faculty and administrators have made transformative shifts in governance, curriculum development, in-and out-of-class teaching and learning, student programming, and other institutional dimensions that affect students on a daily basis. (p. 152)

The student success model of Rendon et al. (2000) is similar to the anti-deficit achievement model proposed by Harper (2010). Both models call for transformation starting with institutions before blaming underrepresented students for lack of success or achievement. The importance of having an inclusive academic environment has been
highlighted by the student social and academic integration model (Tinto, 1975, 1987, 1993). Tinto (1987) also suggested the level of prescribed or informal lived experience can contribute to the decision to remain or drop out of school. Thus, the decision to attract and retain underrepresented engineers could go beyond academics to out-of-class or even out-of-institution college experiences. It is important for underrepresented students to feel they are part of the environment of the engineering school. The importance of a welcoming and inclusive academic environment has been highlighted by the student social and academic integration model (Tinto, 1975, 1987, 1993). Tinto (1975) explained:

The process of dropout from college can be viewed as a longitudinal process of interaction between the individual and the academic and social systems of the college during which a person’s experiences in those systems (as measured by his/her normative and structural integration) continually modify his goal and institutional commitments in ways which lead to persistence and/or to varying forms of dropout. (p. 94)

For underrepresented engineering students, experiencing sincere commitment from both community colleges and four-year universities is vital for the access, retention, and success of underrepresented engineering students.

According to Tinto (1993), “the concept of membership is more useful than integration because it implies a greater diversity” (p. 106). Thus, when it comes to college success for underrepresented engineering students, the feeling of belonging can be as important as the feeling of access, and that makes the difference between feeling like a guest at someone else’s house and feeling at home within the educational institution.
According to Harper (2010), the anti-deficit achievement framework views success of minority students in STEM through three stages. Stage one is the pre-college socialization and readiness stage, which includes familial factors, school forces, and out-of-school experiences. Stage two is the college-stage class interactions, out-of-class engagement, and external opportunities. Stage three is post-college persistence in STEM, which includes careers in STEM fields, pursuing graduate degrees, and careers in research. Harper’s (2010) model focuses on institutional willingness and readiness to change the current academic culture to meet the needs of underrepresented students (see Figure 8).

Figure 8. Anti-Deficit Achievement Model (Harper, 2010).

According to Rendon et al. (2000), Tinto’s social and academic integration model (1975, 1987, 1993) addressed students’ acculturation and assimilation into the learning process by focusing on students’ ability to get incorporated into the new cultural norms of the academic environment. Therefore, Tinto’s model failed to address institutional
responsibilities towards preserving students’ cultural identity. Thus, although both Tinto and Harper addressed socializing and integrating new students into the new environment, Tinto put more emphasis on the student’s ability to be indoctrinated into the school environment, while Harper emphasized the importance of the presence of institutional programs serving disadvantaged students. The theoretical frameworks in this study explain how personal, familial, community, and institutional factors impact underrepresented students who make the successful transfer from community colleges to four-year universities in pursuit of engineering degrees (see Figure 9).

Figure 9. Conceptual Representation of Cultural Capital Model (Bourdieu, 1986) and Anti-Deficit Achievement Model (Harper, 2010).
According to Bertalanffy (1972), general systems theory is concerned with the process of how organizations transform inputs into outputs. So, community colleges as systems can be viewed from the frameworks of cultural capital and anti-deficit achievement in order to understand yield, or whether they are successful in achieving their missions. Figure 10 provides a conceptual framework for the three theories.

Figure 10. Conceptual Representation of Systems Theory (Bertalanffy, 1972), Cultural Capital Model (Bourdieu, 1986) and Anti-Deficit Achievement Model (Harper, 2010).

According to Wai, Lubinski, Benbow, and Steiger (2010), mental inspiration beyond normal coursework can lead students to aim higher and accomplish more. The concept of “educational dose” was defined as “the density of advanced and enriching pre-collegiate learning opportunities beyond the norm which students have participated in” (p. 861). Examples of educational doses in STEM fields are invention projects, competitions, special courses, and research opportunities. Examples of STEM accomplishment criteria are STEM occupations, patents, and publications. The framework of educational doses offered to underrepresented students can be viewed as
anti-deficit achievement institutional initiatives at the pre-college stage, where schools can prepare underrepresented students to choose engineering as a major.

**Conclusions**

The exploration of community colleges as viable pathways for underrepresented students to gain admission into engineering programs at four-year universities can provide K-12 administrators, community college administrators, four-year university administrators, policymakers, and researchers with a better understanding of the role community colleges can play in expanding the pipeline of engineering students from community colleges to four-year universities and eventually into the workforce to help the United States sustain its global leadership position in technology, increase the diversity of the workforce, and enhance equity and social justice for all Americans.

This chapter provided details of the theoretical frameworks that informed the study, the importance of expanding the engineering pipeline in the United States, and an overview of the public higher-education system in California. This chapter provided demographic, general education, and engineering-related information about White females, African Americans, and Latino/as. The chapter also provided information on the different reasons underrepresented students choose STEM fields as areas of study, peer support and success, and the community cultural wealth model.

The research design, role of researcher, setting and sample, instrumentation, data collection, data analysis, protection of participants, and limitations are detailed in Chapter
3. Chapter 4 presents data coding and analysis, and findings and recommendations are presented in Chapter 5.
Chapter 3

METHODOLOGY

Introduction

This qualitative study examined the perceptions and experiences of successful African American males, White females, Latinos, and Latinas who utilized community colleges as pathways to engineering schools at four-year universities in California. This chapter explains the logic behind using qualitative research in this study. The chapter also provides details on the research design, theoretical frameworks guiding this study’s research questions, the research questions themselves, role of the researcher, setting and sample, instrumentation and material, data collection, data analysis, the protection of participants, and limitations.

Research Design

Qualitative research was used to explore details beyond the numbers of underrepresented groups in engineering. According to Bogdan and Biklen (2007), “Qualitative research is descriptive. The data collected take the form of words or pictures rather than numbers” (p. 5). The purpose of qualitative research is to inquire about details (Green & Thorogood, 2004).

White females, Latino/as, and African Americans are underrepresented within jobs requiring four-year engineering degrees (NSF, 2013; U.S. Census, 2010). Phenomenological research explores human experience through the words and expressions of participants (Creswell, 2009). Phenomenological research was used in
this study to understand the individual pathways of participants through open-ended questions. According to Merriam (2009), “Phenomenology focuses on the experience itself and how experiencing something is transformed into consciousness” (p. 24). Therefore, this phenomenological study engaged participants at the personal level to understand their unique experiences as successful transferees from community colleges to four-year universities. The use of the phenomenological approach was important to understand the transfer journey through the perceptions of these successful individuals. Epistemologically, phenomenological studies are concerned with collecting and analyzing participants’ viewpoints and experience, which is aligned with the social constructionist’s view of subjectivity and the presence of more than “one objective reality” (Bess & Dee, 2008, p. 47).

As discussed in Chapter 2, the literature indicates research on underrepresented groups in engineering has primarily employed quantitative approaches showing the underrepresentation of African Americans, Latino/as, and White females in job markets requiring four-year engineering degrees (NSF, 2013; U.S. Census, 2010). Quantitative studies provide generalizations but not details about individual perspectives. Granger (2011) conducted a qualitative study based on interviews with 11 African American students at a community college that highlighted the importance of community college support programs to improve transfer rates. Other qualitative studies basically focused on underrepresented students entering four-year universities out of high school, not
necessarily transfer students (Cruz, 2010; Newman, 2011; Powell, 2005; Robinson, 2012; Shain, 2002; Williams, 2003).

One of the theoretical frameworks guiding this study was Bourdieu’s (1986) cultural capital theory. Consequently, this study explored cultural perceptions and strategies employed by participants as assets to gain admission into engineering schools at four-year universities. A review of the literature might have suggested a deficit model relating low achievement rates to individuals’ characteristics such as low income or lack of role models without considering organizational factors contributing to the underrepresentation of certain groups at four-year engineering schools and in the workforce (Valencia, 1997). Therefore, the second theoretical framework guiding this study was Harper’s (2010) anti-deficit achievement model, which focused on institutional factors and organizational agents that helped participants achieve successful transfer from community colleges to engineering schools at four-year universities. This study explored the perceptions of participants on community colleges, the transfer process, and long-term plans.

**Research Questions**

The theoretical frameworks of the study, namely the cultural capital framework (Bourdieu, 1986) and the anti-deficit achievement model (Harper, 2010), informed the following research questions:

1. What helped these successful individuals choose community colleges as pathways toward engineering majors?
2. What helped these individuals complete the transfer journey from community colleges to engineering schools at four-year universities?

3. What long-term academic and career goals do these individuals have, and how did their community college experience help shape their academic or career goals?

The interview questions were designed to collect data on the cultural capital of participants and anti-deficit achievement agents before, during, and after using community colleges as pathways to gain admission to engineering schools at four-year universities. Interview questions related to individual experiences and perceptions about cultural capital and institutional factors that could have contributed to the successful transfer from a community college to an engineering school at a four-year university.

The interview was conducted using a battery of questions designed to collect sufficient data from participants. The first part of the interview included questions related to background information like gender, race, age group, marital status, colleges attended, and education level of parents. The second part of the interview contained open-ended questions about the participants’ pre-community college experience, community college experience, and post community college experience. A full list of the interview questions can be found in Appendix A.

**Setting and Sample**

The research study included semi-structured interviews with 14 participants recruited through personal e-mails with the help of the researcher’s extended network of personal and professional contacts. The objective was to include at least three
participants from each underrepresented group. To ensure privacy, interviews were conducted in private rooms in the library building at California State University, Sacramento. Participants signed a consent form (see Appendix B) and were given the option to stop the interview or refuse to answer any questions at any time. Due to changes in schedules, three interviews were conducted over the phone. With the written consent of the participants, a digital audio device was used to record the interviews.

White females, Latino/as, and African Americans have been identified as underrepresented groups in job markets requiring four-year engineering degrees (NSF, 2013; U.S. Census, 2010). Therefore, the criteria for inclusion of participants in this study were the following: 18 years of age or older, White women, African Americans, or Latinos/as who have gained admission into an engineering school at a four-year university after attending a community college. In addition to the previous inclusion factors, participants were either current four-year university students or graduates of four-year universities. The final pool of participants in the study included three White females, three African Americans, three Latinos, and five Latinas, for a total of 14 individuals.

**Instrumentation and Material**

The researcher used open-ended questions followed by probing questions related to the participants’ perception of and exposure to engineering pre-community college, during community college, and post community college. The interviews were conducted face-to-face in private library rooms, except for three interviews conducted over the
phone. Although the researcher could not observe the participants’ body language over the phone, the data collected were as rich as the data collected from face-to-face interviews. With the consent of participants, interviews were recorded using a digital device in addition to handwritten notes using pen and paper. All information collected was secured using a lock and key and encryption software. To eliminate any risk of discomfort due to the presence of an audio recording device, participants were given the option to opt out of being recorded and for data to be collected using handwritten notes. All participants agreed to be audio recorded, which gave the researcher the benefit of going back to the digital recordings to search for data and check for accuracy of handwritten notes.

**Data Collection**

Data were collected through semi-structured one-on-one interviews. Interviews lasted 55-97 minutes each. Interviews were recorded using a digital audio device. A total of 14 participants were interviewed. Data were coded, analyzed, and included in the findings. The interview questions were designed to respond to the three research questions. The researcher used probing questions to encourage participants to share more of their successful experience. Findings from all participants were examined to find themes and analyzed through the lenses of the presented theoretical frameworks.

**Data Analysis**

According to Creswell (2009), qualitative data are best analyzed concurrently with data collection. For this study, the researcher collected data from participants while
at the same time analyzing completed interview transcripts. In analyzing the collected data, the focus was on comparing, contrasting, searching for commonalities, and examining differences among all established categories and properties (Glaser & Strauss, 1967). The study used the coding system introduced by Bogdan and Biklen (2007). Developing a coding system requires “searching through your data for regularities and patterns as well as for topics your data cover” (Bogdan & Biklen, 2007, p. 173).

In addition to the codes by Bogdan and Biklen (2007), the researcher created two codes to help answer the research questions for this study. The first was the transformation code, which is focused on influence agents and initiatives that can positively impact admission and graduation rates for underrepresented students. The second was the aspiration code, focused on participants’ future desires to further their education or develop their career. The coding approach for this study included the following codes:

1. Setting/Context codes, which cover settings and localities (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Describe the pros and cons that led you to attend community college on your way to a four-year university.”

2. Situation codes, which cover how participants view their experience at community college and their awareness of its impact on their lives (Bogdan & Biklen, 2007). This code was examined through the following open-ended
question, among others: “Explain using examples whether your expectations were met or not at the community college.”

3. *Perspectives held by participants*, which covers shared visions (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Explain some of your perceived pros and cons of attending a community college prior to attending a four-year university.”

4. *Participants’ ways of thinking about others*, which covers how participants view the world (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Describe the impact that the community college experience has had on you as it relates to preparing you or not for your journey at a four-year university.”

5. *Process codes*, which cover the succession of events (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Tell me about the search and application processes related to your enrolling in a community college.”

6. *Activity codes*, which cover frequent events and actions (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Describe your personal strengths and study habits that have helped you transfer from a community college to a four-year university.”

7. *Event codes*, which cover non-frequent actions or events (Bogdan & Biklen, 2007). This code was examined through the following open-ended question,
among others: “Tell me a story about your most memorable personal experience related to engineering.”

8. *Strategy codes*, which cover tactics used to achieve goals (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Explain your work tactics and strategies towards coursework, i.e. cramming, weekly slots, or daily slots.”

9. *Relationship and social structure codes*, which cover frequent models of behavior beyond formal roles and responsibilities (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Explain how you managed your other commitments like work, family, friends, and other activities.”

10. *Narrative codes*, which cover the particular ways they disclose their life experiences (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Tell me about any other factors that might have assisted you thus far in getting closer to your academic and career goals, i.e. campus clubs, field trips, and internships.

11. *Methods codes*, which cover collateral related to problems and solutions (Bogdan & Biklen, 2007). This code was examined through the following open-ended question, among others: “Explain how you managed your other commitments like work, family, friends, and other activities.”
In addition to the 11 codes by Bogdan & Biklen (2007), the researcher added two more codes necessitated by the responses from the participants regarding their community college experience and the impact it had on their academic and career plans:

12. Transformation codes, which focus on influence agents and initiatives that can positively impact admission and graduation rates for underrepresented students. This code was examined through the following open-ended question, among others: “Tell me about any other factors that might have assisted you thus far in getting closer to your academic and career goals.”

13. Aspiration codes, which focus on participants’ future desires to further their education or develop their careers. This code was examined through the following open-ended question, among others: “Describe how your community college experience helped shape your academic goals and career goals.”

The researcher was able to identify recurring words, concepts, ideas, and experiences using color-coded themes, which were mapped to the theoretical frames and literature. The researcher recognized all participants in the study have achieved success in transferring from a community college to a four-year engineering school. Thus, participants might have mostly positive perspectives. Nonetheless, the researcher was able to document some negative experiences during the interviews.

Protection of Participants

Participation in this study was completely voluntary. Subjects were identified and approached through the researcher’s personal, academic, and professional network of
contacts. Each participant was sent a consent form via e-mail prior to the interview and was given the option to opt out of the interview at any time during or after the interview. The real names of participants, colleges, or universities were not used in the completed study. Interview questions did not lead to collecting any confidential or damaging information from participants. After the completion of the dissertation, all collected data will be destroyed, shredded, or deleted.

**Limitations**

Qualitative research can generate more details about experiences and perceptions than quantitative research. Therefore, qualitative research can be prevailing and persuasive. To collect unfiltered data about the lived experiences of participants, great efforts were made by the researcher to select participants who did not have any personal relationship with the researcher or even knowledge of his background as a community college transfer to a four-year engineering program.

The researcher went to great lengths to collect and include details regarding cultural capital and anti-deficit achievement agents throughout the participants’ educational experience before, during, and after community college. According to Patton (1990), "generalization is not the main objective of qualitative research. The rationale behind qualitative studies is to provide “provide perspective” (p. 491). Therefore, the study findings are based on the lived experiences of the 14 participants in the study and may not be generalized to all African Americans, Latino/as, and White females who utilized community colleges as pathways to gain admission to engineering school at four-
year universities. The coding, analysis, and conclusions were all based on the researcher’s interpretation of the words, meanings, and intentions of participants. The reader is hereby advised to incorporate his/her scrutiny and analysis, and readers are encouraged to contact the researcher with questions and feedback.

The 14 participants who shared their community college experience and the impact it had on their transfer journey and success, attended 17 different community colleges out of 112 community colleges that make up the California community college system. Therefore, the interpretations and findings should be limited to the 17 colleges attended by the participants. Due to distance and scheduling issues, three out of the 14 interviews had to be completed over the phone.

**Role of the Researcher**

The researcher interacted with the participants solely for the purpose of conducting interviews in order to gather data. A semi-structured interview approach was used to collect data from participants. According to Merriam (2009), “The phenomenological interview is the primary method of data collection” (p. 25). The researcher had been a community college transfer student, and bracketing was used to enhance neutrality of the findings. “Bracketing is a scientific process in which a researcher suspends or holds in abeyance his or her presuppositions, biases, assumptions, theories, or previous experiences to see and describe the phenomenon” (Gearing, 2004, p. 1430).
Therefore, the researcher conducted this study setting aside any preconceived notions about the perceptions and experiences of underrepresented students in engineering. In addition to holding an electrical engineering degree and working as adjunct faculty at a community college, the researcher is currently working as a manager at a multinational engineering company with a diverse population. Thus, the researcher is familiar with underrepresented groups in engineering and the rigorous set of requirements to complete transfer and admission to engineering schools at four-year universities.

The author of this study (Samer Musa Batarseh) is a first-generation Jordanian-American who was able to obtain a Bachelor’s of Science in electrical engineering from California State University, Sacramento after attending San Joaquin Delta College, a public community college in California, to complete freshman and sophomore courses in math, chemistry, physics, and computer science.

When the researcher was a very young boy, he already knew he was going to be an electrical engineer. Moral support from parents, five siblings, grandparents, aunts, uncles, cousins, and friends was instrumental to his persistence and success. Thus, he was fortunate to be the recipient of the needed cultural capital throughout the journey to pursue and receive a four-year engineering degree. On the other hand, the researcher’s decision to utilize a community college to complete undergraduate math and science courses was solely based on financial reasons. As a product of the community college system in California, the researcher might have some positive biases towards the system,
as it was his pathway toward an engineering degree from a four-year university.

Therefore, throughout the interview and research process, the researcher was extra vigilant to stay objective in researching, coding, and analyzing the literature review and data from participants.

Currently, the researcher is working for a Fortune® 100 technology company, and he values his education as an engineer and the opportunity he was awarded through the community college system to pursue a four-year degree in engineering. It is his passion and enthusiasm for engineering, education, and equity that led him to conduct this research.
Chapter 4

FINDINGS

Introduction

According to the American Association of Community Colleges (2013), community colleges offer Americans from diverse backgrounds local access to higher education. Based on historical data, women and underrepresented ethnic minority students are more likely to attend community colleges and less likely to attend prestigious universities than male and White students (Snyder & Dillow, 2010). The findings in this study confirmed the historical data related to the use of community colleges by women and underrepresented ethnic minority students.

The purpose of qualitative research study is to inquire into details of what, how, or why beyond the quantitative data (Green & Thorogood, 2004). Therefore, this study focused on the lived experiences of the participants. Qualitative research offers “an emphasis on the qualities of entities and on processes and meaning that are not measured in terms of quantity, amount, intensity and frequency” (Denzin & Lincoln, 2000, p. 8). This chapter provides the findings of this phenomenological qualitative research study based on semi-structured interviews with African American males, Latinos, Latinas, and White female participants. The one-on-one interviews aimed to answer the following research questions: 1) What helped these successful individuals choose community colleges as pathways toward engineering majors? 2) What helped these individuals complete the transfer journey from community colleges to engineering schools at four-
year universities? 3) What long-term academic and career goals do these individuals have, and did their community college experience help shape their academic or career goals?

This qualitative study was influenced by the theoretical frameworks of the cultural capital model (Bourdieu, 1986) and the anti-deficit achievement model (Harper, 2010). The participants in this study shared their engineering educational experience including their early memories as young students, the path to community college, the transfer to a four-year university, success strategies at four-year engineering schools, and academic and career plans beyond obtaining an undergraduate degree in engineering. The collected data were organized into four major categories.

The first category was the “pre community college experience.” In this category, participants were asked to share their experience with factors that might have contributed to their interest in science and engineering. Also, participants were asked about the reasons behind choosing community colleges as their entry institutions for higher education. The second category was the “community college experience.” In this category, participants were asked to describe their experience at community colleges and also offer suggestions to improve community college services for underrepresented minority students in engineering. The third category was the “post community college experience at a four-year engineering school.” In this category, participants were asked to share their success tactics and strategies at a four-year engineering school. The fourth category was the “beyond undergraduate engineering school.” In this category,
participants were asked to share their academic and career goals beyond obtaining an undergraduate degree in engineering.

**Descriptive Characteristics of the Participants**

The research was based on semi-structured interviews with eight female participants and six male participants for a total of 14 participants belonging to underrepresented groups in engineering, which include White females, African American males, and Latino/as. The participants were all transfer students from public community colleges in California to engineering schools at four-year universities. Ten out of the 14 participants currently attend four-year universities, two graduated a month before the interviews took place, and two have been working as engineers for over 15 years. The 14 participants attended 17 different public community colleges in California. The participants attended four different four-year universities of which three were public and one was private. Six of the 14 participants attended more than one community college before transferring to a four-year university. Eight of the 14 participants transferred to four-year universities within 50 miles of the last community college they attended. The average student completed around 93 units at the community college level, which is 23 units more than the allowable maximum number of transfer units.

Eight participants were adults under 25 years of age, four participants were between 25 and 35 years old, and two participants were over 35 years of age. Eleven participants were single and three were married. Eight participants had a high school grade point average (GPA) of 3.0 or higher on a 4.0 scale and the rest had a GPA of 2.99
or less. One participant had a father with a graduate degree, but she did not grow up in the same household with him, two participants had fathers with bachelor’s degrees, one participant had a father with a community college degree, and the rest of the participants had fathers with a high school or lower education level. Two participants had mothers with bachelor’s degrees, one had a mother with a community college degree, and the rest had mothers with high school diplomas or less.

