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The Underrepresentation of Women Studying Engineering: A Grounded Theory Case Study

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THE UNDERREPRESENTATION OF WOMEN STUDYING ENGINEERING: A GROUNDED THEORY CASE STUDY

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The purpose of this case study is to explore the lived experiences of women engineering students. Social cognitive and social cognitive career theories served as the theoretical foundation of this study. In this study, a sample of seven engineering students from a small private university in Ecuador were interviewed using a semi-structured format to explore their perceptions of factors that help and hinder them in pursuing a degree and career in engineering. Using a grounded theory methodology, this study proposed a mid-level theory of the factors and processes that support and challenge them as engineering students at this institution. Themes pertaining to factors supporting students included aptitude, preferences, and passion, relationships that matter, and resilience acquired through life goals and dreams. Themes relating to challenges women engineering students perceived included machismo as hegemonic masculinity, gender socialization, "guy talk," and the weed-out culture of engineering. The implications of these results for students, faculty, and administrators are discussed.

In memory of Xavier Fernández Orrantia

—whose leadership, support, and friendship are dearly missed.

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Chapter 1: Introduction

During the 1990s, higher education around the world experienced a historic demographic shift: Women's participation in higher education grew at a rate faster than that of men's, reaching parity around the year 2000, and growing steadily thereafter to surpass men's enrollment rates (United Nations [UN], 2015). In most regions of the world, women now outnumber men in higher education (UN, 2015). From an aggregate perspective, these data are remarkable; however, if disaggregated, the data reveal that the shift has been almost imperceptible in specific fields of study. Women's participation in higher education is unevenly distributed and segregated according to gender: Women's enrollment is concentrated in the fields designated as education, health and welfare, humanities and the arts, and is sparse in science, engineering, manufacturing, construction, and agriculture (UN, 2015). Of these latter fields of study, the gender disparity most acute globally is found in engineering, where one out of twenty women graduate as opposed to one in five men (UN, 2015).

In the United States, since the 1990s, women have earned 57% of all bachelor's degrees (National Science Foundation [NSF], 2017), but enrollment and degree attainment according to discipline relays a distinct narrative. While in psychology, the biosciences, and social sciences, women represent more than half of graduates at all degree levels, in computer science, physics, and engineering, women enroll and graduate at disproportionately low rates, amounting to less than 20% at the baccalaureate level (NSF, 2017). As engineers enter the workforce, gender disparity becomes an even greater problem: Only 14.5% of engineering professionals in the United States are women (NSF, 2017), and this scarcity resides in a sector where demand far exceeds supply and that is characterized by high growth and well-paid employment opportunities (Vilorio, 2014).

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has declared that women's underrepresentation in science, technology, engineering, and mathematics, widely known as the STEM fields, is a global phenomenon with global cause for concern: "Gender equality in STEM is a matter of principle, a basic human right; it should also be considered as a crucial means to promote scientific and technological excellence" (UNESCO, n.d.). The field of engineering in particular is central to promoting scientific and technological excellence and has been identified as crucial to societal progress and increasing prosperity (Gill, Sharp, Mills, & Franzway, 2008). However, engineering's potential to innovate in the service of societies is limited by the "homogenous nature of the profession and its associated resistance to greater inclusivity of people other than the mainstream males" (Gill et al., 2008, p. 391). Indeed, the paucity of women in engineering is strikingly at odds with the gender demographics of the populations it is intended to serve (Gill et al., 2008). Women comprise more than half of the global population, are thus disproportionately affected by the world's economic, social, and environmental challenges, yet are a minoritized presence in the development of solutions: "If only one kind of person asks the questions and interprets the results, then the field of scientific inquiry will be narrow and inbred" (Blickenstaff, 2005, p. 383) and it will continue to reinforce systematic gender disparity and a culture and climate of exclusion.