According to the Education Commission of the States (2013), remediation is defined as “coursework offered at a postsecondary institution that is below college-level work” (para. 1). Most participants in this study stated they had used community colleges for remediation related to math, English, or science. Table 1 provides a snapshot of demographic and personal characteristics related to the participants in this study.
Table 1

Demographics and Personal Characteristics

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Gender</th>
<th>Race</th>
<th>Age Group</th>
<th>Marital Status</th>
<th>High School GPA</th>
<th>Engineering Major</th>
<th>Number of Community Colleges Attended</th>
<th>Number of Units Completed at Community College(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Savanna</td>
<td>Female</td>
<td>White</td>
<td>26-35</td>
<td>Married</td>
<td>3.5-4.0</td>
<td>Chemical</td>
<td>2</td>
<td>124</td>
</tr>
<tr>
<td>2</td>
<td>Sally</td>
<td>Female</td>
<td>White</td>
<td>18-25</td>
<td>Single</td>
<td>3.5-4.0</td>
<td>Aerospace</td>
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<td>137</td>
</tr>
<tr>
<td>3</td>
<td>Ladonna</td>
<td>Female</td>
<td>Latina</td>
<td>26-35</td>
<td>Single</td>
<td>3.5-4.0</td>
<td>Electrical</td>
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<td>90</td>
</tr>
<tr>
<td>4</td>
<td>Dan</td>
<td>Male</td>
<td>Latino</td>
<td>18-25</td>
<td>Single</td>
<td>3.5-4.0</td>
<td>Electrical</td>
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<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Janis</td>
<td>Female</td>
<td>Latina</td>
<td>18-25</td>
<td>Single</td>
<td>3.5-4.0</td>
<td>Electrical</td>
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<td>118</td>
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<tr>
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<td>Female</td>
<td>Latina</td>
<td>18-25</td>
<td>Single</td>
<td>2.5-2.99</td>
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<tr>
<td>7</td>
<td>Leon</td>
<td>Male</td>
<td>Latino</td>
<td>18-25</td>
<td>Single</td>
<td>3.5-4.0</td>
<td>Civil</td>
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<td>90</td>
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<tr>
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<td>Latina</td>
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<td>Single</td>
<td>2.5-2.99</td>
<td>Mechanical</td>
<td>2</td>
<td>90</td>
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<tr>
<td>9</td>
<td>Cassandra</td>
<td>Female</td>
<td>Latina</td>
<td>36-45</td>
<td>Married</td>
<td>3.0-3.49</td>
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<td>90</td>
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<td>10</td>
<td>Juan</td>
<td>Male</td>
<td>Latino</td>
<td>55+</td>
<td>Married</td>
<td>2.5-2.99</td>
<td>Electrical</td>
<td>3</td>
<td>80</td>
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<td>11</td>
<td>Camellia</td>
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<td>Civil</td>
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<td>African American</td>
<td>26-35</td>
<td>Single</td>
<td>2.5-2.99</td>
<td>Mechanical</td>
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<td>African American</td>
<td>26-35</td>
<td>Single</td>
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<td>Male</td>
<td>African American</td>
<td>18-25</td>
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Table 1 (continued)

<table>
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<th>Race</th>
<th>Father Highest Education</th>
<th>Mother Highest Education</th>
<th>Number of Relatives who Attended/Attending College</th>
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<td>White</td>
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<td>Sally</td>
<td>Female</td>
<td>White</td>
<td>Associate Degree</td>
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<td>Latino</td>
<td>Junior High School</td>
<td>Elementary</td>
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<td>4</td>
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<td>Male</td>
<td>Latino</td>
<td>High School</td>
<td>Associate Degree</td>
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<td>Latino</td>
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<td>High School</td>
<td>2</td>
</tr>
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<td>Some College</td>
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<td>Carlita</td>
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<td>Latino</td>
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<td>9</td>
<td>Cassandra</td>
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<td>Latino</td>
<td>Graduate Degree</td>
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Table 1 (continued)

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Gender</th>
<th>Race</th>
<th>Age Group</th>
<th>Marital Status</th>
<th>Number of Community Colleges Attended</th>
<th>Number of Units Completed at Community College(s)</th>
<th>Distance from Last Community College Attended to Four-Year University (miles)</th>
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<td>111</td>
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<td>Male</td>
<td>Latino</td>
<td>18-25</td>
<td>Single</td>
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<td>100</td>
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<td>Janis</td>
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<td>Single</td>
<td>1</td>
<td>118</td>
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<td>Female</td>
<td>Latina</td>
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<td>Single</td>
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<td>79</td>
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<td>Leon</td>
<td>Male</td>
<td>Latino</td>
<td>18-25</td>
<td>Single</td>
<td>1</td>
<td>90</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Carlita</td>
<td>Female</td>
<td>Latina</td>
<td>18-25</td>
<td>Single</td>
<td>2</td>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>9</td>
<td>Cassandra</td>
<td>Female</td>
<td>Latina</td>
<td>36-45</td>
<td>Married</td>
<td>1</td>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Juan</td>
<td>Male</td>
<td>Latino</td>
<td>55+</td>
<td>Married</td>
<td>3</td>
<td>80</td>
<td>95</td>
</tr>
<tr>
<td>11</td>
<td>Camellia</td>
<td>Female</td>
<td>White</td>
<td>18-25</td>
<td>Single</td>
<td>1</td>
<td>95</td>
<td>23</td>
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<tr>
<td>12</td>
<td>Stan</td>
<td>Male</td>
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<td>26-35</td>
<td>Single</td>
<td>1</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Adam</td>
<td>Male</td>
<td>African American</td>
<td>26-35</td>
<td>Single</td>
<td>3</td>
<td>64</td>
<td>17</td>
</tr>
<tr>
<td>14</td>
<td>Kevin</td>
<td>Male</td>
<td>African American</td>
<td>18-25</td>
<td>Single</td>
<td>1</td>
<td>79</td>
<td>17</td>
</tr>
</tbody>
</table>
Profile of Participants

Participant 1

Savanna is a White female engineering student with the following demographic characteristics in Table 2.

Table 2

Savannah’s Characteristics

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>Chemical</td>
</tr>
<tr>
<td>Age</td>
<td>26-35 years old</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Married</td>
</tr>
<tr>
<td>High School GPA</td>
<td>3.5-4.0</td>
</tr>
<tr>
<td>Number of Community Colleges Attended</td>
<td>2</td>
</tr>
<tr>
<td>Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>Number of Units Completed at Community College</td>
<td>124</td>
</tr>
<tr>
<td>Father’s Highest Level of Education</td>
<td>Bachelor’s of Science</td>
</tr>
<tr>
<td>Mother’s Highest Level of Education</td>
<td>Some College</td>
</tr>
<tr>
<td>Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>5</td>
</tr>
</tbody>
</table>

Savanna is an engineering student at a University of California (UC). Although Savanna had a relatively good GPA that would have allowed her to attend a four-year university straight out of high school, she decided to attend a community college due to its lower cost compared to a four-year university and due to the fact she wanted to stay close to home. Savanna completed 124 community college semester credits, which is more than the maximum 70 allowable transfer credits, due to having to take remediation
courses in math, physics, and chemistry. Savanna chose to transfer to a four-year university located less than 50 miles from her hometown so she could commute to the university daily. Because of distances and scheduling, the interview with Savanna was conducted over the phone.

**Participant 2**

Sally is a White female engineering student with the following demographic characteristics in Table 3.

**Table 3**

<table>
<thead>
<tr>
<th>Sally’s Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Engineering Major</td>
</tr>
<tr>
<td>- Age</td>
</tr>
<tr>
<td>- Marital Status</td>
</tr>
<tr>
<td>- High School GPA</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
</tr>
</tbody>
</table>

- Aerospace
- 18-25 years old
- Single
- 3.5-4.0
- 2
- 1
- 137
- Junior High School
- Elementary School
- 1

Sally is an engineering student at a private university in southern California. Sally had a relatively high GPA in high school but chose to attend community college due to the fact a local community college provided a low cost alternative to acquiring higher education. Sally completed 137 community college credits, which is more than
the maximum 70 allowable semester credits transferable to a four-year university, due to having to take remediation courses in math, physics, and chemistry. Sally chose to transfer to a four-year university located less than 100 miles from her hometown so she could go back and see her family on weekends. Because of distances and scheduling, the interview with Sally was conducted over the phone.

Participant 3

Ladonna is a Latina (female) engineering student with the following demographic characteristics in Table 4.

Table 4

Ladonna’s Characteristics

<table>
<thead>
<tr>
<th>- Engineering Major</th>
<th>- Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age</td>
<td>- 26-35 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>- Single</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>- 3.5-4.0</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>- 1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>- 1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>- 90</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>- High School</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>- Associate’s of Art</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>- 3</td>
</tr>
</tbody>
</table>

Ladonna is an engineering student at a California State University (CSU) campus. Ladonna had a relatively high grade point average (GPA) in high school, which would have allowed her to attend a four-year university without having to attend a community
college, but she chose to attend community college due to local community college providing a low-cost alternative to acquiring higher education. Ladonna completed 90 community college credits, which is more than the allowable maximum 70 transferable credits, due to having to take remediation courses in math, physics, and chemistry.

Ladonna chose to transfer to a four-year university located 110 miles from her hometown so she could go back and see her family when needed.

**Participant 4**

Dan is a Latino (male) engineering student with the following demographic characteristics in Table 5.

**Table 5**

*Dan’s Characteristics*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>Electrical</td>
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<td>Age</td>
<td>18-25 years old</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single</td>
</tr>
<tr>
<td>High School GPA</td>
<td>3.5-4.0</td>
</tr>
<tr>
<td>Number of Community Colleges Attended</td>
<td>1</td>
</tr>
<tr>
<td>Number of Four-Year Universities Attended</td>
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</tr>
<tr>
<td>Number of Units Completed at Community College</td>
<td>100</td>
</tr>
<tr>
<td>Father’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>Mother’s Highest Level of Education</td>
<td>High School</td>
</tr>
<tr>
<td>Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>2</td>
</tr>
</tbody>
</table>

Dan is an engineering student at a California State University (CSU) campus. Dan had a relatively high GPA in high school, which would have allowed him to attend a
four-year university without having to attend a community college. Dan chose to attend a community college due to local community college providing a low-cost alternative to acquiring higher education, and also because he followed in his brother’s footsteps into the local community college. Dan completed 100 community college credits, which is more than the allowable maximum 70 transferable credits, due to having to take remediation courses in math, physics, and chemistry. Dan chose to transfer to a four-year university located 50 miles from his hometown so he could still live in the same town as his parents and still spend time with his parents on weekends.

Participant 5

Janis is a Latina (female) engineering student with the following demographic characteristics in Table 6.

Table 6

<table>
<thead>
<tr>
<th>Janis’s Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Engineering Major - Electrical</td>
</tr>
<tr>
<td>- Age - 18-25 years old</td>
</tr>
<tr>
<td>- Marital Status - Single</td>
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<tr>
<td>- High School GPA - 2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended - 1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended - 1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College - 118</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education - Some College</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education - Some College</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College - 1</td>
</tr>
</tbody>
</table>

Janis is an engineering student at a California State University (CSU) campus.

Janis’s high school GPA was not high enough to offer her direct admission into a four-
year university. Janis chose to attend a community college because it was a low-cost means of acquiring higher education readily available to her. Janis completed 118 community college credits, which is more than the allowable maximum 70 transferable credits, due to having to take remediation courses in math, English, physics, and chemistry. Janis chose to transfer to a four-year university located 98 miles from her hometown so she could still visit her family on weekends.

**Participant 6**

Anita is a Latina (female) engineering student with the following demographic characteristics in Table 7.

Table 7

*Anita’s Characteristics*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Engineering Major</td>
<td>Civil</td>
</tr>
<tr>
<td>- Age</td>
<td>18-25 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>Single</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>79</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>Some College</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>Some College</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>1</td>
</tr>
</tbody>
</table>

Anita is an engineering student at a California State University (CSU) campus. Anita’s high school GPA was not high enough to offer her direct admission into a four-year university. Anita chose to attend community college because it was a means of
acquiring higher education both available to her and low cost; and some of her friends from high school went there. Anita completed 79 community college credits, which is nine more credits than the allowable maximum transferable credits, due to having to take remediation courses in math. Anita chose to transfer to a four-year university located in southern California, 365 miles from her hometown, so she could dedicate her time to engineering school but still go back to see her family during long school breaks.

**Participant 7**

Leon is a Latino (male) engineering student with the following demographic characteristics in Table 8.

Table 8

*Leon’s Characteristics*

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>Civil</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>18-25 years old</td>
<td></td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single</td>
<td></td>
</tr>
<tr>
<td>High School GPA</td>
<td>3.5-4.0</td>
<td></td>
</tr>
<tr>
<td>Number of Community Colleges Attended</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of Four-Year Universities Attended</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Number of Units Completed at Community College</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>Father’s Highest Level of Education</td>
<td>Elementary School</td>
<td></td>
</tr>
<tr>
<td>Mother’s Highest Level of Education</td>
<td>Elementary School</td>
<td></td>
</tr>
<tr>
<td>Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Leon is an engineering student a California State University (CSU). Leon’s high school GPA was not high enough to offer him direct admission into a four-year university. Leon chose to attend a community college because it was a means of
acquiring higher education both available to him and low cost; and because of a bunch of his high school friends decided to go there after high school. Leon completed 90 community college credits, 20 more than the allowable maximum transferable credits, because he had to take remediation courses in math, English, and physics. Leon chose to transfer to a four-year university located 20 miles from his hometown so he could still live at home.

**Participant 8**

Carlita is a Latina (female) engineering student with the following demographic characteristics in Table 9.

**Table 9**

*Carlita’s Characteristics*

<table>
<thead>
<tr>
<th>- Engineering Major</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age</td>
<td>18-25 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>Single</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>2</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>90</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>2</td>
</tr>
</tbody>
</table>

Carlita is an engineering student at a California State University (CSU). Carlita’s high school GPA was not high enough to offer her direct admission into a four-year university. Carlita chose to attend a community college because it was a means of
acquiring higher education both available to her and low cost. Carlita completed 90 community college credits, 20 more than the allowable maximum transferable credits, due to having to take remediation courses in math, English, and physics. Carlita chose to transfer to a four-year university 95 miles from her hometown so she could still go home on weekends and school breaks.

Participant 9

Cassandra is a Latina (female) engineer with the following demographic characteristics in Table 10.

Table 10

Cassandra’s Characteristics

<table>
<thead>
<tr>
<th>- Engineering Major</th>
<th>- Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age</td>
<td>36-45 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>Married</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>3.0-3.49</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>90</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>Master of Arts</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>High School</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>2</td>
</tr>
</tbody>
</table>

Cassandra is a retired software engineer who worked for a multinational engineering company that manufactures computers and accessories. She graduated from a California State University (CSU) institution. Cassandra’s high school GPA may not have been high enough to offer her direct admission into a four-year university.

Cassandra chose to attend a community college because it was a means of acquiring
higher education both available to her and at low cost. Cassandra completed 90 community college credits, 20 more than the allowable maximum transferable credits, due to having to take remediation courses in math and computer science. Cassandra chose to transfer to a four-year university located 50 miles from her hometown so she could still go home on breaks and weekends to spend time with her family and friends. Cassandra works as a volunteer at a local public library teaching migrant workers basic English language skills.

**Participant 10**

Juan is a Latino (male) engineer with the following demographic characteristics in Table 11.
Table 11

*Juan’s Characteristics*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>Electrical</td>
</tr>
<tr>
<td>Age</td>
<td>46-55 years old</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Married</td>
</tr>
<tr>
<td>High School GPA</td>
<td>2.5-2.99</td>
</tr>
<tr>
<td>Number of Community Colleges Attended</td>
<td>3</td>
</tr>
<tr>
<td>Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>Number of Units Completed at Community College</td>
<td>80</td>
</tr>
<tr>
<td>Father’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>Mother’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>Number of Extended Family Members who have Attended</td>
<td>0</td>
</tr>
<tr>
<td>or are Currently Attending College</td>
<td></td>
</tr>
</tbody>
</table>

For the past 18 years, Juan has been working as an engineer for a multinational engineering company that designs computer hardware products. Juan started attending community college while serving in the United States Navy when classes were held on base. Juan’s high school GPA was not high enough to offer him direct admission into a four-year university. Juan completed 80 community college credits, 10 more than the allowable maximum transferable credits. Juan chose to transfer to a four-year university close to his last duty station in the US Navy Juan graduated from a California State University (CSU) campus. Juan works as a volunteer at a four-year engineering school mentoring minority engineering students.
Participant 11

Camellia is a White female engineering student with the following demographic characteristics in Table 12.

Table 12

Camellia’s Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Civil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Major</td>
<td>Civil</td>
</tr>
<tr>
<td>Age</td>
<td>18-25 years old</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single</td>
</tr>
<tr>
<td>High School GPA</td>
<td>3.5-4.0</td>
</tr>
<tr>
<td>Number of Community Colleges Attended</td>
<td>1</td>
</tr>
<tr>
<td>Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>Number of Units Completed at Community College</td>
<td>95</td>
</tr>
<tr>
<td>Father’s Highest Level of Education</td>
<td>Elementary School</td>
</tr>
<tr>
<td>Mother’s Highest Level of Education</td>
<td>High School</td>
</tr>
<tr>
<td>Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>1</td>
</tr>
</tbody>
</table>

Camellia is an engineering student at California State University (CSU) campus. Camellia had a relatively high GPA in high school, which would have allowed her to attend a four-year university without having to attend a community college. Camellia chose to attend a community college due to the fact a local community college provided a low-cost alternative to acquiring higher education and also some of her school friends went to community college. Camellia completed 95 community college credits, 25 more than the allowable maximum transferable credits, due to having to take remediation courses in math and physics. Camellia chose to transfer to a four-year university 23
miles from her hometown so she would not have to move away from her family and friends.

**Participant 12**

Stan is an African American male student with the following demographic characteristics in Table 13.

Table 13

*Stan’s Characteristics*

<table>
<thead>
<tr>
<th>- Engineering Major</th>
<th>- Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age</td>
<td>- 26-35 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>- Single</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>- 2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>- 1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>- 1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>- 55</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>- Some College</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>- Bachelors of Arts</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>- 3</td>
</tr>
</tbody>
</table>

Stan is an engineering student at a California State University (CSU) campus. Stan chose to attend community college due to the fact that a local community college provided a low-cost alternative to acquiring higher education. Stan was a reverse transfer student. He completed 55 community college credits only, since he had already attended a four-year university and wanted to go back and attend a community college to be better prepared to succeed in his pursuit of an engineering degree from a four-year university. Stan utilized the community college to complete remediation courses in math and
science. Stan chose to transfer to a four-year university located 10 miles from his community college because he had already been admitted to the university prior to attending community college. Due to distances and scheduling, the interview with Stan was conducted over the phone.

**Participant 13**

Adam is an African American male student with the following demographic characteristics in Table 14.

Table 14

*Adam’s Characteristics*

<table>
<thead>
<tr>
<th>- Engineering Major -</th>
<th>Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age                -</td>
<td>26-35 years old</td>
</tr>
<tr>
<td>- Marital Status     -</td>
<td>Single</td>
</tr>
<tr>
<td>- High School GPA    -</td>
<td>2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended -</td>
<td>3</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended -</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College -</td>
<td>64</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education -</td>
<td>Some College</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education -</td>
<td>High School</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College -</td>
<td>2</td>
</tr>
</tbody>
</table>

Adam is an engineering student at a California State University (CSU). Adam’s high school GPA was not high enough to offer him direct admission into a four-year university. Adam chose to attend a community college because it was a means of acquiring higher education both available to him and low cost. Adam completed 64 community college credits, around the maximum allowable transferable credits, due to
the fact that he was totally prepared for community college as a bridge to transfer to a four-year university. Adam chose to transfer to a four-year university 17 miles from his home so he can still live with his family while attending university. A few weeks after the interview, Adam earned his four-year engineering degree.

**Participant 14**

Kevin is an African American male student with the following demographic characteristics in Table 15.

**Table 15**

*Kevin’s Characteristics*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Engineering Major</td>
<td>Electrical</td>
</tr>
<tr>
<td>- Age</td>
<td>18-26 years old</td>
</tr>
<tr>
<td>- Marital Status</td>
<td>Single</td>
</tr>
<tr>
<td>- High School GPA</td>
<td>2.5-2.99</td>
</tr>
<tr>
<td>- Number of Community Colleges Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Four-Year Universities Attended</td>
<td>1</td>
</tr>
<tr>
<td>- Number of Units Completed at Community College</td>
<td>79</td>
</tr>
<tr>
<td>- Father’s Highest Level of Education</td>
<td>Bachelor of Science</td>
</tr>
<tr>
<td>- Mother’s Highest Level of Education</td>
<td>Master of Art</td>
</tr>
<tr>
<td>- Number of Extended Family Members who have Attended or are Currently Attending College</td>
<td>2</td>
</tr>
</tbody>
</table>

Kevin is an engineering student at a California State University (CSU). Kevin’s high school GPA was not high enough to offer him direct admission into a four-year university. Kevin chose to attend a community college because it was a means of acquiring higher education both available to him and low cost. Kevin completed 79 community college credits, nine more than the maximum allowable transferable credits,
due to having to take math and English remediation courses. Kevin chose to transfer to a four-year university 17 miles from his home so he could still be close to his family. A few weeks after the interview, Kevin earned his four-year engineering degree.

The findings for this study were guided by the Bogdan and Biklen (2007) coding family and two additional codes created by the researcher to help answer the research questions. The first code created by the researcher was the transformation code, focused on influence agents and initiatives that can positively impact admission and graduation rates for minority students. The second was the aspiration code, focusing on participants’ future desires to further their education or develop their careers.
Table 16

**Codes**

<table>
<thead>
<tr>
<th>1. Setting/Context Codes</th>
<th>“This term refers to codes under which the most general information on the setting, topic, or subjects can be sorted” (Bogdan &amp; Biklen, 2007, p. 174).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptions of participants’ home, high school, and community college setting</td>
<td></td>
</tr>
<tr>
<td>• Home setting as it relates to getting young students interested in science and engineering.</td>
<td></td>
</tr>
<tr>
<td>• High school setting as it relates to leading students to select engineering as a major in college.</td>
<td></td>
</tr>
<tr>
<td>• Community college setting as it relates to preparing students to transfer to an engineering school at a university.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Situation Codes</th>
<th>“Under this type of code your aim is to place units of data that tell you how the subjects define the setting or particular topics” (Bogdan &amp; Biklen, 2007, p. 174).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptions of participants’ perceptions of community college system and of engineering studies at community colleges.</td>
<td></td>
</tr>
<tr>
<td>• Obtaining general information about community colleges.</td>
<td></td>
</tr>
<tr>
<td>• Obtaining general information about engineering-related courses at community colleges.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Perspectives Held by Subjects Codes</th>
<th>“This family includes codes oriented toward ways of thinking toward particular aspects of setting” (Bogdan &amp; Biklen, 2007, p. 175).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptions of participants’ orientation towards community college and four-year university education</td>
<td></td>
</tr>
<tr>
<td>• Admission and registration process at community colleges.</td>
<td></td>
</tr>
<tr>
<td>• Interacting with community college instructors.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Subjects’ Ways of Thinking about People and Objects Codes</th>
<th>“This family of codes gets at the subjects’ understanding of each other, of outsiders, and of the objects that make up their world” (Bogdan &amp; Biklen, 2007, p. 175).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptions of participants’ of personal, social, and cultural attributes which can assist them in earning engineering degrees</td>
<td></td>
</tr>
<tr>
<td>• Perspective on math, science, and engineering</td>
<td></td>
</tr>
<tr>
<td>• Understanding self as part of underrepresented groups within the engineering community.</td>
<td></td>
</tr>
</tbody>
</table>
Table 16 (continued)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Process Codes</td>
<td>“Process codes are words and phrases that facilitate categorizing sequences of events, changes over time, or passages from one type or kind of status to another” (Bogdan &amp; Biklen, 2007, p. 176).</td>
</tr>
<tr>
<td></td>
<td>Descriptions regarding the impact community colleges had on participants’ academic preparedness for engineering schools at four-year universities</td>
</tr>
<tr>
<td></td>
<td>• Academic rigor of engineering-related courses at community colleges.</td>
</tr>
<tr>
<td></td>
<td>• Advantages of attending community colleges prior to entering engineering schools at four-year universities.</td>
</tr>
<tr>
<td></td>
<td>• Disadvantages of attending community colleges prior to entering engineering schools at four-year universities.</td>
</tr>
<tr>
<td>6. Activity Codes</td>
<td>“Codes that are directed at regularly occurring kinds of behavior are what we call activity codes” (Bogdan &amp; Biklen, 2007, p. 176).</td>
</tr>
<tr>
<td></td>
<td>Descriptions of the participants’ successful study tactics and strategies</td>
</tr>
<tr>
<td></td>
<td>• Individual study approaches.</td>
</tr>
<tr>
<td></td>
<td>• Group study approaches.</td>
</tr>
<tr>
<td>7. Event Codes</td>
<td>“These kinds of codes are directed at units of data that are related to specific activities that occur in the setting or the lives of subjects you are interviewing” (Bogdan &amp; Biklen, 2007, p. 177).</td>
</tr>
<tr>
<td></td>
<td>Descriptions of infrequent activities which impacted participants’ progress towards transferring to a four-year universities</td>
</tr>
<tr>
<td></td>
<td>• Counseling services at high schools.</td>
</tr>
<tr>
<td></td>
<td>• Accessing information and counseling services at community colleges.</td>
</tr>
<tr>
<td>8. Strategy Codes</td>
<td>“Strategies refer to tactics, methods, techniques, maneuvers, ploys, and other conscious ways people accomplish various things” (Bogdan &amp; Biklen, 2007, p. 177).</td>
</tr>
<tr>
<td></td>
<td>Descriptions of participants’ strategies to achieve their goal of transferring to a four-year university</td>
</tr>
<tr>
<td></td>
<td>• Basic Skills: Time management, multitasking, and perseverance</td>
</tr>
<tr>
<td></td>
<td>• Higher Level Skills: Networking, team work, and feeling empowered.</td>
</tr>
</tbody>
</table>
### Table 16 (continued)

<table>
<thead>
<tr>
<th>9. Relationship and Social Structure Codes</th>
<th>• “Regular patterned of behavior among people not officially defined by organizational chart are what we group under relationships” (Bogdan &amp; Biklen, 2007, p. 177).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Descriptions of participants’ tactics and strategies to create professional networks in order to gain social and cultural capital.</td>
</tr>
<tr>
<td></td>
<td>• <em>Involvement in campus societies and clubs.</em></td>
</tr>
<tr>
<td></td>
<td>• <em>Pursuing internship opportunities at engineering firms.</em></td>
</tr>
<tr>
<td></td>
<td>• <em>Field trips to engineering entities.</em></td>
</tr>
<tr>
<td>10. Narrative Codes</td>
<td>• “Narrative codes describe the structure of talk itself. When informants tell you their stories, they offer an account of their lives framed in a particular way” (Bogdan &amp; Biklen, 2007, p. 178).</td>
</tr>
<tr>
<td></td>
<td>• Descriptions of participants’ words and tones when sharing their feelings about their dreams and visions through engineering</td>
</tr>
<tr>
<td></td>
<td>• Driving forces behind current and future educational and career goals.</td>
</tr>
<tr>
<td>11. Methods Codes</td>
<td>• “This coding family isolates material pertinent to research procedures, problems, joys, dilemmas, and the like” (Bogdan &amp; Biklen, 2007, p. 179).</td>
</tr>
<tr>
<td></td>
<td>• Descriptions of participants’ management of problems and solutions throughout their transfer journey</td>
</tr>
<tr>
<td></td>
<td>• <em>Managing commitments beyond scholastic obligations.</em></td>
</tr>
<tr>
<td>12. Transformation Agent Code</td>
<td>• This code focuses on influence agents, initiatives, and programs which can positively impact access and success rates of minority students.</td>
</tr>
<tr>
<td></td>
<td>• Description of participants’ interactions, engagements, and exchanges with community college instructors</td>
</tr>
<tr>
<td></td>
<td>• <em>Positive agents of transformation at community colleges.</em></td>
</tr>
<tr>
<td>13. Aspiration Code</td>
<td>• This coding family was created by the researcher and focuses on future plans or desires to further education and develops careers.</td>
</tr>
<tr>
<td></td>
<td>• Description of participants’ future academic or career plans.</td>
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<tr>
<td></td>
<td>• <em>Academic goals or career objectives after completing an undergraduate degree in engineering.</em></td>
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</table>
Discussion of Themes

This qualitative study was based on interviews with 14 participants. This qualitative study used the Bogdan and Biklen (2006) coding family, which consists of 11 codes. Two more codes were added based on Harper’s (2010) anti-deficit achievement model, related to the role of “institutional agents, policies, programs, and resources” in the success of minority students (p. 66). These two codes were the transformation code and the aspiration code, which were based on transfer success and future academic and career plans. The collected data were categorized into general codes and more specific themes. For this qualitative study, the themes were used to compare, contrast, search for commonalities, and examine differences among established categories and properties (Glaser & Strauss, 1967). According to Glaser and Strauss (1967), large numbers of observations and cases are not prerequisites to creating theory. “One case could be used to generate conceptual categories and a few more cases used to confirm the indication” (Glaser & Strauss, 1967, p. 30). A conceptual model was created based on the collected data, themes, and findings.

1. Setting/Context Code

According to Bogdan and Biklen (2007), “This term refers to codes under which the most general information on the setting, topic, or subjects can be sorted” (p. 174). This code is focused on the general climate, localities, and environment that could have helped students become more interested in engineering. The settings include home, high school, community college. This code was used to categorize the collected data based on
the participants’ descriptions of the different environments like home, high school, and community college, on their way to becoming engineering students at four-year universities. The majority of the participants had some memorable formal and informal educational experiences related to science and engineering that could have contributed to their interest in studying engineering and transferring to a four-year university.

Home Setting

In response to the questions on their home-related experience and exposure to science and engineering, the majority of the participants had some memorable experiences, which could have contributed to their interest in engineering. There were three subthemes related to participants’ experience and exposure to engineering at home. These were role models, coaching and mentorship, and learning moments.

Based on Bhanot and Javanovic’s (2009) findings, the involvement of a mother with her children’s homework activities at home can have a positive impact on daughters’ self-assessment and a negative impact on sons’ self-assessment. The following two excerpts from participants provided examples of exposure to engineering through role models who happened to be family members:

My stepdad is an electrical engineer, so I remember growing up and he worked at a steel mill, so I went to steel mills at young ages and I was always really into industry. - Savanna

I guess I have two uncles, one is an industrial engineer, and the other one is mechanical engineer, who exposed me to engineering. - Anita

Healthy interactions between parents and children can positively impact the formation of self-theories to enhance children’s academic success (Dweck, 2006; Eccles,
2005). The following two excerpts from participants provide examples of exposure to
ing工程学通过教练和导师。

I asked my dad what I could do with math besides teaching and he said
工程学，而且我说那不是开火车的人。像我完全不知道工程学是什么。我来自一个从未上过大学的家庭。
-Camellia

As a kid, I had a passion for building structures whether it’s bridges or houses.
My parents encouraged me and talked to me about how great a career engineering
was. And they also pointed out people like relatives or family friends that were
engineers who were successful. - Kevin

Based on a survey of about 1,400 scientists and members of the American
Association for the Advancement of Science Foundation, 80% of the scientists were
impacted by being introduced to science toys and equipment like chemistry sets and
telescopes, and 76% stated they were impacted by visits to science museums as children
(Bayer Corporation, 1998). The following three statements from participants provide
examples of exposure to engineering through learning moments through playing with
toys, observing others, and field trips.

As a kid, I definitely really wanted to know the ins and outs on how things work.
I did boy scouts so there was a lot of aspects of boy scouts that you can kind of
like implement like design ideas into or just kind of just build things you know,
and so one of the biggest things is there was a summer camp with boy scouts. We
were able to do a lot of building in general in terms of like wooden bridge, and
wood you know tied together with ropes and things like that so. – Stan

My dad he is very hands on. Sometimes some things will break for some reason
my dad would always fix them and they would never break. – Carlita

In high school, I went to factories for science projects; we learned how to develop
alcohol from molasses. - Anita
Overall, the impact of the home setting on children’s interest in education in general and in engineering specifically would fall under social capital and the embodied and objectified forms of cultural capital (Bourdieu, 1986). Also, the home setting would be part of stage one or the pre-college socialization and readiness stage of the anti-deficit achievement model, which includes familial factors and out-of-school experiences (Harper, 2010).

**High School Setting**

When asked about their exposure to engineering in high school, the descriptions of experiences among participants varied with regards to developing interest in engineering. Two subthemes emerged showing the different impacts high school education had on the participants’ interest in engineering. Based on participants’ statements, high schools can serve as “sparkplugs” or “shut-off switches” when it comes to building students’ interest in engineering.

The introduction to advanced science and math curriculum in high school is vital for students who are planning on entering STEM fields in college (Oakes, 1990; Oakes, Muir, & Joseph, 2000). The first subtheme related to how hands-on or application-based approaches to teaching science courses in high schools can serve as “sparkplugs” to ignite students’ interest in science and engineering.

In high school, I loved all my science classes because my teachers were pretty good. They always answer the questions that we had, and they went on through there, and explain, and talk about how you could actually use this in the real world. So, it was always – their classes were always interesting. – Anita
I think freshman year in high school, I took, well, they put me in a class that I did not sign up for. So, I was the only girl. It was like intro to industrial arts, so it was like a quarter wood shop, quarter auto shop, quarter drafting, and a quarter of computer, but I thought there was a section for girls, but I was the only girl in that class, but the drafting class really got my attention because we kind of did like Computer Aided Drafting (CAD) and drafting. – Ladonna

In high school, I took an automotive class, my teacher was really passionate about us wanting to do some form of technical career and he explained the difference between a technician and a designer or engineer. – Stan

This subtheme could be related to stage one, or the pre-college socialization and readiness stage of the anti-deficit achievement model, which includes school forces (Harper, 2010). In this subtheme, the high school serves as a positive change agent in exposing students to science and other engineering-related topics. According to Wai et al. (2010), mental inspiration beyond normal coursework can lead students to aim higher and accomplish more. The concept of “educational dose” was defined as “the density of advanced and enriching pre-collegiate learning opportunities beyond the norm which students have participated in” (p. 861). On the other hand, according to Perna (2002), lower-income students are less likely to be “academically prepared for college because of the characteristics of the schools they attend and because of such practices as curricular tracking and ability grouping” (p. 120).

This was also an observation in this study based on excerpts from participants. Thus, the second subtheme is related to how the lack of hands-on science experiments in high school can serve as a “shut-off switch” that can prevent students from pursuing science courses and eventually majoring in engineering in college.
My high school experience also with science was pretty bad, like the only class I took was basic biology and that they didn’t even have a lab. – Janis

High school was not a good experience. In high school, I used to do well in math but not science, you needed to read English. My English reading and writing skills weren’t that great so I struggled with it since Spanish was my first language. - Juan

Overall, the impact of high school as a “shut-off switch” to minority students’ interest in science and engineering would be part of deficit theory where institutional factors are not considered barriers to success (Valencia, 1997). Also, high school serving in that capacity would be depriving students of embodied, objectified, and institutionalized forms of cultural capital that can help students be ready for STEM courses in college (Bourdieu, 1986).

Community College Setting

The majority of participants described their community college setting as positive with regards to steering them towards engineering or enhancing their interest in engineering and helping get them ready to transfer to a four-year university. Statements from participants are used to show four different subthemes related to the participants’ decisions to attend community college and its impact on the participants’ success at transferring to a four-year university. The four subthemes related to open access, affordability, sharpening academic skills, and experiencing higher education.

One of the charters of the community college system is to provide “open access” to create “opportunities” for all adults (Douglass & Greenspan, 2002, p. 1). The first subtheme is based on descriptions by participants of how the “open access” policy at
California community colleges provided an opportunity to access and try higher education:

I went to Community College just because one of my high school friends was going there. I was indecisive of what my plan was really to go to work, but I was kind of like you know it might work, might be fun or whatever to go to school for a while. – Carlita

So I kind of grew up always thinking you know, I am really bad in math. I was home-schooled all my life. I had never been in a classroom before I went to community college. I never had a teacher before, so it was a big deal for me just to walk in to a classroom and me be like oh my gosh that’s my teacher, this is a school. I never really got into school until I went to community college. – Sally

Open-access policies at community colleges have provided viable higher education alternatives for a diverse population of higher education students (Tsapogas, 2004). This subtheme is related to stage two or the college stage of the anti-deficit achievement model, which includes class interactions, out-of-class engagement, and external opportunities (Harper, 2010).

Community colleges offer a low-cost higher education alternative. Therefore, community colleges remain a well-travelled pathway for low-income, first-generation, and minority students on their way to obtaining four-year degrees (Deil-Amen, Rosenbaum, & Person, 2005). The second subtheme is based on descriptions by all participants of how affordability of California community colleges and the perception of a high return on investment (ROI) helped the participants benefit from their community college experience and eventually transfer to a four-year engineering program.

I decided to work and go to a community college and also save money. That’s another thing, save money. It’s a big factor in choosing a community college. - Anita
It was the cost. My parents weren’t real keen with paying for a four-year university because the cost is so high. – Savanna

I went to community college partly because my family doesn’t have any money to pay for higher education. So it’s definitely the cost. – Camellia

Noel-Levitz (2009) reported cost as the main factor for minority and non-minority students when choosing a community college as a pathway into higher education. This could be related to the low levels of financial capital, embodied cultural capital, and objectified cultural capital some of the participants had and their need to obtain institutionalized cultural capital at a low cost (Bourdieu, 1986). According to Perna (2002), lower-income students are less likely to be “academically prepared for college because of the characteristics of the schools they attend and because of such practices as curricular tracking and ability grouping” (p. 120). Thus, participants in this study, who were all low income and minority students, were more likely to attend community college to update their math and science knowledge. The third subtheme is based on descriptions by participants of how the community college experience helped them sharpen their academic skills to gain admission to four-year universities.

I feel my experience at the Junior College was really instrumental in preparing me for the bigger university. - Kevin

Community college was a good place to re-sharpen my skills, since I backed off so much in high school, I really need to get back into the game in terms of reading the material before class, making sure that my work that I handed in was up to par. - Savanna

I loved community college. I felt like I grew a lot and I think it was a good, maybe, because I didn’t have a good high school experience. - Ladonna
I really didn’t have any memorable experience about engineering during high school. Engineering wasn’t even in any of my thoughts until I got to community college. – *Janis*

I decided to go to electronic engineering while I was in the community college. – *Dan*

It wasn’t until community college when I took my science courses. - *Leon*

The participants’ decisions to attend community college were mainly related to lack of financial capital, embodied cultural capital, and objectified cultural capital. Some participants also needed to obtain institutionalized cultural capital at a low cost in order to have the formal credentials to transfer to a four-year university (Bourdieu, 1986). In this subtheme, community colleges are serving as anti-deficit achievement agents by helping participants acquire the needed skills to transfer to four-year universities.

Due to low cost, location, and open access, the community college system serves as a test-drive vehicle for those unsure about pursuing higher education degrees. The fourth subtheme is based on descriptions by participants of how they utilized community college as “test-drive vehicles” to enter the unfamiliar higher education highway and eventually commit to a certain destination or college major.

I just wasn’t sure how I wanted to do it. I wanted the experience of how college was going to be before I actually decided. - *Anita*

I went to community college just because I was indecisive of what my plan was but I was kind of like you know it might work, might be fun or whatever to go to school for a while. – *Carlita*
The descriptions by participants are within the charter of the community college system, which includes “open access” in order to generate “opportunities” for those seeking higher education (Douglass & Greenspan, 2002, p. 1).

2. Situation Code

According to Bogdan and Biklen (2007), “Under this type of code your aim is to place units of data that tell you how the subjects define the setting or particular topics” (p. 174). Their code was used to categorize participants’ perceptions about the community college system and about engineering studies at community college. The code was split into two. One code was related to awareness of higher education options at community colleges and the other to engineering alternatives at community colleges.

**Awareness of higher education options at community colleges.** Since most participants were first-generation college students, they did not have the needed social and cultural capital to understand the ways of the higher education system. In regard to higher education, many participants were in completely unchartered territory, as evident from a statement by one participant:

> I wasn’t quite familiar yet with Free Application for Federal Student Aid (FAFSA) and how to apply for it. I didn’t have any of that help because I was completely on my own because my parents they were mostly emotionally, but they cannot really give me advice…. I can't just go to my parents to answer some of the questions I have – Ladonna

According to Quatroche (2004), when promoting community colleges based on location and low cost, direct mail, brochures, and radio advertisements are among the most effective methods to reach the greatest number of prospective students. When
asked about their awareness of higher education options through community colleges, the majority of participants described their awareness of the community college system as a “low-hanging fruit,” that is, an option as a starting point for a low-cost higher education journey. Nonetheless, statements from participants show that prior to enrolling in community colleges, the participants could be classified into two groups or subthemes with distinct perceptions of community college education. The first subtheme was based on participants’ understanding that community colleges are an integrated part of the higher education system, as evident from the following statements:

We have some relatives who talked to my parents about the cost of college, both private universities, public universities, and community colleges. They kind of outlined all the cost. And we found out that community colleges were the least expensive. – Kevin

My parents could not afford four-year universities, so my next option was to go a community college, which wasn’t really a bad idea. – Adam

Community colleges are democratic institutions where access is open to all regardless of academic achievement or possession of any form of capital (Cohen & Brawer, 2008), as evident from the following statements:

My parents didn’t go to school. They only finished like second or third grade. That’s it. So, it wasn’t really like my father’s motivating me to go to school and stuff like that. Pretty much it was on my own that I want to do this. – Leon

In this setting, community colleges serve as anti-deficit achievement agents of change in helping underrepresented minority students pursue engineering degrees (Harper, 2010). Some participants viewed community college as the only option they had due to lack of restrictions on admission and the low cost of attending. According to
Turner et al. (2002), there is a higher presence of underrepresented students in developmental or remedial courses.

According to Lewis and Middleton (2003), community colleges offer prospects for students from all backgrounds to start their higher education journeys before transferring to four-year institutions. The second subtheme based on participants’ responses was community college education is for “second stringers” who are not ready yet to start their higher education at four-year universities, as evident from the following statements:

Community college instructors were fighting against the stereotypes because they all know that, people who go to community college they are people who just think automatically assume they were just weren’t good enough to go to a four-year. - Ladonna

In my household my mom really wanted me to go to a four-year institution directly after high school because she assumed that I would probably not end up transferring if I did a two-year institution first. – Stan

According to Tsapogas (2004), open access at community colleges offers students from diverse backgrounds a good pathway into higher education. Within this subtheme, the open-access opportunity served as an anti-deficit achievement process in helping participants access higher education (Harper, 2010). Moreover, the community college experience helped participants acquire objectified, embodied, and institutionalized forms of cultural capital in order to transfer to a four-year university (Bourdieu, 1986).

**Awareness of engineering alternatives at community colleges.** The responses to questions about participants’ awareness of pre-engineering programs and alternatives in the community college system resulted in three classifications or three different
subthemes. The first subtheme was based on responses from participants who came into the community college system with a predetermined decision to become engineers and already had the advanced math and science courses. The second subtheme was based on responses from participants who came into the community college system with a predetermined decision to become engineers but did not have the advanced math and science courses. The third subtheme was based on responses from participants who did not have pre-defined educational objectives much less a goal to become engineers.

The first subtheme was based on responses from participants who came into the community college system with a prior decision to pursue engineering as a college major and a prior understanding of transferability of different courses in math, physics, chemistry, and engineering. Participants who came into the community college system with a target goal and a specific plan were able to transfer with an average of 68 units. These participants were Stan, Adam, and Kevin, although Stan had a slightly different experience than Adam and Kevin since he found out about engineering education at community colleges after first struggling as a freshman engineering student at a four-year university. Both Adam and Kevin came into community college equipped with all the needed high school courses in math, physics, and chemistry and basically cruised through community college on their way to a four-year university.

In high school, they talked about community college, but they really pushed four-year institutions. So, I went straight into a four-year university and I was not ready for it. So, I had to leave and go to a community college before coming back to a four-year university. — Stan
Information about engineering was available at the admissions office of my community college. - Adam

My uncle and my dad actually went to the same community college when they were younger. My uncle had really good experience with the system, the educational system and he explained things to me. – Kevin

These participants are the ones who had some level of embodied cultural capital allowing them to realize the importance of taking the needed courses in high school (Bourdieu, 1986).

The second subtheme was based on responses from participants who came into the community college system with the intent to become engineers but did not have the required classes from high school so were able to utilize the community colleges as a “high school retake” stage.

I went to my high school counselor and I mentioned to her I wanted to be an engineer and I told her that I heard someone say, they mentioned Cal Poly San Luis Obispo and then she was like, “Oh, but I don’t think you’ll probably get in.” And she was like, “You should just go to community college.” - Ladonna

The third subtheme was based on responses from participants who did not have pre-defined educational objectives much less a goal to become engineers. However, they were transformed into engineering students through their studies, interactions, and exposure at community college.

Coming out of high school I had zero motivation, zero drive. At that time, I lived in my parents’ house and basically my parents said you better get a job or go to community college. - Savanna

It was six of my friends and I decided to go and apply and I don’t know, I never – it wasn’t like taking it seriously. It was like, whatever, just keep going to school and one of my priorities was to improve my English. It wasn’t until community college when I took my science courses. – Leon
My brother is a year older than me and he went to a community college and I followed him. - Dan

Among STEM four-year university graduates, women, low-income, and underrepresented minorities are more likely to have attended a community college (Malcom, 2010). This can be related to the participants’ need to acquire more objectified and embodied forms of cultural capital before transferring to larger and less familiar four-year higher education institutions (Bourdieu, 1986).

3. Perspectives Held by Participants Code

Based on research by Bogdan and Biklen (2007), “This family includes codes oriented toward ways of thinking toward particular aspects of setting” (p. 175). This code was used to categorize participants’ descriptions when asked about their experience enrolling and attending community colleges. All 14 participants attended community colleges within a few blocks or a few miles of their homes. So, participants were able to pursue higher education without having to leave their familiar geographical surroundings. In response to questions about the enrollment process and other observations of the community college experience, two subthemes emerged. The first subtheme was related to the admissions process and the second to student interaction with community college professors.

Open access is one of the main charters of the community colleges system (Douglass & Greenspan, 2002). The first subtheme was based on participants’ descriptions of the admissions process. Participants were extremely pleased with the ease and speed of the admissions process at California community colleges.
The process was relatively quick. I didn’t have to wait for a long time. Basically, I just walked in there into the admissions office. - Kevin

My father and I went down and we waited in line, filled up the papers, turned them in and went, at the time the college wasn’t even automated. Now, to enroll in the college, people fill out an online application. – Sally

Involvement can be evident in academic forms like honor programs and non-academic forms like student-faculty involvement (Astin, 1984). The second subtheme was based on participants’ descriptions of their interaction with community college professors. Participants were satisfied with the personal touch and attentiveness they received from community college instructors.

Compared to university professors, community college professors were very approachable and they were more available and I could talk to them and they were more one-on-one help. – Camellia

My experience at the community college was definitely positive because I got to build relationships with my teacher. - Sally

I loved community college. I liked the teachers. They pushed us even harder because they were like, “when you transfer we want them to know that wow, you could have been here but you were smart enough not to, you know, just economically.” - Ladonna

I knew more of my community college professors I do at the four-year university. - Cassandra

If we had problems at the community college, we could go to our professors during class or after class. The professors were always willing to help us. - Kevin

Most participants expressed gratitude to their community college instructors, which supports previous research associating students’ interactions with instructors outside classrooms with higher persistence and success rates (Hernandez & Lopez, 2004). According to another qualitative study, women of color in STEM fields found positive
values in their interactions with their community college instructors (Reyes, 2011). The positive impact of instructors on the participants confirms the findings by Rendon et al. (2000) related to the “transformative shifts in governance, curriculum development, and in- and out-of-class teaching and learning” and their positive impact on persistence and success (p. 152).

4. Participants’ Ways of Thinking about the Others Code

According to Bogdan and Biklen (2007), “This family of codes gets at the subjects’ understanding of each other, of outsiders, and of the objects that make up their world” (p. 175). All participants in the study were content with their choice of community college as pathway into four-year engineering programs. When asked about their personal strengths, two subthemes emerged based on statements from the participants. The first subtheme related to the way participants viewed and understood coursework in math, science, and engineering. The second related to the way they viewed and understood themselves as members of underrepresented groups within the engineering community.

Analytical mental talent refers to a person’s ability to “dissect a problem and analyze its parts” (Renzulli, 2003, p. 89). The first subtheme was based on participants’ description of participants’ perspective on math, science, and engineering. Instead of viewing math and science as complicated and hard to understand, many participants viewed their academic work as challenging yet interesting, as described in the following statements:
My engineering study habit were basically, breaking things down into pieces. Big picture, start breaking it down, once you break it all down and say, “This is what I got. This is what I’m missing, here’s the best equation that fits that.” Once you figure that thinking, things start clicking. – Juan

Engineers love puzzles. – Anita

I looked at the sciences as challenging. I wanted something that could challenge me. - Kevin

Participants viewed demanding engineering classwork as consisting of surmountable obstacles that could be overcome with vigilant analysis and persistence. The participants shared the perspective they were in control of the outcome based on the quality and quantity of work they produced. This view of self is described as an internal locus of control, which is “a strong belief that he/she can control his/her own destiny is likely to...be more alert to those aspects of the environment which provide useful information” (Rotter, 1966, p. 25). Participants were keen on understanding their surrounding environment and utilizing observed data to find alternatives.

Having only one, two, or maybe three minority students in science classes or science majors is the norm (Walters, 1997). The second subtheme was based on participants’ descriptions of how they viewed and understood themselves as members of underrepresented groups within the engineering community at school. According to Van Gennep (1960), the rites of passage model presents a three-stage process of separation, transition, and incorporation. The community college provided participants with the rites of passage into the world of engineering at four-year universities. At the community college, the participants were able to experience separation from their old ways and
transition into the world of basic engineering in preparation for the engineering world at four-year universities.

I really didn’t talk to anybody at first. But once I started taking the calculus, the physics that’s when I made a lot of friends. – Janis

In the beginning, I wasn’t quite familiar yet with things. I didn’t have any of that help at home because I was completely on my own because my parents they were there mostly emotionally, but they cannot really give me advice. So, I asked others. - Ladonna

As a female and a minority, I felt everybody was welcoming. I was comfortable with all these guys. - Janis

Going into engineering and noticing that I was the only girl, I actually felt special. I felt like I am smarter than I thought. - Camellia

When I joined the Society of Women Engineers (SWE), I met a lot of people through the professional chapter here. I have noticed that networking is amazing. Last year, I got the opportunity to do hands-on projects and meet working engineer. – Camellia

I think I got used to being the only girl in engineering classes. Then, I started noticing that I’m the only Hispanic too in the room sometimes, like there aren’t many Hispanics either so – but I just got used to it, and I feel like maybe some professor – like the older professors maybe - but I think they get past it once they realize that I’m not dumb. – Ladonna

The participants in this study were aware of their uniqueness as outsiders to the engineering environment. Nonetheless, they did not allow that uniqueness to hinder their progress due to their belief others would eventually evaluate them based on their academic skills and not their gender or ethnic background. The findings of this study confirmed the findings of the study by Cruz (2010), which concluded minority individuals felt STEM environments were concerned with effort and outcomes rather
than ethnicities. For this subtheme, the STEM environment at community colleges offered an anti-deficit achievement environment in helping underrepresented minority students focus on classwork rather than deal with inequities (Harper, 2010).