In Ecuador, the historical development and current rates of women's participation in higher education and engineering are similar to that of the United States. In the 1990s, women's enrollment in higher education reached parity, and since then has grown incrementally, representing approximately 55% of the student population (Troya, 2016). Like the United States, women's enrollment differs significantly according to field of study: Approximately 65% of women's enrollment is concentrated in business and administration, education, and health and social services, and only 5% in the segment classified as engineering and construction (Troya, 2016). Women are overrepresented in the social sciences and humanities and underrepresented in fields traditionally adopted by a masculine majority, such as the applied sciences and engineering (Ovando Crespo, 2014). The result is a higher education system of feminine and masculine disciplines, in which gendered stereotypes are transmitted and reinforced (Acosta, 2016).

Understanding gender and its relation to the educational and career choices women make is a vital step in improving their participation in engineering. Fouad et al. (2010) have described women's participation in STEM fields as a "systematic and differential filtration" (p. 362), which, as evidenced by the research, is not due to gender differences in basic abilities or aptitudes (Else-Quest, Mineo, & Higgins, 2013). The historical and pervasive myth that boys are better than girls in math and science has been contested by the rapid improvement of girls' achievement scores in mathematics and science (Hill, Corbett, & St. Rose, 2010). In looking at the influence of gender on educational and occupational decisions, research has found a relation between gender disparities in STEM participation and attitudinal differences (Else-Quest et al., 2013). Sadler, Sonnert, Hazari, and Tai (2012) found that gender differences in the K-12 system were expressed through girls' attitudes toward science that were either less positive than boys' or decreased more significantly with age. Research of this nature has pivoted attention away from traditional assumptions of innate ability determined by biological gender differences and toward an examination of the cultural factors and societal beliefs that impact women's academic achievement, interests, and choices (Hill et al., 2010). In other words, other influences are actively contributing to the chronic underrepresentation of women studying engineering—and these become ground for inquiry and potential for greater understanding.

Gender: Social and socialized construct. To clarify and set the context for this study, it is important to comment on the term gender. Gender supplies the premise and essential framework to understand women's underrepresentation in engineering. This qualitative study assumes that gender is a social and socialized construct: Biology may define biological sex, but gender determines "how humans think about biological differences, how they assign social activities based on what they perceive to be such differences" (Harding & McGregor, 1996, p. 303). Tonso (2008) defined gender "as a complex social construction: contingent, contextual, contested ways that masculinities and femininities are embodied, enacted, and differentiated in everyday social life" (p. 31). Gender is the social construct and the "social contribution to the relationship between men and women" (Harding & McGregor, 1996, p. 303).

Harding and McGregor (1996) discussed the "gender dimension of science and technology," which presents the argument that rather than extracting the culture of science and technology and viewing it in isolation from society, it should be understood as embedded in the social meanings and cultural patterns that are differentiated by gender (p. 302). Science is neither an isolated nor a non-partisan construct but a conceptualization configured, Chandler (1996) asserted, by men's perspectives of reality.

The culture and practices of science and technology interact with socially constructed differences between men and women, to shape and be shaped by them (Harding & McGregor, 1996). Socialized gender differentiation is problematic because of the differentiated values it ascribes to male and female (Bussey & Bandura, 1999), and the gender typing of disciplines it produces, such as science and math as male (Hill et al., 2010). In the male-dominated environment of engineering, gender is essential to relational dynamics and the academic and career experiences of women (Smith and Gayles, 2018). At the same time, however, the social configuration of STEM may also represent the source of opportunity: “The notion that science rather than being etched-in-stone [in] fact is culturally and socially constructed, opens up the possibility of reconfiguration and inclusivity that was previously normatively illegitimate” (Hartman, 2008, p. 6). Thus the purpose and intent of this qualitative study arises also from the premise of opportunity and a stance of advocating for change.

Purpose of the Study

The persistent gender disparity among engineering students motivates the need for further research into women’s perceptions of the factors and processes that help and hinder them in pursing a degree and career in engineering. Consistent with this need, the purpose of this study is to explore the lived experiences of women engineering students. For this purpose, a qualitative approach was adopted to focus on lived experiences, or how women experience engineering—“how they perceive it, describe it, feel about it, judge it, remember it, make sense of it, and talk about it with others” (Patton, 2002, p. 104).

Research Questions

The research questions were organized into a central, overarching question along with three sub-questions:

Central question:

- What are the lived experiences of women engineering students?