5. Process Code

According to Bogdan and Biklen (2007), “Process codes are words and phrases that facilitate categorizing sequences of events, changes over time, or passages from one type or kind of status to another” (p. 176). This code was used to categorize the succession of events and experiences from the participants’ descriptions regarding the impact community colleges had on their academic preparedness for engineering schools at four-year universities. In response to the question about factors that helped in their successful transfer journey from a community college, all participants felt without their community college experience they would not have been able to complete the journey to a four-year engineering program. Moreover, three subthemes emerged based on responses from participants. The three subthemes related to academic rigor at community colleges, advantages of attending community colleges, and some of the disadvantages of attending community colleges as perceived by the participants.

Hayward, Jones, McGuiness, Timar, and Shulock (2004) found within the California Community College system there were variable levels of academic rigor. On the other hand, the 14 participants in this study, who attended 17 different community college campuses, felt the rigor of courses at community colleges rivaled that at four-year universities. The first subtheme was related to coursework and at community colleges.
I was expecting community college to be a better experience than high school, which it was. I was also expecting it to be easy, but it wasn’t. – Ladonna

I assumed and a lot of people assume that community college will be easier but that is not the case. My professors at the community college said that one of the reasons why they make classes more difficult was that they want to prepare us for a four-year university. My community college helped prepare me because it was surprisingly more difficult but the same time they were a lot smaller classrooms. – Camellia

At the high school not much studying was really needed to maintain good grades. Community college was a little different. Once you got into the math and the sciences, definitely you have to study. - Dan

Community college definitely prepared me for engineering school at a four-year university I mean the teachers were amazing and they pushed me. - Stan

The community college standards are very similar to what is expected here at the four-year university in terms of things like writing a technical lab report, meeting deadlines, midterm, finals and in terms of those things upper division classes were such a huge help in the transition to a four-year school, if I had gone straight from high school to here again I don’t know that I would have continued because I don’t think I would have been on that level I think community college put me on that level. - Savanna

Some previous research not specific to engineering-related courses concluded community colleges do not adequately prepare students for transfer to four-year universities (Graham & Hughes, 1994; Kinnick & Kempner, 1988). However, the views of all participants were unanimous in confirming the rigor of community college courses.

The second subtheme was related to perceived advantages of attending community colleges prior to entering engineering schools at four-year universities. Based on participants’ descriptions, four subcategories emerged within this subtheme. These subcategories were transfer time, student services and support, engineering activities, and perception of future employers. Participants listed the well-known
advantages of community colleges like accessibility, location, and cost. All participants mentioned proximity to home as a primary reason for considering higher education through the California public community college system.

I was home-schooled all my life. I had never been in a classroom before I went to community college. I never had a teacher before, so it was a big deal for me just walk in to a classroom and me be like oh my gosh that’s my teacher, this is a school. – Sally

The pros at community college are I could stay at home. I went to community college because of money. Universities are lot more expensive than community college. – Dan

One of the advantages of community college I would say it’s going to save me lots of money. - Adam

Research by Deil-Amen et al. (2005) concluded community colleges offer affordable higher education alternatives to minority students, confirmed by the participants of this study. For the participants of this study, location was not just associated with cost. Location was associated with staying at home and helping parents and siblings with expenses, homework, paying bills, or interacting with the outside world, since some parents could not communicate well in English.

Location, especially living with my parents and help them out with the bills too, that’s another thing, the responsibility of helping them out with bills and stuff. – Leon

It's just a lot harder when a lot of people require your attention as well, like when I'm at home, like my brother and sisters, parents. It's just running errands, because I'm the second out of four kids so my older sister she moved out, so then I became like the oldest so then every question she had like she would ask me like “Oh I heard about this, can you do the research on this?” Or “Help your brother like-like” – “Oh can you help me fill out the forms?” Like I've been filling out my school forms for like – when I was little, and being like the
translator at the hospitals, you know like I would always like very independent, I think very mature since the younger age. – Ladonna

There was some real instability in my household and that made me feel responsible to stay. I didn’t know what I was doing, but I didn’t want to leave my mom alone - Cassandra

Moreover, participants described community colleges as higher-education institutions that provide high-quality engineering education, offer small class sizes, and teach new skills beyond curriculum like teamwork.

**Quality Engineering Education**

In high school, I had not been prepared on how to study, how to read, how to write, read the textbook, what you need, how to take notes, how to write a term paper, nothing like that. Community college was an excessive way to gain that skill set on how to be a student, a real student. - Cassandra

I think, overall, I think I preferred the teachers over there. I don’t know, but I felt like maybe they were better than four-year university instructors. I don’t know why. – Ladonna

My community college professors knew us engineering students by name. We could ask them anything. – Kevin

**Small Class Size**

The advantage of community colleges is that it offers a small class size, a more intimate of class setting where the professors kind of have almost like a one-on-one interaction with every student. At community colleges students can get more help, whereas at universities, the professor might be busy with the doctoral students, graduate students and more on the graduate students. - Kevin

So I feel like I had a huge advantage in being in smaller classes for physics and for organic chemistry that is a huge advantage over the rest of the four-year students here who had to take those classes with 500 people, boy, what a valuable thing. The other valuable thing is I got to kind of dabble in other fields like welding and auto repair, which allowed me to figure out I didn’t want a career in that but I think they are good valuable things for industry. – Savanna
Teach New Skills

The community college helped me build myself from scratch and become a well-rounded individual. - Juan

Organization, ability to multitask, and time management those are all skills I really strengthened and sharpened and developed at the Community College. - Savanna

I think if I would’ve gone straight into a university, I probably would have failed. - Juan

At the community college, I got to be a tutor. I tutored high school students I was a writing tutor, I was a math tutor. Then, I did chemistry tutoring and then became a TA. - Sally

What helped me transfer are self-confidence and social IQ which gave me the feeling that I can do this and I can work with people and get everybody to contribute. – Cassandra

Everyone just feels so negative about community colleges. But, now I'm proud to say I came from a community college. - Ladonna

Once I started my first semester at the community college, I really felt like I actually was learning or keeping the knowledge of the subjects because when I was in high school I felt like everything I learned was gone. - Janis

A study by Tsapogas (2004) concluding community colleges offer low cost, flexibility, locality, and open-access policies for diverse populations was also confirmed by the responses from participants in this study. Moreover, based on research by Lewis and Middleton (2003), the transfer bridge offers access to four-year universities for those who would not be admitted based on high school grades. Thus, community colleges appear to serve as anti-deficit achievement agents for underrepresented minority students (Harper, 2010). Also, based on Bourdieu’s (1986) framework, community colleges
appear to provide underrepresented minority students objectified and embodied forms of
cultural capital helpful for a successful transfer journey.

The third subtheme related to perceived disadvantages of attending community
college from the perspective of the participants, members of underrepresented groups in
engineering. Based on participants’ responses, four subcategories emerged within this
subtheme. These subcategories are transfer time, student services and support,
engineering activities, and perception of future employers.

Transfer Time

I think that maybe the bad side of community college, I would say, maybe I didn’t
really see the end quite so clearly until I actually transferred. Because I was like,
“Oh I have time, like it’s going to take a while.” – Ladonna

I was at the community college for a long time, way longer than I should have
been. - Dan

One of the disadvantages of going to a community college is that I think it takes
longer for people to finish school. I spent four years in the community college. I
was discouraged at the end. - Leon

According to Turner et al. (2002) minority students are overrepresented in
remedial or developmental courses, which could part of the reason why the participants
spent more time in community college. Clark (1960) acknowledged some of the good
services community colleges provide, but also explained community colleges can be
“cool out” institutions that take low-income students out of the higher-education pipeline.
Also, according to Pascarella and Terenzini (1991), “the public two-year college system
is a form of tracking in which predominantly working- and lower-middle-class, first-
generation, and minority students are led away from the path to a bachelor’s degree” (p.
Some participants felt they ended up spending more time than they wanted to at the community college. Fortunately, that disadvantage of the community college system did not affect any of the participants to the point they ended up dropping out of college.

**Student Services and Support**

I don't know if community college counselors don't know or they don't care. - *Dan*

There weren’t any coaching or mentoring at the community college. - *Juan*

The descriptions of lack of academic advising confirmed previous research concluding community colleges did not provide students with adequate student services in the form of academic advising.

California community colleges’ students increasingly enter the system with little in their personal experiences that equips them to succeed in college without proactive and continual guidance. Yet students are allowed to make their own choices largely without guidance. (Shulock & Moore, 2007, p. 13)

**Engineering Activities**

There weren’t a lot of engineering activities or event or clubs at the community college compared to a four-year university. - *Cassandra*

Ways to improve community college is to have more engineering societies and clubs. I was less attached to my community college than my four-year college because I know community college was just a temporary stop in my way to a four-year university. – *Adam*

The one disadvantage I could think of is about community college is like the research opportunities aren't there as much. - *Stan*

One of the disadvantages of community colleges is that they don’t have so many clubs and societies and they don’t have much funding as the university does. – *Kevin*
Improving ties between the community college and industry and or research tied in with the community college system so have more guest lecturers, have more professional development and also just push career fairs, and even things outside of the community college campus you know, let them know about local career fair events and things like that. So that way the students are constantly engaged. – Stan

The participants’ complaints about the lack of engineering-related events and activities reflects a valid disadvantage within the community college system whose negative impact on students has been documented by previous research by Tinto (1987), who suggested students’ retention and success rates were related to their involvement in campus activities. The lack of engineering-related activities could impact students’ transfer journey negatively and increase their deficit with regard to objectified and embodied forms of cultural capital (Bourdieu, 1986).

**Perception by Future Employers**

If you're going to go for a certain job they want to see that you actually just went to like one school or because they want to only hire like people who went to like MIT or Berkeley. - Carlita

This disadvantage perceived by one of the participants might not be a major disadvantage, based on the research of Walker (2005), “Community colleges have a rich history of responsiveness to their communities. Meeting the growing demands by students and employers for a higher level of workforce-related knowledge and skill is a logical next step for community colleges.” (p. 101).

**6. Activity Code**

According to Bogdan and Biklen (2007), “Codes that are directed at regularly occurring kinds of behavior are what we call activity codes” (p. 176). This code was
used to categorize the participants’ descriptions based on their study habits and approaches to understanding math, science, and engineering concepts. Based on participants’ responses to the question about study habits, two subthemes were constructed. The first subtheme was learning new pedagogies of individual study habits and the second subtheme related to group studies. Most participants described their individual study routines as daily and gradual in order to understand the principles of differential equations, thermodynamics, electromagnetism, fluid mechanics, circuit analysis, and other engineering-related concepts. Most participants deliberately avoided “cramming” before exams as they believed it only worked for general education courses but not science or engineering courses, where concepts and chapters build on one another.

I study day by day. I put everything that I need to do on my planner and then I will make a to-do list and I always make sure to put little check boxes next to it because it is really satisfying to be able to check them off. - Camellia

When I get the syllabus at the beginning I kind of plan it by that depending on what kind of assignments I am going to be getting. I know one of my professor gives a weekly quiz, so I give myself a couple of days before that to finish the problem sets so that I can just review before the quiz and not have to stress about learning the material before the quiz. – Dan

I read the chapter before I go in to the class and then when the teacher explains it I’m acquiesced with the knowledge and it helps to stick. I’ve also taken advantage of all the open course, MIT’s open coursework is amazing. Khan Academy, really got me through differential equations, the internet is a fantastic resource for things like you know, having access to MIT’s physics lectures, I mean that’s what is so valuable. – Savanna

I read that textbook front and back like I actually read every single chapter and you know it’s just that rigorous dedication and this wanting to understand everything not to see like why or how it works the way that it does. - Stan
I studied all the time. I studied a lot. I did my homework on time. I turned in projects on time. I turned in homework on time. I never studied the night before. I always got good sleep. - Kevin

Rotter (1966) explained individuals with an internal locus of control possess intrinsic confidence that they are able to “control their own destiny” (p. 25). Having an internal locus of control as a personal quality helped participants gain objectified, embodied, and institutionalized forms of cultural capital in order to transfer to a four-year university (Bourdieu, 1986).

The second subtheme was learning the new pedagogies of group-based approaches to studying math, science, and engineering. All participants described study groups as a vital strategy for success. Participants mentioned study groups as a necessity, not an option. Participants viewed study groups as academic and moral support groups.

I start studying a week before exams by myself and then when there is maybe 4 days left or 3, I will join the study group. - Anita

Around exam time, after studying alone, three or less of us get together and sit at the table and if any of us had a question we feel like oh, how did you do this one? – Carlita

I think as an engineer I need help from somebody else. That’s why I prefer small study groups. – Leon

My study partners would motivate me when there were times I don’t want to study. They will be Oh! Come on let’s go and study and we would go and be there at friends house or Starbucks and we would do work on home, so I think that I had pretty good study habit at the community college. – Janis

In classrooms, I usually sit upfront and talk to the people because they are usually the ones that are there to learn and it’s worked great so far. These are the one who actually want to get in study groups and it has been working for me. - Dan
Studying with my classmates was fun because I liked math and physics and I also found similar friends and we became quite close working on solving problems. - Adam

The descriptions by the participants regarding the importance of study groups were in alignment with research showing peer support improved success and persistence rates (Granger, 2011; Larose, Robertson, Roy, & Legault, 1998). For this subtheme, group interactions appear to provide anti-deficit achievement services (Harper, 2010). Also, based on Bourdieu’s (1986) framework, community colleges appear to provide underrepresented minority students objectified and embodied forms of cultural capital helpful in their successful transfer journeys.

7. Event Code

According to Bogdan and Biklen (2007), “These kinds of codes are directed at units of data that are related to specific activities that occur in the setting or the lives of subjects you are interviewing” (p. 177). This code was used to categorize non-frequent actions or events, including the participants’ descriptions of infrequent activities that impacted their progress towards achieving their goals and transferring to four-year universities. In response to the questions about exposure to engineering and seeking information about engineering studies, the participants’ responses generated two subthemes. The first subtheme was the lack of good counseling at high schools that offer students alternatives to study engineering based on their capabilities and circumstances.

During high school, I can remember sitting around in the counseling office in a group and doing something more about filling out applications for jobs at places like Burger King. – Cassandra
I didn’t really talk to counselors at high school. I followed my brother to a community college. – *Dan*

In high school, counselors talked about community colleges but actually pushed four-year universities. – *Stan*

I went to my high school counselor and I mentioned to her I wanted to be an engineer and I told her that I heard someone say, they mentioned Cal Poly San Luis Obispo and then she was like, “Oh, but I don’t think you'll probably get in.” And she was like, “You should just go to community college.” - *Ladonna*

According to Solórzano, Villalpando, and Oseguera (2005), minority students were not prepared for college due to focus by high school counselors on vocational tracking, which leads to deficit thinking about minorities (Valencia, 1997). Also, the lack of college-centered high school academic advising can deprive minority students of all forms of cultural capital to get them prepared for college (Bourdieu, 1986). Tatum (2001) concluded a weak transfer-centric culture at community college leads to low transfer rates. The second subtheme was the lack of good formal counseling at community colleges as stated in the following excerpts from participants:

At the community college, there is no value in spending even 5 minutes with the counselor. - *Camellia*

Counselors at community college were having me take classes I didn’t need, classes that overlapped. That didn’t make sense. I think community college education is solid, I think their counseling needs a lot of work especially when it comes to transfer to engineering school. - *Dan*

Community college counselors’ expertise was very limited when it comes to course sequence and engineering requirements. - *Sally*

Counselors at my community college don’t know that much especially about engineering. –*Leon*
There’s not a big relationship with counselors in the community college – like it is the case at four-year universities -- because there’s a lot of people and they see a lot of people every day in all different majors. At the community college, to get information about engineering, I viewed websites, asked my peers, and also talked to professors. – Anita

I think the biggest benefit would be to get some kind of specialist in there who, who’s specializes in STEM field like I said the counseling was pretty much non-existent they didn’t really understand the expectations of a university and they weren’t really realistic that to get your pre-reqs done it really does take three to four years, their attitude was more, well you’ve been here for too long, you need move on, they just, they have got no empathy for STEM majors whereas here at the college of engineering they have people who specialize in the field and they understand our concerns and struggles and they can cater to that more so I think the biggest benefit would be to bring somebody in who specializes in STEM field and can help with course progression in terms of pre-reqs, things to expect what you should take before you get to a four-year university and what not really that big of a deal because there was really no one telling us that at least. - Savanna

According to Solórzano et al. (2005), the lack of proper academic advising is one of the main reasons for failure to transfer. The absence of adequate academic advising can shift the focus to attrition variables (Bean, 1980) and deficit models (Valencia, 1997) rather than focus on the anti-deficit achievement model (Harper, 2010). Also, the lack of academic advising can deprive minority students of possible objectified, embodied, and institutionalized forms of cultural capital that can increase the success and transfer rates for future students (Bourdieu, 1986).

8. Strategy Codes

According to Bogdan and Biklen (2007), “Strategies refer to tactics, methods, techniques, maneuvers, ploys, and other conscious ways people accomplish various things” (p. 177). This code was used to categorize strategies and plans used by participants to achieve their transfer goals from a community college to a four-year
university. When participants were asked to describe work strategies, tactics, and personal strengths that helped them achieve their transfer goals, they mentioned their willingness to learn new skills. Participants mentioned basic tactics like time management, multitasking, and perseverance. Also, they mentioned higher-level tactics involving networking, teamwork, and feeling empowered.

Organization, ability to multitask, and time management. - Savanna

Perseverance, not giving up, not giving up on tasks, always trying to find solutions to tasks, always in for a challenge. I always had a competitive nature and that helped me throughout my study of engineering. – Kevin

A sense of empowerment and responsibility. - Camellia

Meeting new people that you can actually work with especially because of engineering is a lot of group work, a lot of dependency on study groups. – Janis

Hagedorn et al. (2008) concluded many factors like personal tactics, strategies, resources, and institutional factors like student services impact the transfer journey from community college to a four-year university. According to Laanan (2004), transfer student capital is the process to gain the assets of familiarity with the new environment and the proficiency needed for successful transition from community colleges to four-year universities. Shain (2002) concluded having self-confidence and a future vision helped participants implement tactical and strategic goals. Therefore, transfer student capital can be related to Harper’s (2010) anti-deficit achievement services and Bourdieu’s (1986) objectified, embodied, and institutionalized forms of cultural capital that can help minority students complete the transfer journey successfully.
9. Relationship and Social Structure Code

According to Bogdan and Biklen (2007), “Regular patterns of behavior among people not officially defined by organizational charts are what we group under relationships” (p. 177). This code was used to categorize descriptions by participants regarding frequent models of behavior to create professional networks in order to gain social and cultural capital. Based on participants’ responses to the question regarding factors that helped them get closer to their end goal of graduating with an engineering degree from a four-year university, three subthemes emerged in the form of campus societies, internships, and field trips. The subthemes overlapped for some participants who had been involved in more than one pattern of behavior.

The first subtheme related to the positive experience participants had as a result of joining different campus societies and clubs.

I take different things from the organizations here at a four-year university than I did at the Community College. The Community College it was more about friendship and network of you know people to study with and resources whereas here it’s more valuable career information, things like résumé workshop, people speaking from companies like Northrop Grumman, so I take different things from here, but both were valuable in their own respect. – Savanna

I wouldn’t have gotten that job if I hadn’t participated in Society of Women Engineers and the Society of Hispanic Professional Engineers. – Cassandra

I am a member of (SWE) The Society of Women Engineers and then (AIChE) American Institute Of Chemical Engineers. – Savanna

During university days, I was part of SHPE is the Society of Hispanic Professional Engineers. – Juan

I am part of the National Society of Black Engineers (NSBE) and that help me build a good network. – Stan
At my four-year university, I joined the National Society for Black Engineers (NSBE). – Adam

The second subtheme related to the positive impact internships had on participants’ understanding of the work demands and expectations within the engineering industry.

The internships are really important. I had two internships since I transferred. One with a manufacturer and one with an electric power distribution company. One of them extended an offer of employment after graduation. - Ladonna

I’ve got to say that my community college internship gave me so much confidence. – Savanna

I had an internship at the Department for Water Resources which was had an office on campus. Having a job in campus made a huge difference in focusing on my schoolwork. – Camellia

I had an internship down in Southern California with a mechanical contractor and they do HVAC and plumbing of newly constructed buildings, and they do huge, huge projects. New hospitals, new federal buildings, and defense. That was an eye-opener on what mechanical engineers can do. - Stan

I had two internships with electrical engineering firms and they reinforced my motivation to work hard in school and graduate. Through my internships, I interacted with engineers. I saw the way they lived their daily lives. I saw the work they did. I saw how they interacted with one another. They also gave me some tips. They also gave me some strategies. So, looking at their life, looking at what they are doing right now, I was motivated because they were basically my role models because I could see them, I could talk to them about anything that was bothering me, any advice I needed. They motivated me to continue on with my education. – Kevin

The third subtheme related to the positive impact field trips to engineering entities had on participants’ understanding of the value of engineering to society and connecting classroom theories to applied engineering.
A field trip to the electric power plant with the Math, Engineering, Science, Achievement club (MESA) at my community college got me more interested in electrical engineering. – Carlita

A trip to the human resources office of an engineering company also got me more interested in electrical engineering. – Carlita

The Society of Women engineers I belong to did a field trip to the water treatment plant. – Camellia

We had a field trip to a power substation and that really reinforced my motivation because I saw how the power substation looked. There were so many components in it and it was just an awesome design. – Kevin

According to Wai et al. (2010), mental inspiration beyond normal coursework can lead students to aim higher and accomplish more. The concept of “educational dose” was defined as “the density of advanced and enriching pre-collegiate learning opportunities beyond the norm which students have participated in” (p. 861). Moreover, according to Astin (1984), involvement is “the amount of physical and psychological energy that the student devotes to the academic experience” (p. 297). Therefore, involvement can impact student ability to gain the necessary objectified and embodied forms of cultural capital as explained by Bourdieu (1986). Moreover, lack of involvement could also deprive students from acquiring navigational capital, which includes dealing with and adapting to systems implemented by and for non-minorities (Solórzano & Villalpando, 1998), and also linguistic capital, which includes mental and communal skills gained through the use of unique vernaculars, styles, and languages (Orellana et al., 2003).
10. Narrative Code

According to Bogdan and Biklen (2007), “Narrative codes describe the structure of talk itself. When informants tell you their stories, they offer an account of their lives framed in a particular way” (p. 178). This code was used to categorize the particular ways participants disclosed their life experiences using words and tones to share their feelings about their dreams and visions about engineering. In response to the question about the driving forces behind the participants’ current and future academic and career goals, the participants expressed a view of engineering as their ticket to improve their lives and the lives of others. Four subthemes emerged from the participants’ descriptions. The subthemes overlapped for some participants, who expressed more than one driving force behind their goals.

The first subtheme related to the participants’ self-motivation and intrinsic drive to succeed.

Engineering is about creating things. That’s the beauty about Engineering. You dream it. You put it on paper. The fire under the engine is I want to be a professional. – Juan

I feel that if you want to be competitive in this current economy especially for a minority, you need to even go beyond an undergraduate degree. - Adam

Engineering is at the forefront of technology. Engineering is responsible for most of the technology we have right now. So, as an engineer, I feel proud of being one of the designers, being one of those who could provide solutions to problems, to everyday problems and to make people live comfortably, better the lives of people, better the lives of children, better the lives of families through technology. I really wanted to be part of something big. I love solving problems, finding solutions and answers to difficult questions. – Kevin
The second subtheme related to the participants’ desire to be role models and allow others in society to dream and achieve.

I'm the firstborn of the family and I have younger brothers and a younger sister and I wanted to make it so they also will follow that example and do very well too. I want to prove to them that if I could do it, they could do it. – Kevin

I kind of want to become an engineer to change what problems we have now to influence people to become better. - Carlita

I want to be able to like leave my mark on society and have something that withstands in test times. I would say that I was part of creating and that's just a very rewarding experience that I have kind of been able to skim the surface on so far. – Stan

The third subtheme related to the participants’ being trailblazers as the first engineers or even college graduates in the family and making the family proud.

My parents, they didn’t graduate from college. So I’ll be their first one I want to be a good role model for others in my family. – Anita

It was not a priority for my family to go to school. But I wanted to do something else. I don’t want to be just like the regular people. I wanted to finish school and also like, prove to my family that I was able to make them proud. – Leon

I wanted to be the first in my family to graduate from college. – Juan

The fourth subtheme related to the participants’ desire to improve their own living standards and the living standards of their loved ones.

The driving force behind academic and career plans is seeking financial independence. – Cassandra

I work in the warehouse and I don’t want to be pretty much aligning boxes forever. I have seen people that were there too some of them left school and they got stuck in the warehouse forever. – Leon

I guess number one would be my daughter and my husband. My daughter is four now and she is in private school which is very expensive and with a bad experience that I had with public education I’d like to give her the best
educational opportunities that I can possibly provide. Buying a house, a nice house, that’s definitely a huge drive. Yeah just the needs and what does my family not just meet the basic needs to my family, but to be able to go on things like vacation and you know, have extra money in the bank it’s important to break down in stuff. – Savanna

Ryan and Deci (2000) concluded, “choice, recognition of feelings, and opportunities for self-direction were found to enhance intrinsic motivation because they allow people a greater feeling of autonomy” (p. 70). In a qualitative study conducted by Robinson (2012) on successful Latina students in engineering, success factors were found to be related to family expectations, seeking social justice, challenging doubters, and a desire to become role models in their communities.

11. Methods Code

According to Bogdan and Biklen (2007), “This coding family isolates material pertinent to research procedures, problems, joys, dilemmas, and the like” (p. 179). This code was used to categorize procedures and methods related to problems and solutions through participants’ descriptions of how they managed problems and created alternatives for issues beyond academic obligations throughout their transfer journey. In response to the questions regarding familial, social, religious, and work commitments outside engineering, the participants all agreed as engineering students they had to minimize all other commitments and obligations outside engineering studies. Some participants even pointed out this was not the case for all college students and it was just the norm for engineering students.
I have sacrificed social life pretty much. I do not go out with my friends anymore because I do not have the time for it. I want to finish my homework and stuff. - Leon

College and Engineering became my life so I really gave up a lot. - Juan

I voluntarily was sacrificing the time that I was supposed to spend with family and friends. I was studying or working because those responsibilities just came on as a part of growing up. – Kevin

Commitments to family and friend and time management are a challenge. I tell people this all the time. I have two jobs, and have classes on campus and then a girlfriend that was 100 miles away that I need to visit, and family that doesn’t live in the area. It was the biggest challenge for me because every day you constantly have the new, unexpected event or something that you need to address that now it needs to be taken into consideration in terms of your planning out of your time. - Stan

I have schedule, like in my computer, and I fill it out with whatever homework and projects that I have to do and it has my class schedule already and also the times that I go to a gym or in the weekends, the times that to go to church or do laundry or clean or whatever. It has everything in there. – Anita

I usually write things down, and then I usually input them into my iPhone. I put things into my iPhone along the lines of on my calendar, on my iPhone I put like my class times obviously that’s beneficial at the beginning of the semester, but I always put my teacher’s office hours like lifted in my weekly schedule like that way I can always just quick look. – Stan

The responses by participants confirmed the findings of a research study conducted by Nicholls, Wolfe, Besterfield-Sacre, Shuman, and Larpkiattaworn (2007) concluding STEM students spend more time on homework and on studying than non-STEM students. Therefore, it was necessary for the participants to sacrifice time with family and learn personal management skills.

12. Transformation Agent Code
This code was created by the researcher and focuses on human influence agents who positively impacted access and success rates of minority students. This code was used to understand the interactions between participants and community college instructors and their impact on converting the outlook and actions of participants. In response to the question about how the community college helped shape participants’ academic and career goals, all participants mentioned their community college instructors had a major positive impact on their choice or retention.

My physics instructor at the community college noticed that there weren’t a lot of girls in his physics class, so he was very encouraging and he helped me get a scholarship. – Camellia

My math professor at the community college was very enthusiastic about engineering and would answer any of my questions. – Carlita

My physics instructor at the community college, he was very encouraging because he deals with a lot of engineering students so he knows a lot of kind of like the routine. If I had questions I could talk to him. But as far as the school helping me figure out what I want to do or leading me to engineering now, I really couldn’t say that I would attribute that to the college. - Sally

My community college professors knew my name, they knew my daughter’s name, they knew I was married, they knew I have another job, so they, I mean they knew me. I knew my professors and they know me now. At the four-year university, I wouldn’t say that professors are unfriendly or unreachable, but it’s just a lot harder when they got 120 people who want their attention as well. - Savanna

At my community college, you can easily see that the professors are totally there to help you understand material and make sure that you’re successful in the class, and they even have like additional office hours. – Stan

Most of the professors knew us engineering students who want to go to four-year universities so it’s like that they were preparing us. So they try to like make us understand the basic stuff so when we transfer, we would actually have a better understanding of engineering concepts. - Adam
My community college professors knew us engineering students by name. We could ask them anything. If we had problems, we could go to our professors during class or after class. The professors were always willing to help us. Resources like computers and information and all that stuff were easily accessible. I also joined the Math Engineering, Science Achievement (MESA) club at the community college. – Kevin

The help and counseling provided by community college professors is an example of the college stage anti-deficit achievement efforts during the college stage (Harper, 2010). Also, since counseling was an informal service provided by instructors acting beyond their formal job description and serving as mentors and inspirational figures encouraging students to face the challenges of engineering and to gain the skills to transfer to four-year universities, it might additionally fall under the different forms of Bourdieu’s (1986) cultural capital which is vital to complete the transfer process. Based on participants’ descriptions, community college professors played multiple roles when dealing with engineering students by also explaining the expectations of engineering and highlighting the long-term rewards.

13. Aspiration Code

This coding family was created by the researcher and focused on future plans and desires to further education and develop careers. This code was used to categorize participants’ descriptions of future academic or career plans. All the participants in the study strongly believed without the community college system they would not be where they are at this point in their lives. Based on the following excerpt, even the two participants who were successful engineers working in the technology industry for over
15 years still considered their community college experience crucial and pivotal to their success.

The community college helped me build myself from scratch and become a well-rounded individual. I think if I would’ve gone straight into a university, I probably would have failed. - Juan

Based on participants’ responses when asked how the community college experience helped shape their academic and career goals and aspirations, all participants were appreciative of the community college system and the non-financial capital they earned there as students. Based on participants’ responses, four subthemes emerged within the academic and career aspiration code. The first subtheme related to working as engineers, the second to pursuing graduate degrees, the third to entrepreneurial ambitions, and the fourth to volunteering as coaches and mentors.

The first subtheme related to aspirations to work as engineers.

I want to be a designer. I want to be doing actual engineering. – Stan

When I was intern, I met engineers who love their job. So for me, I think it is more like what I don’t want to be. I don’t want to wake up in the morning and go like, Darn it! I have to go to work, I hate my job. That’s why I want to be an engineer. – Sally

After graduating, I think I just want to work … and maybe do workshops or mentoring students. – Carlita

In the future, I see myself leading in some engineering aspects so that’s my current goal. - Adam

For the next 10 years I would like to work as an engineer. - Ladonna
A few weeks after Ladonna was interviewed for this study, she earned her bachelor’s degree in engineering and received an offer to work for one of the largest electrical utility power companies in Northern California.

The second subtheme related to aspiration to acquire graduate degrees to further their knowledge of engineering and improve their career options.

In the future, I’d like to go to graduate school – Savanna

I don’t think I want to be in school forever. But yeah, master’s definitely. – Anita

I am thinking about a master’s. But now probably my goal right now is to finish my bachelor’s and then try to get a job. - Leon

I came this far, why stop so maybe I will go for a master’s degree. - Janis

I would like to get a professional engineering certificate (P.E.C) and later get my master’s in electrical power engineering. – Kevin

The third subtheme related to aspirations to become entrepreneurs as a way to improve their own living standards and provide opportunities to others.

After graduating from engineering school, I have been playing with the idea of getting a master’s in business and maybe eventually owning my own business. - Dan

I think I would like to get at least a master’s. To get a doctorate, I will decide probably in the future if I am up for it. Ultimately, I would like to really own my own business. – Camellia

The fourth subtheme related to aspirations to mentor engineering students as a way to repay their communities and help others going through the same experience.

After graduating, I think I just want to work and maybe do workshops or mentoring students. – Carlita
After working as an engineer for 15 years, I am now doing volunteer work for migrant workers at a public library and also mentoring minority engineering students. – Cassandra

After working as an engineer for 18 years, I am now part of a mentoring program for minority engineering students. – Juan

According to Yosso (2005), aspirational capital includes “resiliency to hope, dream, and achieve beyond the tangibles” (p. 22). Also, according to Wai et al. (2010), mental inspiration beyond normal coursework can lead students to aim higher and accomplish more. The desire to work as engineers is supported by economic data from NSF (2012), which found half of workers in science and engineering occupations earned $73,290 or more in 2010 compared to the median earnings ($33,840) of the overall U.S. workforce. Based on the participants’ responses, it appears most participants have already gained the necessary cultural capital to understand the big societal picture of being part of a community. Some participants have already decided they want to go beyond just working as an engineer and plan on starting their own companies or mentoring or coaching others. Table 17 shows the different academic and career aspirations for the participants in this study. All participants saw working as engineers as the immediate career goal. Some were already eyeing graduate degrees in engineering or business, and other participants expressed interest in entrepreneurship and owning their own business, and others wanted to get into community service through coaching and mentoring other minority members.
Table 17

*Academic and Career Aspirations*

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<td>Work as an Engineer</td>
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Summary and Conclusion

The purpose of this study was to understand the experiences of 14 participants who are part of underrepresented minority groups in engineering. The study included semi-structured interviews with three White women, three African American men, three Latinos, and five Latinas who were able to successfully transfer from a community college to a four-year university. The purpose of Chapter 4 was to present the findings of this phenomenological qualitative study. Qualitative data were collected from the 14 participants. The purpose of the study was to understand the impact of the participants’ community college experience on their success in transferring to four-year universities and on their long-term academic and career plans in engineering. The 14 participants had been community college students at 17 different community colleges in California, members of the overall community college system that includes 112 community colleges. As suggested by Merriam (1998), the transcripts of the 14 interviews were analyzed, and “recurring patterns” within the participants’ responses to the interview questions were categorized in the forms of themes and subthemes (p. 11).

The major themes that emerged from analyzing the qualitative data included distinctive similarities apparent and widespread for all participants. These major themes included: cost as the main reason for attending community college, ease of access to community college education, academic rigor at community colleges, importance of study groups for engineering students, understanding self as part of underrepresented groups within engineering communities, positive agents of transformation, and lack of
formal counseling services for engineering students at community colleges. The subthemes that emerged from the findings related to: home and high school settings, perceived disadvantages of attending community colleges, strategies to create professional networks at community colleges, and academic and career objectives beyond four-year university engineering degrees.

The findings presented in this chapter provided insights to the lived experiences of White women, Latino/as, and African American men who started their engineering education at community colleges mainly due to financial reasons yet ended up transferring to four-year universities with new earned capital beyond financial savings.

In Chapter 5, steered by the probing questions of the study, the themes and subthemes are analyzed. The findings, with emphasis on the different settings including home, high schools, community colleges, and four-year universities, are presented in the form of recommendations to improve or change current practices and impact future dispositions and policies in order to increase the number of engineers in the United States and especially engineers from underrepresented minority groups like White women, Latino/as, and African American men. Also, in Chapter 5, the researcher’s reflective commentary is presented to “record the researcher’s initial impressions of each data collection session, patterns appearing to emerge in the data collected, and theories generated” (Shenton, 2004, p. 67). As an engineer and a product of the public community college system in California, the researcher reflects on his own transfer
journey by comparing and contrasting his experience with that of the participants in this study.
Chapter 5
DISCUSSION OF FINDINGS AND RECOMMENDATIONS

Overview of the Study

Based on current graduation rates, the U.S. is expected to experience shortages in university graduates with engineering degrees (Sinkele & Mupinga, 2011). In 2009, about 4% of all bachelor's degrees awarded in the U.S. were in engineering compared to 31% in China and about 19% throughout Asia (NSF, 2012). Based on the 2012-2013 Global Competitive Index (GCI), the United States is losing its overall global competitive leadership position based on global ranking by the World Economic Forum, which had the U.S. dropping from first in 2008 to seventh in 2012 (World Economic Forum, 2012).

According to Newman (2011), there are three important reasons behind the emphasis on understanding and improving the science, technology, engineering, and mathematics (STEM) pipeline for all Americans. The first reason is related to the United States’ global competitiveness, the second to the advantages of diversity in the engineering labor force, and the third to equity for all in the land of the free.

Using semi-structured interviews, this study sought to understand the experiences of underrepresented minority individuals who were successful in transferring from community colleges to four-year institutions by asking the following research questions:

1. What helped these successful individuals choose community colleges as pathways toward engineering majors?
2. What helped these individuals complete the transfer journey from community colleges to engineering schools at four-year universities?

3. What long-term academic and career goals do these individuals have, and did their community college experience help shape their academic or career goals?

For this phenomenological qualitative study, data were collected from participants using demographic surveys and semi-structured individual interviews. The sample of participants comprised 14 underrepresented minority individuals who had attended community college prior to obtaining entry into a four-year college engineering program. Participants included three White women, three African American men, three Latinos, and five Latinas who were engineering students who had successfully transferred from a community college to a four-year university. The 14 participants were community college students who attended 17 out of the 112 different public community colleges in California.

This chapter includes a summary of the findings presented in Chapter 4 followed by a comparison of these findings with findings of prior research on minority engineering students who were successful in their transfer journey from community colleges to four-year engineering programs. The findings were analyzed through the lenses of the theoretical frameworks guiding the study and other relevant frameworks that helped in understanding the experiences of minority transfer students. The chapter also includes discussions and recommendations related to the different educational phases a transfer student goes through, which include pre-community college, community college, and the
four-year university phases. A conceptual model expanding the theoretical models guiding this study is presented in light of participants’ answers to the research questions.

Implications were provided through the lenses of transformational leadership, policy, and data-based decision-making practices, which are the cornerstones of the doctorate in educational leaders program at CSU, Sacramento, and which bear relevance to the study conducted and to previous research. According to Leithwood, Seashore-Louis, Anderson, and Wahlstrom (2004), educational leadership is a key factor in influencing student success. Also, policies can influence actions and highlight urgency for transformation (Ezzani, 2009; Kelley & Shaw, 2009). Ikemoto and Marsh (2007) highlighted the need for educational leaders to draw from multiple types of data for better decision making. These include input data such as student demographics, process data such as instructional practices, outcome data such as student assessments, and satisfaction data such as access, retention, and success. Finally, implications for future research, related reflections from the researcher, and conclusions are presented.

**Analysis of Findings**

Extensive research has been done on STEM minority students at four-year higher education institutions. This study adds to the existing body of knowledge by specifically exploring the engineering part of the STEM disciplines and by focusing on understanding the community college system as a transfer vehicle for minority students. Through analysis of the findings of this study from Chapter 4, the purpose of this section is to understand the participants’ perceptions and experiences as engineering transfer students
at community colleges. The goal is to understand what role, if any, the community college experience played in helping the participants complete the transfer journey successfully. The study examined both personal characteristics and institutional agents that may have contributed to their successful transfer to a four-year engineering program. Success of minority students is affected by psychological factors and situational factors (Steele, 2011). Also, a successful transfer can be influenced by personal and institutional factors (Hagedorn et al., 2008). Therefore, this study was guided by two theoretical frameworks – the individual cultural capital model of Bourdieu (1986) and Harper’s anti-deficit achievement model (2010), which focuses on institutional factors that could impact educational success for minority students. The analysis of the findings was used to answer the three questions of this study, starting with the first question:

1. **What helped these successful minority individuals choose community colleges as pathways towards engineering majors?**

   According to the literature, one of the main missions of the community college system is open access to all adult learners in order to create opportunities for those seeking higher education (Douglass & Greenspan, 2002, p. 1). The community college is a practical alternative due to the high return on investment (ROI) in the long run (Sanchez & Laanan, 1997). Community colleges serve a distinctive task as institutions of transition between high schools and universities (Palmer, 2000). Community colleges offer a low cost higher education alternative. Therefore, community colleges provide pathways for low-income, first-generation, and minority students to four-year degrees
Community colleges are democratic institutions where access is open to all, regardless of academic achievement or possession of any form of capital (Cohen & Brawer, 2008). According to Tsapogas (2004), low cost, locality, course flexibility, and open-access policies have attracted students from diverse backgrounds to community colleges. Moreover, beyond open access and ROI advantages, community colleges can offer underrepresented students the comfort of staying close to their roots, communities, and familiar environment while experiencing higher education. Based on a 2001 National Survey of Recent College Graduates, around 40% of science and engineering bachelor’s and master’s graduates had attended community colleges (Tsapogas, 2004). These recent college graduates were more likely to be African American, Latino/a, and Native American. Moreover, Tsapogas also concluded science and engineering students who are married females and those who have children are more likely than male graduates to have attended community college. According to Starobin and Laanan (2008), the diverse environment and culture at community college campuses “may help female students focus on their engineering studies rather than being conscious of their gender” (p. 42). Community colleges offer open access to higher education for first-generation, ethnic minority, low-income, and underprepared students (Bragg, Kim, & Barnett, 2006).

The findings of this study confirmed the findings in the literature review regarding cost as one of the main reasons students attend community colleges. All participants in this study mentioned low cost as the main reason for attending community
college prior to attending a four-year university. The choice based on low cost was not
due to the participants being well-informed consumers who actually had the financial
means to attend four-year universities, but rather to the lack of any other higher education
alternatives within the participants’ economic power. Some participants pointed out
community colleges were the only financially viable option for them to pursue any type
of education beyond high school. One participant stated, “I had no other way to go but
the community college.” This also reinforces the role community colleges play as
democratic institutions granting access to all regardless of academic achievement or
financial resources (Cohen & Brawer, 2008).

Some participants attended community colleges despite having the option to
attend four-year universities straight out of high school; they chose to attend community
colleges based on location in order to remain at home and help their families. These
findings underlined Tsapogas’s (2004) findings that many female and underrepresented
minority students opt for community colleges in order to remain at home and fulfill
cultural obligations towards family. Some participants, even had they not been first-
generation college students and had the cultural capital needed to access four-year
universities straight from high school, would still have attended community colleges due
to family ties and the importance of family commitment. One participant stated, “I could
not leave my mom and dad because they needed someone who can speak English well
enough to take them to their doctors’ appointments.” The participant’s plan was to attend
community college and prolong her stay at home until a younger sibling was old enough
to take on some of the family responsibilities. Another participant stated, “I wanted to stay with my parents and help them out with the house bills.” The findings of this study expand on the current body of knowledge viewing the community college as an affordable higher education alternative. For some participants in the study, the community college may be symbolic of a temple where students can freely practice their rituals of family loyalty (Bolman & Gallos, 2011). The community college may offer the alternative to attend college without uprooting minority individuals away from their families. Most participants in this study did not possess needed capital and knowledge to attend four-year universities straight out of high school. However, based on the findings of this study, some participants had their own version of cultural capital which was different than Bourdieu’s (1986) objectified, embodied, and institutionalized cultural capital. The participants’ version of cultural capital was related to commitment, obligation, and loyalty to parents. Therefore, they willingly chose community colleges as their entry point into higher education.

Experiencing higher education through the open access and affordability of the community college system was another finding in this study. Some participants stated they decided to attend community college because it was a local entity and a part of the community. These were the participants who started community college without the intent to pursue any four-year degree yet ended up transferring into engineering schools at four-year universities. This finding underscores the study done on first-time students at community colleges, which concluded there are six different clusters of students at
California community colleges: transfer, vocational, drop-in, noncredit, experimental, and exploratory (Bahr, 2010). Some participants came from homes without the expected cultural capital (Bourdieu, 1986) to propel them into higher education. For example, one participant stated:

> I was scared to go into a community college so I started working as a cashier in a gasoline station and that made me rethink, well, maybe I should do something else rather than do this for the rest of my life.

Also, most participants were not offered any anti-deficit (Harper, 2010) assistance in high school to think about higher education beyond community college. For example, one participant stated, “I didn’t take calculus in high school. So, I didn’t really get exposed to it until I went into the community college.” These participants, in the researcher’s view, attended community college to explore or experiment with the concept of higher education. One participant who had good enough grades to attend a four-year university was told by a high school counselor to focus on a community college to see if she liked college first. The lack of knowledge of higher education intricacies on the part of the participants reinforced the importance of acquiring cultural capital in order to understand the alternatives available in higher education and especially for future engineering students (Bourdieu, 1986). For example, one participant stated, “I wasn’t quite familiar yet with Free Application for Federal Student Aid (FAFSA) and how to apply for it. I didn’t have any of that help because I was completely on my own.” Also, engineering is not the type of college major students can easily access or succeed in based on graduating from high school.
Based on the researcher’s personal experience, unless a student leaves high school with a solid knowledge base in mathematics, science, and physics, they might end up spending years in remediation courses. In fact, one participant stated she spent four years at the community college because she came unprepared and had to take a long sequence of math courses to get to the math courses transferable to four-year engineering schools. Moreover, the lack of support from high school counselors intensifies the cultural capital gap and highlights the absence of institutional agents willing to work with underrepresented students from an anti-deficit achievement lens by offering solutions and alternatives rather than obstacles and blocks (Harper, 2010). This lack of guidance and the absence of any role models in engineering could be mapped to the pre-college socialization and readiness stage of the anti-deficit achievement model, which includes familial factors, school forces, and out-of-school experiences (Harper, 2010). The choices for higher education were not presented to some participants in this study since they were constrained by the lack of college knowledge at home and the lack of student counseling at high school. Only two out of the 14 participants in the study gave any positive feedback about their experience with high school counselors. For example, a Latino participant was advised by his counselor to study criminal justice and aim to become a parole officer. Other participants explained high school counselors basically provided general brochures about local universities and community colleges without any specialized knowledge related to engineering or how to prepare for engineering schools while in high school.
Some participants in the study stated they attended community college as a result of peer pressure from high school friends who decided to attend community college. These participants did not have a specific plan or clear goal to go into engineering and attended the community college on a trial basis. The findings of this study reinforced those of Tsapogas (2004) about the lack of higher education role models for many community college students. Thus, some participants attended community college as a result of group think, seeking to stay close with friends from high school. One participant stated, “It was six of my friends and I decided to go and apply. I was not taking it seriously. It was like, whatever, just keep going to school.”

One participant attended community college as a “reverse transfer” student. Reverse transfer students are defined as “individuals who, prior to attending a two-year college, were last enrolled at a four-year institution” (Kajstura & Keim, 1992, p. 39). The reverse transfer participant had the grades entitling him admission into a four-year engineering program straight from high school, but as he explained, he did not have the right knowledge, skills, and rigor in math and science to let him succeed. So he left the four-year university, went back to a community college, and returned a better-prepared engineering student. The study demonstrated community colleges can serve as remediation stations within the higher education system.

At the time of the interview, the participant was a graduating senior, and he proudly stated, “Without the community college, I would not be here now working on my senior project.” The participant had already gone through the three-stage model of
college choices of personal influences, the search process, and institutional choice (Hossler & Gallagher, 1987). Nonetheless, his lack of success at a four-year university led him to employ the three-stage model of college choices again and, due to open access, he was able to revamp his study skills and return as a more qualified student. The reverse transfer participant was as satisfied with his community college experience as the rest of the participants, mainly due to smaller class sizes and personal interactions with community college instructors. The findings of this study reinforced the literature showing underrepresented students could encounter unfamiliar and uncomfortable environments at higher education institutions (Tsapogas, 2004). In the case of this reverse transfer study participant, the community college helped him retool his skills and lay the groundwork necessary to return to and succeed at a four-year engineering program. Table 18 shows a summary of the answers to the first research question for this study.
Table 18

Answers to Research Question One

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<tr>
<td>1</td>
<td>Low Cost</td>
<td>“I went to community college partly because my family doesn’t have any money to pay for higher education. So it’s definitely the cost.” – Camellia</td>
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<tr>
<td>2</td>
<td>Location</td>
<td>“Living with my parents to help them out with the bills too, that’s another thing, the responsibility of helping them out with bills and stuff.” – Leon</td>
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<td>3</td>
<td>Experiencing Higher Education</td>
<td>“I wanted the experience of how college was going to be before I actually decided.” – Anita</td>
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<td>4</td>
<td>Peer Pressure</td>
<td>“I went to Community College just because one of my high schools friends was going there.” – Carlita</td>
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<tr>
<td>5</td>
<td>Remediation</td>
<td>“One of my priorities was to improve my English. It wasn’t until community college when I took my science courses.” – Leon</td>
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2. What helped these individuals complete the transfer journey from community colleges to engineering schools at four-year universities?