Sub-questions:

- What are the factors and processes that support women who study engineering?
- What are the factors and processes that hinder women who study engineering?
- How do women who study engineering overcome challenges?

Theoretical Perspectives

The research and literature have discussed gender disparity in STEM fields and specifically engineering to help provide an understanding of the factors and processes that influence women as they pursue their study majors and careers. Social cognitive and social cognitive career theory have synthesized the role of gender and environmental influences into theoretical models that conceptualize and examine women's academic and occupational pathways.

A social cognitive approach to gender development and differentiation. Social cognitive theory examines the psychosocial factors and processes by which individuals are socialized within society (Bussey & Bandura, 1999, p. 676). Social cognitive theory provides a conceptual framework to understand how gender differences and the assignment of gender roles and attributes "arise more from cultural design than biological endowment" (Bussey & Bandura, 1999, p. 676). As such, this perspective rejects a determinist view in which biology dictates gender role and conduct and reduces social behavior to rules of nature (Bussey & Bandura, 1999).

Gender is paramount in social cognitive theory. Gender acts as the basis of human differentiation (Bussey & Bandura, 1999) and as an organizing concept of society (Patton, Renn, Guido, & Quaye, 2016). According to social cognitive research:

> Gender development is a fundamental issue because some of the most important aspects of people's lives, such as the talents they cultivate, the conceptions they hold of themselves and others, the sociostructural opportunities and constraints they encounter, and the social life and occupational paths they pursue are heavily prescribed by societal gender-typing. It is the primary basis on which people get differentiated with pervasive effects on their daily lives. (Bussey & Bandura, 1999, p. 676)

Social cognitive theory contributes further depth and dimension to the analysis of gender by locating it at the core of a model of *triadic reciprocality* (Bussey & Bandura, 1999). This approach to gender is based on the reciprocal interactions that occur between personal, behavioral, and environmental components (Bussey & Bandura, 1999). Personal components include gender-related cognitions, judgmental standards, and self-regulatory influences; behavioral components are the actions linked to gender; and environmental components are the numerous social influences that abound through family, peers, educational settings, and media (Patton et al., 2016). A social cognitive approach to gender development and differentiation unravels a host of psychological and sociocultural determinants that influence each other and produce gender conceptions and behavior (Bussey & Bandura, 1999)—or, in other words, determine how men and women "do gender" (Powell, Bagilhole, & Dainty, 2009, p. 1). And, for the purpose of enriching this study, how women do gender in male-dominated environments such as engineering (Powell et al., 2009).

The literature has shown that women's underrepresentation in engineering is not a matter of aptitude or ability (Else-Quest et al., 2013). Social cognitive theory identifies self-efficacy as an additional variable of influence. Women's perceived self-efficacy, or their self-beliefs about their capabilities, present "a common pathway through which different forms of social influence affect the quality of human functioning throughout the life course" (Bussey & Bandura, 1999, p. 691). Eccles (1994) asserted the importance of confidence in one's abilities to succeed and personal efficacy as linked to the behavioral choice involved in education and career decisions. Bussey and Bandura (1999) concluded that perceived self-efficacy applies a heavy filter and process of selection when individuals contemplate education and career choice to the extent that a range of vocational possibilities may be eliminated, regardless of their potential benefits. Furthermore, this variable demonstrates another dimension of gender differentiation in the sense that, compared to men, women's vocational choices are more heavily influenced by perceived self-efficacy (Bussey & Bandura, 1999).

Social cognitive career theory (SCCT). Rooted in general social cognitive theory, social cognitive career theory reiterates the model of interaction between person, environmental, and behavioral variables and expands the analysis of how this interplay affects people's educational and occupational interests, choices, and performance outcomes (Lent et al., 2005). SCCT examines "three key areas of academic and career development: a) how basic academic and career interests develop, b) how educational and career choices are made, and c) what factors affect academic and career success" (Miller et al., 2015, p. 49). The SCCT literature has set forth the argument that women face unique educational and occupational challenges in STEM fields (Miller et al., 2015). SCCT research has been applied to the study of women in engineering to offer a more comprehensive and coherent theoretical base from which to understand their underrepresentation, specifically the role of gender in influencing women's choice of and persistence in STEM (Miller et al., 2015).