The participants of this study were among a small percentage of higher education students in California able to benefit from the open-access and low-cost community college system as a pathway into four-year universities. According to a study by Moore, Shulock, and Ceja (2007) on California community college students over a six-year period, “76 percent of degree-seeking students had not completed a certificate or degree,
and had not transferred to a university, with most of the non-completers having dropped out” (p. 8).

The 14 participants in this study were part of the 24% cluster of students successful in achieving institutional cultural capital in the form of completing the transfer requirements from community college and gaining admission to engineering programs at four-year universities. Collectively, study findings indicated participants were satisfied with the rigor of the math, science, and engineering curriculum at community college. The participants stated their transition time at the community college assisted them immensely in becoming better prepared for the rigor and demands of engineering courses at four-year universities. Even the few participants who could have attended four-year universities straight out of high school stated without the rigor of the courses at the community college, they would not have been able to pass their courses at four-year universities.

The statements by the above participants were corroborated by the reverse transfer participant who went back to a community college after attending a four-year university for a few semesters. While still living at home with family, the community college served as a transition stage, which helped participants prepare for the challenge of studying engineering at four-year universities. Some participants stated general education courses at four-year universities were more demanding than general education courses they had taken at community colleges. However, all the participants in this study emphasized the rigor and quality of math, science, and engineering courses at community
colleges. The participants felt there was no difference in rigor or quality between math, science, and engineering courses taken at community colleges and those taken at four-year universities. In a study by Hayward, Jones, McGuiness, Timar, and Shulock (2004), there was evidence of varying levels of academic rigor among community colleges, as some courses were not as rigorous as similar courses at four-year universities. However, considering the 14 participants in this study had attended 17 different community colleges and all emphasized rigor at community colleges, the findings of this study were not aligned with the findings of the study by Hayward et al. (2004). Moreover, one participant stated she felt engineering-related courses at community college were as rigorous as four-year university courses but she felt general education courses or non-engineering-related courses at four-year universities were much more rigorous in terms of exams, expected research, and overall writing requirements.

The participants stated staying home and close to family for the first few years of their higher education experience had helped them prepare financially, academically, and culturally by saving money, building proficiencies, and learning academic traditions and customs vital for success in higher education and especially at four-year universities. The study found, despite staying at home, the community college experience provided the participants with the needed objectified and embodied cultural capital to value and appreciate higher education (Bourdieu, 1986). The community college experience provided participants with the objectified form of cultural capital that associates an individual with a certain societal status in the form of becoming a four-year university
student. Also, the community college experience provided the participants with the embodied form of cultural capital in the form of lived experiences as individuals valuing education as a service and as a tool for social justice. For example, one of the participants stated:

When I first started at the community college, I was intimidated and was just thinking if I got an associate’s degree that would be amazing. Every semester I decided to aim a little higher and here I am at a four-year university.

The study reinforced the concept of transfer student capital presented by Laanan (2004) in explaining the successful transition from community colleges to four-year universities through the process of gaining awareness of the available resources within the new surroundings.

According to Van Gennep (1960), the rites of passage model presents a three-stage process of separation, transition, and incorporation. This study demonstrated underrepresented students in engineering experience both separation and transition during their community college years despite living at home with their family. Some first-generation college students in this study pointed out it was hard for their parents to understand the level of commitment to school-related activities such as individual study time and group work. Separation activities include setting time aside for schoolwork and decreasing the levels of nonessential social engagements with family. Also, one participant explained the community college was a separation point from high school friends who were “either in jail or pregnant.” This finding disagreed with Tinto’s (1988) findings regarding students who attend college while living at home. Tinto (1998) stated
students who stay home while attending college might not experience separation or the shedding of past associations to become part of the new culture of academia. Many participants in this study experienced some level of separation while living at home but due to familial obligations and cultural expectations did not disconnect from family completely. The findings of this study reinforced the findings by Braxton (2004) regarding separation. Braxton (2004) also rejected Tinto’s (1988) hypothesis that underrepresented students should discard their cultural beliefs in order “to successfully incorporate the values and beliefs of the institution into which they are attempting to integrate” (p. 132). One participant stated his parents do not speak English or understand engineering but are still proud of him based on what they hear from others about engineering. Therefore, this study found the California community college system can serve as an incubator to nurture students of color, reaffirming the findings of Turner (1990):

The transitory nature of the community college setting affects all students…students with fewer family connections to higher education may be more adversely affected…Coming to community college is a major step for us Hispanics who usually do not continue their education past high school. This is why it is critical to nurture the Hispanics who do make it to community college. (pp. 17-18)

This study found community colleges can offer underrepresented students the opportunity to acquire new cultural capital and academic identities without having to abandon their own cultural identities. Based on the analysis of participants’ responses and major themes, this study demonstrated California community colleges can serve as
positive agents to help underrepresented students as explained in Harper’s anti-deficit achievement model (2010).

Beyond the rigor of the curriculum, participants stated the community college experience was a transition stage where they learned new pedagogies including individual study skills and group skills in studying math and science. Participants stated the quality of effort and number of hours dedicated to community college coursework was tremendously higher than that for high school coursework. With regard to individual study skills, participants learned new pedagogies such as multitasking and project management skills. Moreover, participants learned new communication and group skills in approaching math and science coursework. The findings in the study affirmed the importance of the cultural capital model and the importance of underrepresented students having the right set of skills in order to maneuver the unfamiliar ecosystems of higher education (Bourdieu, 1986).

All participants in this study have had some form of transformative experience through interactions with passionate instructors at community colleges. According to Stanton-Salazar (1997), institutional agents are those “who have the capacity and commitment to transmit directly, or negotiate the transmission of, institutional resources and opportunities” (p. 6). Based on the findings of this study, as first-generation engineers the participants felt they were obligated to give back to their communities through role modeling and moral support. Stanton-Salazar (1997) presented six different types of institutional support vital for academic success: a) offering of funds of
knowledge, b) bridging to opportunities and social networks, c) advocacy, d) role modeling, e) emotional and moral support, and f) feedback and guidance. This study found community college instructors who teach engineering-related courses like math, physics, and chemistry serve as role models, provide academic advice, and offer funds of knowledge related to engineering beyond the community college. Engagement is defined as “participation in educationally effective practices, both inside and outside the classroom, which leads to a range of measureable outcomes” (Harper & Quaye, 2009, p. 3).

The study found community college instructors offered underrepresented minority students in engineering the embodied cultural capital they were unable to obtain at home. Participants did not indicate whether the instructors who made a difference were underrepresented minorities or not, but a few participants indicated once engineering-related courses started, students evaluated each other based on abilities and not gender or race. The embodied capital gained by participants was in the form of better appreciation of science, technology, books, and education as a whole. According to Aronowitz (2004), underrepresented students lack the cultural capital needed to comprehend the conventions and regulations regarding school standards, curriculum, and testing. The study found that community college instructors respond to academic and cultural deficiencies by going beyond the call of duty by serving as counselors and mentors. The participants really valued and appreciated the out-of-class interactions with their instructors. Speaking about her community college instructors, one participant stated,
“They actually like it when you go to their office hours and ask things, and they’re open to answer any question you have.” This finding confirmed those of Reyes (2011), who concluded STEM students valued positive interactions with community college instructors. Female participants confirmed the findings by Rayman and Brett (1995), who found receiving career advice from faculty contributed to women’s persistence in science careers. This common practice by instructors of engineering-related courses at community colleges affirmed the importance of Harper’s (2010) anti-deficit agents for the success of minority students.

This study found participants who experienced engineering-related internships while studying at community colleges came back with a renewed sense of purpose and determination to transfer and eventually become engineers. The participants stated internships provided them with confidence, motivation, and understanding of what engineers do. The finding of this study confirmed those by Knouse, Tanner, and Harris (1999), who conducted a study on two congruent sets of students and concluded students who participate in internship opportunities tend to have higher GPAs than those who do not.

The findings of this study also reflected those of Wai et al. (2010) regarding the importance of mental inspiration, which can elevate the goals and ambitions of students. One participant attended community college without a specific educational or career goal. She stated, “Initially right out of high school, I didn’t know what I wanted to do I guess things have been rearranged because while I was at community college I did an internship
at an engineering company and interacted with engineers.” Also, the findings of this study regarding the importance of internships aligned with Astin’s (1984) emphasis on involvement, defined as “the amount of physical and psychological energy the student devotes to the academic experience” (p. 297). The process of providing internships for community college students is part of stage two or the college stage of the anti-deficit achievement model, which includes external opportunities (Harper, 2010). An internship could also serve as a bridge to provide students with institutionalized cultural capital as they experience validation in working in their field of study (Bourdieu, 1986). Partnering with businesses where interns can be placed can help community colleges improve their prestige and at the same time increase enrollment (Divine, Linrud, Miller, & Wilson, 2007). Study findings also confirmed those of Greenhaus, Callanan, and Godshalk (2000), which indicated work related to college studies can assist students in formulating a concept of self and gauging their desires and career requirements (Greenhaus et al. 2000).

The participants in this study emphasized the importance of field trips to engineering offices and actual work sites as a way to help them understand abstract concepts in class and get them more familiar with what engineers do on the job on a day-to-day basis. One of the participants stated the field trip to the electric power substation reinforced his motivation to study and become an engineer. The study reinforced the findings by Millane (2011), which deemed field trips important inclusion tools to get students more engaged in college work. Field trips “provide exposure to the business,
governmental, and cultural community to increase the students’ social and cultural capital” (Millane, 2011, p. 194). Based on statements from participants, field trips helped them become more interested in investigating the abstract concepts of engineering further by reading and asking questions. The findings in this study reaffirmed the research done by Zoldosova and Prokop (2006) who concluded science students who were part of biology and chemistry field trips were more likely to choose related books afterward. Also, the participants stated field trips illustrated the impact engineering had on society as a whole and made them more interested in engineering. The findings of this study confirmed those of Falk and Adelman (2003), who concluded visitors to aquariums become more interested in ecosystem conservation after the visit. Field trips can serve as important mechanisms to acquire the embodied form of cultural capital through the development of specific tastes and preferences to appreciate cultural goods and services like museums and theaters (Bourdieu, 1986).

The study found joining science clubs and academic societies on campus helped participants persist and succeed. Participants were members of campus clubs, chapters, or societies like the Society of Hispanic Engineers (SHPE), Society of Women Engineers (SWE), the American Institute Of Chemical Engineers (AIChE), and the National Society of Black Engineers (NSBE). The participants felt being part of groups focused on science and engineering helped them understand the expectations and demands of engineering studies. Support from the group can become even more valuable when the support group shares the same ethnic background and cultural values of students. The
participants explained through interacting with more experienced colleagues through campus societies, they learned how to navigate the educational system. This finding confirmed those of Solórzano and Villalpando (1998) regarding navigational capital, which minority students need in order to adapt to educational systems designed by and for non-minorities. Also, the findings of this study confirmed those of Orellana et al. (2003) regarding the importance of linguistic capital, which is related to interacting using the proper vernaculars and styles. For example, participants were talking about their internships and courses with great confidence and fluency. One participant stated, “At this point, I’d like to go to graduate school. I am still not really sure what for and will decide after my fluid mechanics course…the internship at the community college gave me so much confidence.”

Some participants felt there were not adequate academic clubs and societies on community college campuses. Having experienced clubs and societies at community colleges and at four-year universities, some participants felt future community college students would benefit from joining campus clubs early in their educational journeys. Some participants suggested creating and promoting more active clubs at community colleges similar to those they experienced at four-year universities. The findings of the study related to increased academic and career aspirations corroborated those of Wai et al. (2010) mentioned earlier. Also, the impact of campus clubs and societies could be associated with stage two of the anti-deficit achievement model, including class interactions, out-of-class engagement, and external opportunities (Harper, 2010),
instructional cultural capital (Bourdieu (1986), navigational capital (Solórzano & Villalpando, 1998), and linguistic capital (Orellana et al., 2003).

Student engagement is defined as “participation in educationally effective practices, both inside and outside the classroom, which led to a range of measureable outcomes” (Harper & Quaye, 2009, p. 3). Internships, field trips, and academic clubs are forms of out-of-class engagement that lead to measurable positive outcomes like increasing confidence, enhancing motivation, and fostering persistence for underrepresented engineering students. Table 19 shows a summary of the answers to the second research question for this study.
Table 19

*Answers to Research Question Two*

<table>
<thead>
<tr>
<th></th>
<th>Research Questions #2: What helped the participants complete the transfer journey from community colleges to engineering schools at four-year universities?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Staying at Home</td>
</tr>
<tr>
<td>2</td>
<td>Rite of Passage</td>
</tr>
<tr>
<td>3</td>
<td>Rigorous Curriculum</td>
</tr>
<tr>
<td>4</td>
<td>New Pedagogies</td>
</tr>
<tr>
<td>5</td>
<td>Passionate Instructors</td>
</tr>
<tr>
<td>6</td>
<td>Internships</td>
</tr>
<tr>
<td>7</td>
<td>Campus clubs</td>
</tr>
<tr>
<td>8</td>
<td>Field Trips</td>
</tr>
</tbody>
</table>
3. What long-term academic and career goals do these individuals have and how did their community college experience help shape their academic or career goals?

The study found the community college experience had positively impacted participants. The participants in this study stated four distinctive goals related to their academic and career plans beyond transferring to four-year universities. These goals were: working as engineers, pursuing graduate degrees, becoming entrepreneurs, and repaying their communities through coaching and mentorship. The positive impact of the community college experience led to the creation or elevation of participants’ academic and career goals. The finding of this study confirmed Yosso’s (2005) finding regarding aspirational capital, which includes “resiliency to hope, dream, and achieve beyond the tangibles” (p. 22). Also, the findings aligned with a study on mental inspiration and its impact on higher accomplishments (Wai et al., 2010). Overall, the findings of this study mirrored Dewey’s (1973) conclusions regarding education as “the fundamental method of social progress and reform” (p. 453).

Transfer student capital is the process to gain familiarity and proficiency with the new environment needed for successful transitions from community colleges to four-year universities (Laanan, 2004). The participants declared without their community college experience, they would not have been able to adapt to the four-year environment psychologically, socially, or academically. The findings of this study corroborated Laanan’s findings. The community college experience provided underrepresented
students the transfer capital needed to complete the requirements for admission at four-year universities.

The creation and elevation of career goals and ambitions based on community college experience is a good example of gaining institutionalized cultural capital (Bourdieu, 1986). Moreover, this finding can be directly mapped to stage three or the post-college persistence of the anti-deficit achievement model, which includes pursuing careers in STEM fields and seeking graduate degrees (Harper, 2010). This study found the coaching received from community college instructors was extremely vital to the adaptability and persistence of minority engineering students at community colleges.

The study found after transferring and even after graduating from four-year universities, the participants of the study still appreciated the relationships and interactions they had with their community college instructors. The findings of this study corroborated the findings of Reyes (2011) that women of color in undergraduate STEM disciplines at four-year universities were grateful for and appreciative of the relationships resulting from faculty-student associations at community colleges.

The findings of this study regarding the positive impact of interaction between community college students and instructors confirmed those of Pascarella and Terenzini (2005). The impact of interaction goes beyond academic achievement to the expansion of students’ hopes and dreams. The findings of this study are aligned with the findings of Rendon et al. (2000) regarding focusing on the positive variables that help students succeed. According to Rendon et al. (2000),
Students will elect to stay or leave college not so much because of theory, but because college and university faculty and administrators have made transformative shifts in governance, curriculum development, in-and out-of-class teaching and learning, student programming, and other institutional dimensions that affect students on a daily basis. (p. 152)

From the lenses of deficit models (Valencia, 1997) and attrition variables (Bean, 1980), the focus is on symptoms of failure. On the other hand, Rendon et al. (2000) call for focus on positive factors or variables in order to understand successful pathways. The student success model by Rendon et al. (2000) is similar to the anti-deficit achievement model by Harper (2010) who calls for the evaluation of institutional transformation agents as a way to understand low achievement rates for minority students in STEM fields. Table 20 shows a summary of the answers to the third research question for this study.

Table 20

*Answers to Research Question Three*

<table>
<thead>
<tr>
<th>Research Questions #3: What long-term academic and career goals were shaped by the community college experience?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Working as engineers - “For the next 10 years, I would like to work as an engineer.” - Ladonna</td>
</tr>
<tr>
<td>2- Pursuing Graduate Studies - “I would like to get a professional engineering certificate (P.E.C) and later get my master in electrical power engineering.” – Kevin</td>
</tr>
<tr>
<td>3- Entrepreneurship - “After graduating from engineering school, I have been playing with the idea of getting a master’s in business and maybe eventually owning my own business.”- Dan</td>
</tr>
<tr>
<td>4- Mentoring - “After working as an engineer for 18 years, I am now part of a mentoring program for minority engineering students.” – Juan</td>
</tr>
</tbody>
</table>
A New Theoretical Framework

Based on the findings in this study, the participants, individuals from underrepresented backgrounds in engineering, benefited from the open access, low-cost, and the close-to-home nature of community colleges. Most participants came into community college without the necessary cultural capital to understand the higher education system, without understanding the demands of the study of engineering, and without fully understanding the transfer process from community colleges to four-year universities. Most participants left community college with almost 50% of an undergraduate engineering degree and the academic, social, and cultural skills needed to transfer and succeed at four-year universities.

To succeed in higher education, an individual must have a few different types of capital like economic capital, social capital, and cultural capital. Economic capital is measured in terms of income, property, and wealth. Social capital is “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintances and recognition” (Bourdieu, 1986, p. 248). Stanton-Salazar (1997) considered social capital as “social freeways” allowing people to navigate the pathways of privilege and power (1997, p. 4). Cultural capital is a process to sustain and formalize status within society. Cultural capital comes in the form of objectified capital, embodied capital, and institutionalized capital (Bourdieu, 1986). Therefore, cultural capital is a way to uphold status within society. From an academic standpoint, cultural capital is “sanctioned by legally
guaranteed qualifications, formally independent of the person” (Bourdieu, 1986, p. 247).

The objectified form of cultural capital refers to cultural products and symbols associating an individual with a certain societal class or status. For these underrepresented students, community college provided objectified cultural capital in the form of education and verified college credits. Also, through community colleges, the underrepresented students gained an embodied form of cultural capital through the development of appreciation of education and engineering. Institutionalized cultural capital refers to the formal certifications and diplomas that validate the possession of cultural capital. Finally, through the actual success indicator of transfer and admission to a four-year engineering program, community colleges provided institutional cultural capital.

The view of an individual’s ability to succeed in higher education based on capital is constructed upon a deficit model (Valencia, 1997). On the other hand, the anti-deficit achievement framework focuses on institutional willingness and readiness to change the current academic culture to meet the needs of underrepresented students (Harper, 2010). Harper views success of minority students in STEM through three stages. Stage one is the pre-college socialization and readiness stage, which include familial factors, school forces, and out-of-school experiences. Stage two is the college-stage class interactions, out-of-class engagement, and external opportunities. Stage three is post-college persistence in STEM, which includes careers in STEM fields, pursuing graduate degrees, and careers in research (Harper, 2010).
Based on the perceptions of the participants in this study, the community college system has areas with need for improvement, such as lack of proper counseling for engineering students and lack of coordination with four-year universities. Nonetheless, the community college system can provide transactional, transformational, and aspirational pathways to help underrepresented students in engineering break the glass ceiling for women and the “tinted ceiling” for students of color. According to Nevarez et al. (2013), transformative leadership is a “social-justice-oriented approach undergirded by notions of democracy” (p. 143). Based on the findings in this study, most community college instructors teaching engineering-related courses serve as anti-deficit institutional agents and transformative leaders by providing underrepresented students in engineering the necessary cultural capital to succeed and transfer to four-year universities. Other anti-deficit factors that helped students complete the transfer process successfully are internships, campus academic clubs, and field trips.

Moreover, transformative anti-deficit agents were able to provide students inspirational capital beyond the academic and cultural capital. Due to the lack of cultural capital, underrepresented students are unable to understand the conventions of formal education, which can lead to more underrepresentation (Aronowitz, 2004). Therefore, educational leaders should address issues of marginalization due to its impact on equity, economics, and social justice. This calls for a new type of educational leadership at all levels. A successful transfer journey from community college to a four-year university is impacted by both personal (psychological) and institutional (situational) variables.
Therefore, addressing both institutional factors and individual variables is vital to increasing the number of minority individuals utilizing community colleges as pathways to earning four-year engineering degrees. Based on the study findings and the literature review, the Community College Transformation and Aspiration Model (CCTAM) provides a framework to the individual and institutional variables impacting the access, persistence, and success of underrepresented minorities in engineering using the community college path toward undergraduate degrees in engineering. See Figure 11 for a conceptual representation of the theoretical frameworks and the findings in this study within the CCTAM.

![Figure 11. The Community College Transformation and Aspiration Model (CCTAM).](image-url)
Recommendations

Based on the literature review and the findings in this study, the recommendations are presented in two different categories. The first category is recommendations for parents and students at three different phases of education: pre-community college, community college, and post-community college. The second category is related to implications for leadership, policy, and data-based decision making. The goal is to provide practical alternatives for all stakeholders to help the nation face the challenge of increasing the numbers of American engineers in the workforce by increasing the number of engineers from underrepresented groups within the United States like African Americans, Latino/as, and White females. The first category of recommendation is for parents and students at three different phases of education, which include pre-community college, community college, and post-community college.

Recommendations for Parents and Students

Pre-community college.

Recommendation #1. Parents should take the responsibility of supporting, influencing, and planning children’s STEM aspirations early in life.

My parents influenced my decision. They talked to me about how great of a career engineering was. – Kevin

Although my parents don’t really have the highest level of education, but they were also quite supportive and tried to make sure my sister and I went to college. - Adam

The study of engineering does not start on the first day of college due to its dependence on skills from so many other areas like math, physics, and chemistry. Therefore, parents
should start emphasizing STEM topics as early as possible through homework and casual discussions. Parents should build children’s cultural capital in STEM early in life by enhancing their objectified capital by acquiring or borrowing objects such as science books and films. For embodied forms of capital, parents should help children build capital through visits to museums, trips to dams, discussing engineering projects like bridges to build a sense of curiosity and appreciation for education and engineering.

**Recommendation #2.** Parents should communicate with teachers and administrators.

My parents didn’t have the resources and they don’t have the resources until today, so it’s pretty much on my own. – Leon

Aligning goals between home and school is a must when multiple stakeholders are involved in the achievement of common goals. Alignment and communication is even more important for parents from underrepresented groups in engineering to prevent any stereotyping by teachers or administrators. When parents communicate with teachers, both are able to identify strengths and diagnose areas of development in order to find solutions such as choosing the right classes, doing extra assignments, seeking tutoring, and completing class projects that can be aligned with STEM fields. This alignment and communication can help students avoid remediation and shorten the time spent at a community college.

**Recommendation #3.** Students should be prepared for the rigor of STEM courses at community colleges. According to the Student Success Task Force (2012), only 46.2% of students who enter California community colleges at one level below transfer level in
math end up achieving a certificate, degree, or transfer. Of those students entering four
levels below transfer level, only 25.5% ever achieve those outcomes. Students should
take all the advanced math, physics, and chemistry courses available at high school in
order to be academically ready for the rigor of community college courses as stated by
one of the participants in this study.

Our community college teachers pushed us even harder because they were like,
“when you transfer we want them to know that, wow, you could have been here
but you were smart enough not to because community college was cheaper” –
Ladonna

I was there (at the community college) for a long time, way longer than I should
have been. – Dan

Another advantage of being prepared is avoiding remediation courses and, thus spending
less time at a community college before transferring, especially when many basic math
and science courses can be completed for free during high school. Table 20 provides a
summary of recommendations for students and parents related to the pre-community
college stage.
Table 20

Summary of Recommendations for Parents and Students: Pre-community College Stage

- Recommendations for Students and Parents during the Pre-Community College Stage

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Reflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Parents should take the responsibility of supporting, influencing, and planning children’s STEM plans early in life</td>
<td>“My parents influenced my decision. They talked to me about how great of a career engineering was.” – Kevin</td>
</tr>
<tr>
<td>2- Parents should communicate with teachers and administrators</td>
<td>“My parents didn’t have the resources so I was pretty much on my own.” – Leon</td>
</tr>
<tr>
<td>3- Students should be prepared for the rigor of STEM courses at community colleges</td>
<td>I was at the community college for a long time, way longer than I should have been. – Dan</td>
</tr>
</tbody>
</table>

During community college.

Recommendation #1. Students should get involved in math, science, and engineering clubs at community college. The community college serves as an evolution and alteration junction that can help minority individuals gain the necessary capital to transfer and succeed at four-year universities. Academic clubs and societies serve as anti-deficit agents to bridge the gaps in cultural capital for students. New students can network with instructors and more experienced students and benefit from new perspectives and suggestions. Based on the findings of this study, not all community college campuses had clubs like Math, Engineering, Science, and Achievement (MESA). However, students should join such clubs wherever and whenever possible and as early as they can in their higher education journey.
**Recommendation #2. Students should seek but verify any advice from community college counselors.** Some of the participants in this study perceived community college counselors as not having the proper knowledge to advise engineering transfer students. One of the participants stated, “I don't know if community college counselors don't know or they don't care.” Some participants stated they were given wrong information and ended up taking courses they did not need or were not required at their transfer university. Therefore, prospective community college students should initiate the advising process with community college counselors during high school years. Simultaneously, engineering students at community colleges should also verify the information with the four-year destination institutions where they intend to transfer. A visit to the engineering school at the four-year university is also a good step, especially if the university is within driving distance from home, as was the case for many participants in this study. This will ensure community college students are taking the right courses in the right sequence.

**Recommendation #3. Students should learn multitasking and time management skills.** This study found participants learned the skills of multitasking and time management during their community college years. Part of time management and multitasking is learning to diversify the course workload each semester. For example, engineering students and especially those still trying to acquire the needed cultural capital for higher education should avoid taking multiple laboratory courses in one semester. Diversifying the course load and mixing general education courses with engineering-
related courses would help students in spreading the load, since engineering courses usually require more individual and group study time than history or sociology courses.

**Recommendation #4. Students should seek and join study groups.** Participants in this study valued the benefits from studying in groups, especially right before exams.

I start studying a week before exams by myself and then when there is maybe four days left or three, I will join the study group - *Anita*

Around exam time, after studying alone, three or less of us get together and sit at the table and if any of us had a question we feel like oh, how did you do this one? - *Carlita*

Study groups help students understand the theoretical concepts and also provide a network for emotional support and motivation during hard times.

**Recommendation #5. Students should complete challenging courses at the community college.** One of the participants in the study commented her physics class at the community college had fewer than 20 students while the same course at the four-year university had over 80 students. Community college students should take advantage of the small class sizes, personal access to community college instructors, and the coaching and mentorship provided by community college professors by completing core pre-engineering courses such as Calculus I, Calculus II, Calculus III, Differential Equations, physics, and chemistry at community colleges.

**Recommendation #6. Students should communicate and connect with community college instructors.** Based on the findings in this study, participants really valued and benefited from the personal attention and frequent interactions with community college instructors. Engaging with community college instructors can yield benefits beyond
academic knowledge and advice. Engaging with community college instructors can result in internship opportunities, field trips, academic coaching, and career mentoring.

Table 22 provides a summary of recommendations for students related to the community college stage.

Table 22

Summary of Recommendations for Parents and Students: Community College Stage

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Students should get involved in math, science, and engineering clubs at community colleges</td>
<td>“Through MESA, I got a job at the Department of Water Resources.” - Camellia</td>
</tr>
<tr>
<td>2. Students should seek but verify any advice from community college counselors</td>
<td>“Counselors at community college were having me take classes I didn’t need, classes that overlapped. That didn’t make sense. I think community college education is solid, I think their counseling needs a lot of work especially when it comes to transfer to engineering school.” - Dan</td>
</tr>
<tr>
<td>3. Students should learn multitasking and time management skills</td>
<td>“Tactics that helped me transfer include organization, ability to multitask, and time management.” - Savanna</td>
</tr>
<tr>
<td>4. Students should seek and join study groups</td>
<td>“Engineering is a lot of group work, a lot of dependency on study groups.” - Janis</td>
</tr>
<tr>
<td>5. Students should complete challenging courses at the community college</td>
<td>“At the community college, I had a huge advantage in being in smaller classes for physics and for organic chemistry over the rest of the four-year students here who had to take those classes with 500 people.” - Savanna</td>
</tr>
</tbody>
</table>
Post community college.

**Recommendation #1.** *Students should get involved in engineering clubs on campus.* Lack of engagement in campus networks can have a negative effect on the persistence of minority students (Fleming, 1984; Allen 1988). One of the participants in this study stated she was able to land an internship after attending a meeting for the Society of Hispanic Engineers (SHPE). Based on the findings in this study, campus clubs can help minority students build the social and cultural capital needed to succeed within the new four-year university environment.

**Recommendation #2.** *Students should view an internship as a must, not a choice.* Applied experience affects professional growth (Benner, 2004; Berliner, 1991). The main objective for internships is to provide students with opportunities in a real engineering environment to apply theories learned from textbooks and laboratory experiments. Also, according to Seymour and Hewitt (1997), some students choose engineering as a major without fully understanding what engineers do on the job. Therefore, internships are vital for students to reinforce theoretical learning, understand the engineering profession, build professional networks, and enhance their work experience.

**Recommendation #3.** *Students should seek anti-deficit agents on campus.* Searching for individuals and programs designed to help students from underrepresented groups can sometimes be the responsibility of the student because some of these anti-deficit programs are not adequately promoted on campus. Students should ask other
students, professors, faculty advisors, and deans about the different programs available for engineering students from underrepresented backgrounds like African Americans, Latino/as, and White females. Based on the findings in this study, sometimes anti-deficit agents would be informal agents and not necessarily formal agents of change, as is the case with community college instructors who go beyond the call of duty to serve as academic coaches, transfer advisors, and career mentors. Also, mentors do not have to be professors or professionals in the industry. According to Grant-Vallone and Ensher (2000), “Peer mentors might provide some of the same functions as true mentors” (p. 637). For example, participants really valued advice, academic tutoring, and campus knowledge they gained from study partners. Peers can also inform and encourage students about engineering seminars, guest speaker functions, field trips, career fairs, and networking functions.

The second category of implications is related to transformational leadership, policy, and data-based decision making practices, which are the main pillars of the doctorate in educational leaders program at CSU, Sacramento. This category includes recommendations for all stakeholders including policymakers, leaders, educators, and administrators. Table 23 provides a summary of the recommendations for students related to the post community college stage.
Table 23

Summary of Recommendations for Parents and Students: Post Community College Stage

<table>
<thead>
<tr>
<th>Recommendations for Students and Parents for the Post Community College Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Students should get involved in engineering clubs on campus</td>
</tr>
<tr>
<td>“When I joined the Society of Women Engineers (SWE), I met a lot of people through the professional chapter here. I have noticed that networking is amazing. Last year, I got the opportunity to do hands-on projects and meet working engineers.” – Camellia</td>
</tr>
<tr>
<td>2- Students should view an internship as a must not a choice</td>
</tr>
<tr>
<td>“Internships are really important. I had two internships since I transferred. One with a manufacturer and one with an electric power distribution company. One of them extended an offer of employment after graduation.” – Ladonna</td>
</tr>
<tr>
<td>3- Students should seek anti-deficit agents on campus</td>
</tr>
<tr>
<td>“In the beginning, I wasn’t quite familiar yet with things. I didn’t have any of that help at home because I was completely on my own because my parents they were there mostly emotionally, but they cannot really give me advice. So, I asked others.” – Ladonna</td>
</tr>
</tbody>
</table>

Transformational Leadership

According to Dewey (1916), “A society which makes provision for participation for the good of all its members on equal terms and which secures flexible readjustment of its institutions through interaction of the different forms of associated life is in so far democratic” (p. 99). Thus, access to education by all citizens can be considered one of the indicators of democracy. For example, in 2010, 50% of science and engineering workers earned $73,290 or more annually compared to a $33,840 median for the total U.S. workforce (NSF, 2012). The data on underrepresented groups in engineering can be
viewed as symptomatic of the absence of democratization in STEM fields. The responsibility of ensuring democratization through access and success should be part of the tactical goals and strategic missions for educational leaders at all levels. Following are the implications related to educational leadership.

**Implication #1.** *K-12 leaders should plant the engineering seeds early.* Based on the findings in this study, underrepresented students in engineering fields did not receive the needed cultural capital for engineering during the pre-community college phase. Educational leaders at K-12 should foster and grow classroom and extracurricular activities that expose all students, and especially students from underrepresented groups, to science and engineering in a fun and engaging manner that captures interest. Research by Wai et al. (2010) emphasized the positive impact of extra STEM on students. Wai et al. (2010) defined “educational dose” as “the density of advanced and enriching pre-collegiate learning opportunities beyond the norm which students have participated in” (p. 861). Examples of educational doses in STEM fields are invention projects, competitions, educational films, and hands-on experiments. The framework of educational dose is a good application of anti-deficit achievement actions. K-12 leaders can work with parents, members of the community, private companies, local colleges, and research universities to plan events and activities related to STEM.

**Implication #2.** *Communication, cooperation, and collaboration among parents, leaders in K-12, community college, and four-year university systems, and engineering-sector employers.* The California Master Plan of 1960 clarified missions and roles for all
public levels of education, which include the community college system, the California State University (CSU) system, and the University of California (UC) system (Douglass & Greenspan, 2002). Nonetheless, due to political and economic variables within each system, the different systems have been acting as mutually exclusive silos. Based on the findings of this study, it appears leaders within each educational system in California including K-12 are acting within the paradigm of positivists, where there is a “belief that there is only one reality which exists independently of any one observer’s perspective and includes the whole gamut of organizational phenomena” (Bess & Dee, 2008, p. 46). To achieve the common goal of increasing the number of engineers from underrepresented groups, leadership within all systems of education should collaborate to set correct expectations and agree on common objectives. The current state of education demands new thinking, as outlined in the social constructionist’s paradigm where “there is no one objective reality,” and stakeholders incorporate their own experiences into perspectives on solutions (Bess & Dee, 2008, p. 47). To deal with shortages of engineers from underrepresented groups, educational leaders at all different educational levels should promote pedagogies, curriculum, and extracurricular activities that get students interested in engineering at a young age.

K-12 leaders can enhance interest in STEM engineering specifically by improving counseling services at high schools. Also, leaders should elevate high school graduation requirements for math and science to minimize remediation at community colleges. It is more cost effective for low-income students to minimize remediation time at community
colleges. Also, educational leaders should work with private and public entities employing engineers to host engineers as guest speakers or plan field trips to engineering sites. These are anti-deficit actions and at the same time can lead to augmenting the cultural capital of underrepresented students.

Implication #3. Understanding the challenges, strengths, wants, and needs of underrepresented groups in engineering. Providing access and success to engineering students from underrepresented groups requires leaders have better understanding of how underrepresented individuals in STEM become scientists (Hurtado, Cabrera, Lin, Arellano, & Espinoza, 2009). Educational leaders should engage students and parents from underrepresented groups to understand their cultural perspectives, concerns, and needs. According to Conrad, Canetto, Macphee, and Farro (2009), students from disadvantaged socioeconomic backgrounds are attracted to STEM fields for one or more of the following reasons: a) enthusiasm for science, b) possible social applications, c) high salaries, d) Enjoyment, and e) meaningful relationships with faculty peers in the field. The findings of this study confirmed all five findings by Conrad et al. (2009). Moreover, this study found parents can either influence their child’s interest in engineering or at minimum provide moral support for students to pursue engineering as a field of study.

Implication #4. Community college leaders should create awareness about community colleges as viable and feasible pathways for bachelor’s degrees in engineering. This study found some participants were unaware of the math and science
standards in higher education. Thus, most participants spent more time than they had expected at community colleges taking remediation courses. Educational leaders in K-12 and in community colleges should collaborate to ensure “no potential engineer from any background is left behind.” Leaders across the K-12 and community college systems should coordinate efforts to ensure adequate understanding of higher education requirements, proper preparation to minimize remediation, and a smooth transition of students into community colleges, especially for those students who lack cultural capital to understand higher education. Leaders across systems should act as anti-deficit agents by providing environments to serve those students lacking embodied, objectified, and institutional capital. Community colleges should start engaging with students at the K-12 level to create awareness about the type of courses needed to be taken in high school for engineering majors. A good example of how a community college can reach out and create awareness about its programs and services would be De Anza Community College in Silicon Valley, which attracts around 80% of its students from areas outside its defined service area boundary. De Anza College ranks among the top three colleges in transfer rates to UC and CSU campuses (Accreditation Evaluation Report for De Anza College, 2011).

**Implication #5.** *Improving student services including counseling and advising for engineering transfer students and creating academic clubs and activities on community college campuses.* Some participants of this study stated they had received poor counseling and advising services at community colleges, and some felt there were
not enough engineering-related events or activities at community colleges. Through collaboration with engineering schools at four-year universities, community college leaders can focus on providing more specialized career and academic advising for underrepresented engineering students. Community colleges could partner with four-year universities and engineering firms to create comprehensive counseling conferences, seminars, and sessions to help underrepresented students understand the academic and professional demands and rewards of engineering. Based on the findings, some participants valued the support they received from their community college instructors. Community college leaders should acknowledge and encourage instructors who informally serve as academic and career advisors. These instructors serve as anti-deficit agents by helping underrepresented students gain the cultural capital needed to transfer into a four-year university.

**Implication #6.** Community college leaders should look for creative ways to fund STEM programs, events, and activities. Resource dependence theory explores an organization’s relationships to external entities that control resources and how that control can either limit resources or dictate the usage models for provided resources (Bess & Dee, 2008). Community college leaders should diversify resources by creating win-win arrangements by engaging with engineering companies to acquire the latest laboratory equipment. Also, through mutual benefit partnerships, employers can offer expert guest speakers, field trips, internships, and jobs. In return, employers will have a
greater pool of diversified applicants to choose from and also lower-cost applicants since they do not require costly domestic or international relocation packages.

**Implication #7.** Community college leaders should emulate practices of for-profit higher education institutions. According to the Foundation for California Community Colleges (2011), one quarter of all community college students in the United States are enrolled in a California community college and two-thirds of California’s first-time higher education students begin their academic careers at a community college. Based on sheer numbers, the California community college system is the largest higher education system in the United States. However, according to Bailey (2007), “The growth of new types of educational institutions is potentially altering the role of community colleges within the wider landscape of higher education” (p. 1). Therefore, from a business perspective, community college leaders enjoy a large market share that they could stand to lose to for-profit higher education institutions. Using creative marketing techniques, flexible schedules, online delivery methods, and federal aid programs, for-profit colleges can pose a threat to public community colleges. “In a hypercompetitive economy with increasingly rational buyers faced with abundant choices, a company can win only by fine-tuning the value delivery process and choosing, providing, and communicating superior value” (Kotler & Keller, 2006, p. 36). Thus, community college leaders should learn from best practices at for-profit higher education institutions by increasing their marketing and awareness programs through direct advertising, public speaking events, and engagements with minority leaders. The radio
advertisement for the website icanaffordcollege.com is a good general start. Moreover, community college leaders should create greater awareness within their target market on the importance and affordability of community college education and the associated financial and social benefits of careers in engineering. Table 24 provides a summary of transformational leadership implications.

Table 24

Summary of Transformational Leadership Implications

| Transformational Leadership Implications |  
|----------------------------------------|--------------------------------------------------------------|
| 1- K-12 leaders should plant the engineering seeds early | Research by Wai et al. (2010) emphasized the positive impact of an extra STEM dose on students. Wai et al. (2010) defined “educational dose” as “the density of advanced and enriching pre-collegiate learning opportunities beyond the norm which students have participated in” (p. 861). |
| 2- Communication, Cooperation, and Collaboration among parents, leaders in K-12, community college, four-year university systems, and engineering-sector employers. | The current silo approach and the existing state of STEM education demands new thinking, as outlined in the social constructionist’s paradigm where “there is no one objective reality” and stakeholders incorporate their own experiences into perspectives on solutions (Bess & Dee, 2008, p. 47). |
| 3- Understanding the challenges, strengths, wants, and needs of underrepresented groups in engineering. | Due to their relatively low cost, course flexibility, locality, and open access policies, community colleges have been a good higher education alternative for a diverse population of students (Tsapogas, 2004). |
Table 24 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Transformational Leadership Implications</th>
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<tbody>
<tr>
<td>4-</td>
<td>Community college leaders should create awareness about community colleges as viable and feasible pathways for bachelor’s degrees in engineering.</td>
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<tr>
<td></td>
<td>“The growth of new types of educational institutions is potentially altering the role of community colleges within the wider landscape of higher education” (Bailey, 2007, p. 1).</td>
</tr>
<tr>
<td>5-</td>
<td>Improving student services including counseling and advising for engineering transfer students and creating academic clubs and activities on community college campuses.</td>
</tr>
<tr>
<td></td>
<td>According to Solórzano, et al. (2005), the lack of proper academic advising is one of the main reasons for failure to transfer.</td>
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<td>The absence of adequate academic advising can shift the focus to attrition variables (Bean, 1980) and deficit models (Valencia, 1997) rather than focus on the anti-deficit achievement model (Harper, 2010).</td>
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<tr>
<td>6-</td>
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**Policy**

In the words of President Franklin D. Roosevelt, “the test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little” (Roosevelt, 1937). Fairness and social justice are the cornerstones of policy. The following are implications related to policy in order to
provide better access for underrepresented groups in engineering through community colleges.

**Implication #1.** *Establishing mandates to construct tangible collaboration among high schools, community colleges, and four-year universities.* According to a study by the National Research Council (2005), there is a lack of communication, teamwork, and synchronization among K-12, community colleges, four-year universities, and state higher-education agencies, leading to uncertainty and deficiency in long-term planning. Based on the findings of this study, there is little evidence of any sizable and formal synchronization among high schools, community colleges, and four-year universities with regard to providing clear roadmaps for underrepresented students to utilize community colleges as local and low-cost pathways to bachelor’s degrees in engineering.

From a political framework, “goals and decisions emerge from bargaining and negotiation among competing stakeholders jockeying for their own interest” (Bolman & Deal, 2008, p. 195). Thus, leaders of K-12, community colleges, and four-year universities are more likely to respond to suggestions for more collaboration when these suggestions are tied to incentives within future funding allocations. For example, a small portion of the annual funding or extra grants from the state would be tied to growth in the number of underrepresented high school students pursuing engineering courses at community colleges. Also, community colleges would be rewarded and incentivized to increase the number of underrepresented students transferring to engineering programs at
four-year universities. By the same token, four-year universities would be rewarded with extra research grants for growth in graduation rates of underrepresented students in engineering. This collective and integrative incentive program by the state would incentivize all three educational systems to work together on promotions and awareness programs, counseling and advising across systems, enhancing communication among systems, establishing benchmarks, exchanging data, and creating a shared vision. When all three educational systems are marching towards the same goal and are offered extra needed resources, more communication and collaboration are likely to occur. Incentives and better synchronization can lead to improving the pipeline of underrepresented engineering students from high schools into four-year universities via community college.

**Implication #2.** *Influencing policymakers through emphasis on the economic value of community colleges, return on investment (ROI), and the voting power of underrepresented groups.* To impact policy, it is vital to change perceptions and create awareness about community colleges using documented data to emphasize the value community colleges bring to California’s economy and to those who use the community college system. Community college leaders should clearly communicate to the policymakers the short-term value and long-term benefits of community colleges as pathways to engineering schools at four-year universities. An integrated communication and lobbying campaign in cooperation with local businesses, high schools, community activists, African American and Latino/a community and religious leaders could raise
awareness of the significant role community colleges play and the tangible economic and financial benefits community colleges generate. Community college leaders can use data to influence decision making. Economic and financial data can influence political decisions regarding funding levels and processes.

Following are some key facts about community colleges based on research by the Foundation for California Community Colleges (2011): a) Community colleges are a cost-effective alternative for students who cannot afford to go to a four-year university for all four years; b) A 2% increase in the share of the population with an associate’s degree, combined with a 1% increase in the share with a bachelor’s degree, results in $20 billion in additional economic input, $1.2 billion more in state and local tax revenues annually, and 174,000 new jobs; c) Community colleges enroll the state’s lowest-income students. Full-time students have an annual median income of $16,223, with one-fourth having incomes of less than $5,544 per year; d) For every dollar California invests to get students into and through college, the state’s economy receives a $3 net return on investment; e) Over 60% of community college students are people of diverse ethnic backgrounds and over 55% are female; and f) Two-thirds of California’s first-time higher education students begin their academic careers at a community college. These key facts and figures illustrate the importance of the community college system for California’s economy and for low-income, first-generation college students, and underrepresented groups in education. To ensure adequate political support, California community college leadership can use these facts and projections to demonstrate the size and type of
populations benefiting from the community college system, and perhaps also the impact
this voting bloc can have on the local and state political map.

**Implication #3. Transforming the current funding model for California**

*community colleges.* Enrollment at the California community colleges has grown 44% in
the last 15 years, yet per student state funding in 2009-10 (adjusted for inflation) was
lower than it was in 1995-96 (California Community College Chancellor’s Office, 2012).
At the time the master plan was implemented in 1960, community colleges were funded
by revenue from local property taxes, which increased as property value increased.
However, in 1978, Proposition 13 (Prop 13) was passed, ending any annual property tax
increase based on property value appreciation. Prop 13 was clearly based on a
positivist’s paradigm where there is a “belief that there is only one reality which exists
independently of any one observer’s perspective and includes the whole gamut of
organizational phenomena” (Bess & Dee, 2008, p. 46). Moreover, one of the unintended
consequences or negative byproducts of Prop 13 was the decrease in available funds for
California community colleges and the increase in dependence on the state’s general
fund, including income and sales taxes, which are less predictable than property taxes.
This new unintended consequence resulted in fluctuating funding for community colleges
and has forced community college leaders to focus on short-term tactical goals rather
than on long-term strategic objectives.

This study found student services such academic counseling and engineering
clubs are major areas of improvement at community colleges. This could be the result of
reduced funding for community colleges. According to Bess and Dee (2008), resource dependence theory can be used to explore an organization’s relationship to external entities that control resources. To reduce dependence on fluctuating sources of funding, community college leaders should promote policies that truly consider education as a public good or right and not a privilege for a select few. When education is viewed as a public good, its long-term benefits become more appreciable. According to Darling-Hammond (2010), “High-quality education for all is a public good that is essential for the good of the public” (p. 328). For underrepresented groups, education could be the only way out of poverty. This study found higher education for participants from underrepresented groups was possible through community colleges. Moreover, increasing the number of college graduates from underrepresented groups is good business for the state since high rates of employment can generate savings which “include the more than $200 billion we now lose in wages, taxes, and social costs annually due to dropouts” (Darling-Hammond, 2010, p. 328). Furthermore, low-quality education can negatively impact the global competitiveness of the United States.

Another method to reduce dependence on fluctuating sources of funding would be to create new funding sources through partnerships with private companies and engineering employers in the state to create mutual-benefit initiatives where employers acquire well-trained local employees and community colleges secure new funding sources. Beyond the benefit of well-trained local employees, private companies can also be incentivized when new policies with tax incentives are enacted to reward companies
engaging with community colleges in these types of joint program. Table 25 provides a summary of policy implications.

Table 25

**Summary of Policy Implications**

<table>
<thead>
<tr>
<th>Policy Implications</th>
<th>1- Establishing mandates to create tangible collaboration among high schools, community colleges, and four-year universities</th>
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**Data-based Decision Making**

In 2002, nearly half of White high school graduates (47%) between the ages of 18 and 24 enrolled in college, compared with only 40% of Blacks and 32% of Latino/as.
Moreover, according to the National Center of Education Statistics (2012), African Americans received 5.6% and Latino/as received 4.8% of all bachelor’s degrees awarded in the 2009-2010 academic year. Thus, not only are lower percentages of African Americans and Latino/as attending college after high school, but also yet lower percentages are actually graduating with undergraduate degrees. The following are implications related to data-based decision making.

**Implication #1. Using current demographic data to properly plan for the future.** Increasing the number of engineering graduates from underrepresented groups requires long-term planning starting at the early stages of K-12 education. Leaders at K-12, California community colleges, and four-year universities should utilize qualitative and quantitative data-driven decision-making methods to plan and implement future tactics and strategies. According to Nevarez and Wood (2010), “With the increasing population of students of color in the community college, it is imperative leaders use this demographic information to prepare their institutions to address the needs of these groups” (p. 155). To get a better understanding of the demographics of community colleges of the future, educational leaders should be looking at current K-12 demographics. In the 2009-2010 school year there were 3,118,717 Latino students in California’s Kindergarten through 12th-grade (K-12) public school system, which comes out to around 50% of the total K-12 student population (California Department of Education [CDE], 2010).
For planning purposes, educational leaders can use data such as from the United States Census, which includes birth rates and ages based on zip code. For community college leaders, data from local high schools would also be a good source for decision making due to the fact that the overwhelming majority of students attend community colleges based on location and to stay close to family.

**Implication #2. Using historical data to improve student services.** General systems theory is concerned with the process whereby organizations transform inputs into outputs (Bertalanffy, 1972). For leaders and policymakers, it is important to understand and document the dependent and independent variables and how contributions can yield productivity. During the process of conducting this study, the researcher contacted the director of a MESA program at a community college in California (MESA Director, personal communication, October 18, 2012). The MESA director stated he does not maintain contact information or even a simple database for successful transfer students. Although this one finding cannot be generalized to all 112 community colleges in California, it can be used to illustrate the lack of data-based decision making and highlight the following: a) The MESA program at that community college is unable to provide data on success rates at four-year universities for successful transferees, b) The MESA program is unable to provide any data on employment and employability of community college transfers, and c) The MESA program is unable to contact and host successful MESA graduates as guest speakers for future MESA students. This confirmed the findings of the study regarding some participants’ negative perceptions of student
services at community colleges. Also, this finding confirmed the findings of a study of the National Research Council (2005):

Most often, community colleges lose sight of students once they transfer to four-year institutions, precisely when they should begin tracking their educational and career trajectories. Compiling and publicizing data on transfer students’ success in obtaining B.S. engineering degrees would demonstrate the effectiveness of engineering studies in community colleges and improve their recruitment rates. (p. 5)

The findings of this study demonstrated an anti-deficit achievement program like MESA lacked the data to quantify its success, which could mean the program could be eliminated during periods of decreased funding. Table 26 provides a summary of data-based decision making implications.

Table 26

Summary of Data-based Decision Making Implications

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**Future Studies**

The population of the community college system is very diverse. According to Laanan (2001), “Because of transfer students’ diverse backgrounds, more research is warranted to better understand the factors facilitating or impeding their educational success” (p. 343). Based on the findings, the following are possible future studies that would be logical extensions of this study:

- The participants in this study were transfer students from multiple fields within engineering such as civil, mechanical, computer, and electrical. Also, the participants in this study were male and female and identified themselves with multiple ethnic backgrounds such as Latino/a, African American, and White. A logical follow-up study for this research would be a study based on genders in specific engineering fields. Also, a study based on ethnicity in specific engineering fields for deeper understanding and analysis of the impact of the community college on transfer students based on gender, engineering field, and ethnic background.

- A study on the impact of remediation on the success and persistence of underrepresented students in engineering.

- A study on passionate STEM instructors at community colleges and their role and impact as informal leaders.
• A study on underrepresented individuals as full-time engineering professors at specific institutions and their impact on the success of underrepresented students.

• A follow-up study to see how many of these underrepresented transfer students end up earning an engineering degree from a four-year engineering school.

• The 14 participants in this study were transfer students from 17 different community colleges so a further study of students from one community college at a time would provide deeper understanding, in a case-study format, of each college’s contribution to helping underrepresented students in engineering transfer to four-year universities.

• The 14 participants in this study transferred to four different universities; hence, a future study of students from one community college who transferred to one university would provide data about experiences of different individuals from one community college who transferred to one university.

• A longitudinal study following a group of high school students over a period of five to six years from high school into community colleges and finally through graduation from four-year universities.

• A case study on community colleges with high transfer rates for underrepresented engineering students to understand their exemplary programs and practices.
Some of the Latino/a participants in this study were first-generation immigrants and others were second-generation immigrants. Future studies on each generation separately would help compare and contrast the academic and cultural challenges for each generation.

A longitudinal study following students from similar backgrounds and high schools who decide on engineering through community colleges to discern their persistence and success rates and understand the reasons for dropping out of engineering compared to peers who persisted.

The African American participants in this study transferred to predominantly White institutions (PWIs). Future studies to understand the experience of African Americans who transferred to historically Black colleges and universities.

The Latino/a participants in this study transferred to predominantly White institutions (PWIs). A logical future study would seek to understand the experience of Latino/as who transferred from community colleges to Hispanic serving institutions (HSIs).

The participants in this study did not receive considerable academic or career advising from counseling services at community colleges. A future study of community colleges with more structured counseling services to underrepresented engineering students.
A study on civic engagement efforts such as volunteering, mentoring, and coaching by community college students who were able to earn four-year engineering degrees.

**Researcher Positionality**

Overview: The author of this study (Samer Musa Batarseh) is a first-generation Jordanian-American who obtained a bachelor’s of science in electrical and electronic engineering (BSEEE) from California State University, Sacramento (CSUS) after attending San Joaquin Delta College (SJDC) in Stockton, California, where he completed freshman and sophomore courses in math, chemistry, physics, and computer science. The author has been working for a Fortune® 100 technology company since the year 2000. Also, the author has been an adjunct community college instructor teaching computer science and business courses since 1999.

Positionality: It is my passion and enthusiasm for community colleges, engineering, education, teaching, and equity that led me to pursue a doctoral degree in educational leadership and conduct this specific study on the use of community colleges as pathways to earning four-year engineering degrees. Since I was a young child, I knew I was going to be an engineer. Moral support from my parents, five siblings, grandparents, aunts, uncles, cousins, and friends was instrumental to my persistence despite facing challenges such as being away from my immediate family, extended family, and social support network.
My decision to utilize a community college to complete my undergraduate math and science courses was based solely on cost. I knew my time at community college was just a transition phase or temporary stop on my way to a four-year university. I strongly believe without the community college system and without student financial aid programs like grants and loans, I would not have obtained my undergraduate degree in electrical engineering. The need for financial aid was also a common theme for all participants in my study.

During my community college years, I worked as a teacher’s assistant (TA) in the chemistry laboratory and I used to interact with my instructors and all other instructors in the science department. After transferring to a four-year university, I felt I was on my own. The campus was bigger and the coaching and mentorship relationships I had developed with my community college instructors were not the norm at a four-year institution. So I made a copy of the graduation requirements page from the catalogue and crossed out courses as I completed them. At the four-year university, I did not have any formal coaching, mentoring, or advising. I did not join any engineering campus club, and I did not have any study groups for homework or exams. After interviewing all the participants in this study and realizing they had mentors and joined various campus clubs that offered them support, I was really amazed I actually ended up graduating with an engineering degree. I had not utilized many of the tactics and strategies used by my study participants. I believe my self-concept and an intrinsic sense of determination propelled me to succeed against all odds. My self-concept and sense of determination
have been shaped by many memorable individuals who came into my life at different times. I will present a few of these amazing individuals as space constraints keep me from including the many others who could be mentioned.

**My Grandmother**

One of the most memorable individuals who shaped my identity and strong self-esteem was my grandmother. During the first few years of my life, I was influenced by the daily interactions I had with my grandmother, who lived with us in the same house. She was a lady with a very strong personality shaped by extreme hardship and a will to survive. My grandmother was unable to read or write but compensated for that deficiency by having a transistor radio she carried around with her everywhere she went. Sometimes she would drop it, and she would tie it back together using electrical tape or wrap it with rubber bands, and she would not let it go until my father got her a new one. She listened to her transistor radio periodically throughout the day, and it provided her with a window to the world.

The knowledge base she acquired from listening to shortwave stations throughout the world was impressive, considering she could not read. As soon as I was able to read, my grandmother would sit me down and ask that I read her excerpts from the Bible, books, magazines, and newspapers. She would also ask me questions about what I had just read. Those prolonged reading and questioning sessions helped me develop good reading habits, comprehension abilities, and summarizing skills that have helped me throughout my educational journey and professional career. My illiterate grandmother
was a big education advocate, as she was deprived of this opportunity as a girl. I remember one time when I was a young boy she told me that had she gone to school, she would have been like “Tasher.” When I asked her who was Tasher?, she replied, “Tasher is the Iron Lady who is running the British Empire.” Later, I figured out she was referring to Mrs. Margaret Thatcher, the Prime Minister of England in the 1980s. The many lessons I have learned from an illiterate old lady while growing up in the 1970s and 1980s still prove applicable in the 21st century.

**My Father**

My grandfather passed away when my father was two years old. My grandmother did not have any pictures of my grandfather so my father was always asking friends and relatives whether they had or had seen a picture of his father. One morning, he told us that he saw his father in a dream and when he described him to my grandmother, she confirmed it. I am not sure if that was the truth or it was just my grandmother’s way of giving my father his life’s dream of meeting or seeing his father.

I believe my father’s quest for a picture of his father was symbolic of his deep pain growing up without a father figure. Therefore, my father went on a personal mission and beyond the call of duty to be the best father without having a personal benchmark or frame of reference or firsthand experience of fatherhood. Growing up without any real father figure in his life, my father developed a keen sense of family unity and has always reminded us of the importance of unity as a family. My father was a leader who led by example when it came to hard work, sacrifices to his country, love for his family, loyalty
to friends, and caring for total strangers. During his life, my father treated all people, regardless of their wealth or social status, with the same respect and dignity. My father was a teacher of life who actually spent time with me discussing things beyond academics such as duty, loyalty, and persistence. He would tell me stories from his childhood and about his lost dreams in order to emphasize the importance of education, family, and hard work. My father joined the army at the age of 16 because that was the only alternative for someone without formal education. Nonetheless, he had pride in his work and always epitomized loyalty, hard work, and perfection. His colleagues had nothing but praise for his hard work, dedication, loyalty, and honesty. Throughout his army career, my father visited many countries, including a two-year assignment in the Jordanian embassy in England.

My father’s teachings on moral principles and righteousness helped create my major perceptions about having a higher purpose in life. He actually transformed his own life and the lives of his mother and sister with his hard work ethic and high moral principles. My father spoke Arabic and English fluently; he read books in both languages, and actually translated pieces of literature from one language to another. Growing up without any support system beyond his mother and having to leave school after the seventh grade to support his mother and sister, my father was able to live his educational dreams vicariously through his children. There are six children in my family and among us, five have managed to earn four-year college degrees, four of whom have
gone on to earn graduate degrees in areas such as business administration, nursing, civil engineering, and history.

My father was able to communicate his vision using parables and stories about the importance of knowledge and education. He would always say a person can lose all his/her material possessions, but education will last forever regardless of time or place. My father has always had an extensive library of books, and reading was part of his daily routine and a habit he instilled in all of his children. The home library was my father’s way to compensate for the tough circumstances that prevented him from earning a university degree. The home library had hundreds of books, including books on history, technology, poetry, religion, geography, and politics. I believe my father’s informal education surpassed the formal education of many college graduates because it was based on a passion to learn, not a desire to use education to get a job. He always spoke about education with great passion mixed with sadness that the opportunity to pursue formal education had never been an option for him as his duty to his family was much greater than his personal desire to pursue education. After leaving the army, my father accepted a job with an American company in Saudi Arabia, which meant we would only see him for a week or two every few months. When I became a father, I realized the enormous sacrifice he had made by working away from the family just to make sure we had a good standard of living and, most importantly, a good education through private schools.

On his deathbed, he asked my mother about me and whether I was able to fly from California to Jordan. I arrived within a couple of days and once I got to the house,
he asked the whole family to gather around his bed. He asked us to form a circle by holding hands, and he led everybody in a final prayer with a message that summed up his life and his humanistic philosophy about compassion and unity. After that prayer, he went into a coma for four days and passed away quietly in his bed. Even as the cancer spread through his brain, my father was able to be the consummate teacher, and his final lesson to me was that one must not let distances, times zones, disease, pain, or any other obstacle stand in the way of one’s desire and determination to deliver one last positive message, even if that final message consumes the last ounce of strength. My father was a man of higher purpose that transcended self and family. He always tried to instill in me that I must always look for a higher purpose, and everything else would fall into place.

My Mother

My mother lost her father when she was a very young girl and was sent by her grandfather to a boarding school. She grew up in an orphanage. She married my father when she was 16 years old. Although she had only ninth-grade education, she valued education and pushed all of her children to pursue it, maybe because she had been a high-achieving student who had to quit school to get married like all the other girls of her time. She would always tell us stories about her good grades and how the nuns and teachers in the boarding school used to commend her for her high academic achievements. I believe my mother has always viewed her success through the achievements of her children.
My Best Friend

I met Jacob when I was 13 years old in the neighborhood where we grew up in Amman, Jordan. One of our favorite pastimes as teenagers was to go to the big soccer stadium in town and watch soccer games, since we were fans of the same soccer team. Jacob left Jordan a couple of years before I did, and when I decided to move to the United States, I moved to the same city in California. Although I came from a middle-class family, I lost my support system the minute I arrived in the United States. Nonetheless, my best friend was there for me. Jacob lined up a job for me before I even moved there, and I started working three days after moving to the United States. Three months later, I started attending community college. After a few months of going to college and working, I reached a point where I could not handle or afford doing both and had to reconsider my college plans at least for a while.

When I told Jacob of my decision, he disagreed, and insisted I keep my engineering dreams alive. Later that night, Jacob told his parents about my plans to reconsider college, and they decided to take me in their house as one of their own children. Jacob and I shared a room in his parents’ house in Stockton, California. Jacob is a true example of loyalty and dedication. The friendship I shared with Jacob was the cornerstone of my support structure during my early years in college. Without his support, my life would have taken a whole different direction. Jacob and I are still close friends. I am also the godfather of his son. Also, I was the best man at his wedding in 1990, and he was the best man at my wedding in 2002. Having a home and an adopted
family in the United States gave me the foundation to focus on my college studies and formulate a plan to transfer to a four-year university.

**My Community College Professor**

During my first two years as a community college student, I was influenced by my chemistry instructor at San Joaquin Delta College in Stockton, California. He was one of the most demanding professors in the whole school but in order to get into engineering school, I had to take his chemistry class. In the first class meeting, he announced he was proud of being a tough instructor, and reminded everybody of how life usually gets tougher and tougher as we grow older. During some of his lectures and laboratory time, I was sometimes busy interacting with my classmates and he knew it was not all class-related. Thus, he developed a negative impression of me. A month later, we had our first exam and I scored 96/100, which was one of the highest grades a student had ever had on that specific exam. When I reviewed my exam, I thought I deserved one more point. So I walked up to him and asked him to reconsider the point, and he became visibly angry and in front of the whole class said, “I have given you one of the highest grades ever given on this exam and you are asking for more?” I immediately responded by saying, “You did not give me the grade, I earned that grade.” Needless to say, I was not granted the extra point and he watched every move I made in the class from that day on. A month later we had the second exam, and he refused to give me back my graded exam and asked to see me in his office. In his office, he was visibly upset because I scored only 73/100 and asked me to explain. I was shocked that he actually cared. I
explained to him that I had voluntarily opted to move to the U.S. and even though I came from a middle class family, I was going through hard financial times and since I could not ask my family for help, I had to pick up some extra work that was physically demanding and impacted my study time. He did not say anything and just told me to follow him. He took me to the department office, and introduced me to the person there as his new teacher’s assistant. He left me there to fill out the paperwork and came back later and told me he would assign me 20 hours a week but estimated the actual work would take much less time, but he expected me to use my downtime on the job to study and complete my coursework. During the two years I worked for this professor, he shared some personal stories with me about his experience as an African American young man growing up in the South in the 1960s. The personal moments he shared with me were so powerful they made me feel I could achieve anything. My community college professor served as a coach and mentor. Today, as an adjunct community college instructor, I like to think my approach to teaching is based on my professor’s style of positive outlook and mentoring. I tell my students it is easy to find excuses but if we look carefully, there are always ways and reasons to work hard and succeed. My desire to share my corporate experience with community college students is my way of thanking my community college instructor who picked me up when I was down.

**My Wife**

I met my wife at an engagement party in Jordan. We went out the day after, exchanged e-mail addresses, and then I went back to California in the evening. A few
months of e-mails and a few thousand dollars in phone bills later, we decided to get engaged, and got married one year to the day from the day we met. My wife, who is also an engineer, resigned her job at an architecture design firm to dedicate herself completely to our three children Serene Petra, Lameese Jerash, and Jad Jordan. Her dedication to the physical, mental, social, and spiritual growth of our children is phenomenal. My wife’s encouragement and support are the main forces behind my decision to go back to obtain a doctoral degree while working full-time and teaching part-time. She is the cornerstone of my persistence and eventual completion of my doctoral studies. Her great attitude, endless energy, and unconditional love are the reasons behind all the positivity and joy, and the healthy environment at our home. Her love and compassion are the reasons I strive to be a better husband, a better father, a better son, a better brother, and a better human being.

In my study, the participants’ pathways towards engineering degrees had some commonalities and also some differences with my own pathway. Yet the community college pathway is unique, as it appears to have a “positive change agent” or an “anti-deficit achievement hero” as a common fixture. The community college pathway started as a cost-saving decision and ended up as a life-changing experience that does not seem to lose its impact over time, as evidenced by my own feelings and by the feedback from the two participants who have been working as engineers for over 15 years.
Conclusion

The United States is expected to experience shortages in university graduates with engineering degrees (Sinkele & Mupinga, 2011). Increasing the number of underrepresented individuals in STEM fields can help the United States maintain its global competitiveness, strengthen its workforce through diversity, and enhance social justice (Newman, 2011). Based on the findings of this study, recommendations for students and parents were organized based on three educational stages: the pre-community college stage, the community college stage, and the post-community college stage. Based on the findings and literature review, implications were identified and organized based on the three main pillars of the educational leadership program at California State University Sacramento, which include transformational leadership, policy, and data-based decision making.

Overall, the participants in this study came into community colleges for various reasons such as low cost, proximity to family, peer pressure, remediation, and to experience higher education. Eventually, they ended up utilizing community colleges to complete 50% of course requirements for an undergraduate degree in engineering, acquire new academic skills, more cultural capital, and the aspirations to become engineers, graduate students, entrepreneurs, and volunteers. Bourdieu (1977) defined habitus as:

A system of lasting, transposable dispositions which, integrating past experiences, functions at every moment as a matrix of perceptions, appreciations, and actions and makes possible the achievement of infinitely diversified tasks, thanks to
analogue transfers of schemes permitting the solution of similarly shaped problems. (p. 83)

The participants in this study were low-income and underrepresented individuals in engineering who did not have the needed “habitus” that would prepare them financially or emotionally to pursue degrees in engineering. However, perspectives provided by study participants pointed to the community college experience as providing “habitus” for success. Based on the findings in this study, the drive to succeed was the product of the participants’ pride in being trailblazers, the desire to become role models, the dream to improve their own standards of living and those of their loved ones, and an intrinsic motivation to succeed against all odds.
APPENDICES
APPENDIX A

Interview Questions

I- Background Information

1) Gender: Female / Male

2) Race: Latino, Latina, African-American

3) Age Group: 18-25, 26-35, 36-45, 46-55, 56+

4) Marital Status: Single, Married, Divorced, Single Parent

5) High School GPA:

   ______3.5-4.0 ______3.0-3.49

   ______2.5-2.99 ______2.0-2.49

   Other, please specify ______

6) How many community colleges did you attend before transferring to a four-year university:

   ______One Community College       ______ Two Community Colleges

   ______Three Community Colleges       ______ Four or more Community Colleges

   List the names of all colleges attended:

   ______________________________________________________________

   ______________________________________________________________
7) How many four-year universities did you attend before transferring to a four-year university:

- One University
- Two Universities
- Three Universities
- Four or more Universities

List the names of all four-year universities attended:

- 
- 

8) How many units did you complete and transfer from community college(s) to the four-year university you are currently in or graduated from:

- 5-10 semester units
- 31-35 semester units
- 11-15 semester units
- 36-40 semester units
- 16--20 semester units
- 41-45 semester units
- 21-25 semester units
- 46-50 semester units
- 26-30 semester units
- 51-55 semester units
- 56-60 semester units
- 60+ semester units, please specify

9) What is your father’s highest level of education?

- Elementary School
- Junior High School
- High School
10) What is your mother’s highest level of education?

- Elementary School
- Junior High School
- High School
- Some College
- College - Associate Degree
- University- Undergraduate Degree (Circle one: BA/BS)
- University- Graduate Degree (Circle one: MEd/MA/MS/MBA/EdD/PhD)

11) Which of your family members have attended or are currently attending college?

- Grandparent
- Cousin
- Mother
- Sister
- Father
- Brother
- Uncle
- Aunt
- Other: ........
Pre-Community College Experience

1) Tell me a story about your most memorable personal experience related to engineering

   a. Describe people who influenced you in choosing engineering as a field of study, if any.

   b. Describe any engineers you grew up interacting with or observing.

   c. Tell me about your science experience in high school.

2) Tell me how you came to attend a community college.

   a. Describe what led you to attend community college on your way to a four-year university. Probe: What were the pros and cons? i.e.

      Location, distance, public transportation, car pooling, job locations, family, friends, church, etc.

B- Community College Experience

1) Tell me about your search and application processes for enrolling in a community college

   a. Describe how you obtained information about engineering at community colleges. i.e. Peers, teachers, and counselors,

2) Describe your experience at a community college.

   a. Describe the impact that the community college experience has had on you as it relates to preparing you or not preparing you for your journey at a four-year university.
b. What were your expectations when you enrolled in the community college?

c. Were your expectations met or not? Probe: Please provide some examples.

3) Explain some of your perceived pros and cons of attending a community college prior to attending a four-year university.

4) Based on your experience(s), what would you recommend to further improve the services community colleges provide for minority and/or women engineering students?

C- Post Community College Experience

1) Describe your personal strengths that have helped you transfer from a community college to a four-year university. Probe: Ask about study habits if not mentioned.

   a. Please tell me about your work tactics and strategies towards course work. i.e. Cramming, weekly slots, or daily slots.

   b. Explain how you managed your other commitments like work, family, friends, and other activities.

2) Describe the driving forces behind your commitment to graduating with an engineering degree.

3) Describe how your community college experience helped shape your academic goals and career goals.
a. Tell me about your ultimate academic goal.

b. Tell me about the driving forces behind achieving this academic goal.

c. Tell me about your ultimate career goal.

d. Tell me about the driving forces behind achieving this career goal.

4) Tell me about any other factors that might have assisted you thus far in getting closer to your academic and career goals. i.e. Campus clubs, field trips, and internships.

5) Describe what engineering as a career means to you.

***** Do you have any other information that you would like to share?
APPENDIX B

Consent to Participate in Research

My name is Samer Batarseh, Doctorate Candidate in Educational Leadership and Policy at California State University Sacramento. I am conducting research to explore the personal experience of minority individuals in engineering (specifically male and female African Americans and Latino/as) who opted for community colleges as pathways to gain admission into engineering schools at four-year universities.

I was hoping that you would be willing to be interviewed, at a time and place convenient to you as part of this research during the month of December 2012. The interview should take 60-90 minutes and in exchange for your time and effort you will be given a $20 gift certificate from a national retailer (Target or Wal-Mart). The title of my research project is:

“Understanding the Experiences of Minority Individuals who Utilized Community Colleges as Pathways to Gain Admission into Engineering Schools at Four-Year Universities”

As a participant in this study your anonymity will be maintained at all times. You will be assigned a code number known only to the researcher. No comments will be ascribed to you by name in any written document or verbal presentation. Nor will any data be used from the interview that might identify you to a third party. You can skip any question or stop the interview at any time. If you choose to stop the interview, your data will be destroyed immediately. With your permission, the interview will be recorded using a digital media device. My dissertation will be available electronically through California State University, Sacramento Scholarworks.

Findings from this study will benefit the field of higher education as a whole and will be used to further the understanding of successful pathways towards engineering degrees via community colleges as higher education bridges to four-year universities. There are no foreseeable risks or discomforts to your participation. However, if you become emotional or distressed due to the nature of the questions, please contact the California Board of Psychology. 2005 Evergreen Street, Suite 1400. Sacramento, CA 95815. (916) 263-2699. (www.psychboard.ca.gov)

If you have any questions concerning the nature of the research or are unclear about the extent of your involvement in it please contact email me at samer.m.batarseh@gmail.com or call me at [redacted] or contact my dissertation chairperson Dr. Caroline Turner at csturner@saclink.csus.edu or (916) 278-3580
Your participation in this research is entirely voluntary. If you have read this document and agree to participate, please e-mail me at [REDACTED] or call me at [REDACTED] so that we can arrange for you to sign the consent form before we begin the interview.

Finally, I thank you for taking the time to consider my request. I look forward to your reply.

**Giving of Consent**

I certify that I am at least 18 years of age. I have read this two-page consent form to participate in the study and I understand what is being requested of me as a participant in this study. I freely consent to participate. I have been given satisfactory answers to my questions. The investigator provided me with a copy of this form.

☐ I give consent to be **interviewed** for this research.

____________________________________
Name of Participant (Printed)

____________________________________
Name of Participant (Signed)           Date

☐ I give consent to be **audio taped** during my interview.

____________________________________
Name of Participant (Printed)

____________________________________
Name of Participant (Signed)           Date

____________________________________
Name of Researcher (Signed)            Date
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