According to SCCT, cognitive variables, such as self-efficacy, interact with other aspects of the person and environmental variables to influence an individual's career development (Fouad et al., 2010). In SCCT research, self-efficacy also occupies a central role (Inda, Rodríguez, & Peña, 2013; Cadaret, Hartung, Subich, & Weingold, 2017) and has been shown to have a significant influence on career development and interests, as well as predict persistence intentions and career goals amongst engineering students (Cadaret et al., 2017). A person's belief in their ability to succeed in a particular situation affects their behavior (Johnson & Muse, 2016) and the incentive they feel to act and persist when faced with difficulties (Bussey & Bandura, 1999). When women's judgments of their personal competence are low, when they believe they are not capable, they are unlikely, for example, to persevere in traditionally male-configured STEM fields; women's beliefs of self-efficacy become an instrumental deterrent to their participation in science and engineering (Zeldin & Pajares, 2000).

Supports and barriers. Self-efficacy is shaped by interactions with the environment (Gill et al., 2008). Women's perceptions of their potential for success have been found to be uniquely shaped by contextual influences (Cadaret et al., 2017). Lent, Brown, and Hackett (2000) researched the interplay between environmental and personal barriers to initiate the conceptualization of environmental variables that affect educational and occupational development. From this research, the discussion of contextual supports and barriers emerged (Inda et al., 2013). Within the SCCT literature, contextual barriers and supports are constructs of an influential nature that shape decisions to pursue and persist in engineering (Fouad et al., 2010; Peña-Calvo, Inda-Caro, Rodríguez-Menendez, & Fernandez-García, 2016).

The gender socialization of STEM. Both in the private and public domains, the processes and patterns of gender socialization manifest negative outcomes and gender inequality. Gender socialization and social roles and norms cannot be separated, and they combine to influence academic and career choice, such that individuals make decisions based on social norms and values that define what is gender appropriate (Powell, Dainty, & Bagilhole, 2012). Already in high school, subjects are gendered and mathematics and science classes are perceived as male (Gill et al., 2008). At the college level, career choice correlates with the sex-typing of academic majors (Hackett, 1985). STEM fields are perceived as male domains: Hill et al. (2010) found that the science and math fields are generally considered “male” and the humanities and arts “female.” This maligned perspective distorts the analysis of gender disparity in STEM as evidence of and argument for biologically determined differences between men and women—and thus the “classical formulation” of gender-bound competencies: “Men ‘naturally’ excel in mathematically demanding disciplines, whereas women ‘naturally’ excel in fields using language skills” (Hill et al., 2010, p. xvi).

Gender stereotypes. Women in STEM have to contend with negative stereotypes that question their competence and abilities in these fields (Drury, Siy, & Cheryan, 2011). Stereotypes are rooted in gendered socialization and reinforce the beliefs that competencies are gender specific (Hill et al., 2010). For women in engineering, stereotypes act as a contextual barrier that impact self-efficacy (Cadaret et al., 2017). The "gender stereotyping of pursuits" has a greater influence on self-efficacy than actual capabilities (Bussey & Bandura, 1999, p. 692). Good, Aronson, and Harder (2008) argued that girls and women perform better "when stereotypes are not activated, or if they are nullified by other cues in the environment" (p. 18). Other cues in the environment, such as role models, mentors, and positive peer influences, might be construed as support variables.

Johnson and Muse (2016) concluded their study on gender and self-efficacy by commenting on the need for further research to explore the effects of gender role socialization, stereotypes, and bias on academic choice. Miller et al. (2015) noted that the bulk of research on gender and social cognitive career theory has employed quantitative methods and declared a need for qualitative methods to extend the literature by capturing students' accounts of the specific supports and barriers they identify as crucial in their experiences as minorities in engineering. Peña-Calvo et al. (2016) also concluded that understanding of career supports and barriers in STEM fields would be enriched through qualitative inquiry that explores students' perceptions of these contextual influences. These conclusions highlight the importance of further research into women's perceptions of the factors and processes that help and hinder them in pursing a degree and career in engineering. Exploring the lived experiences of women engineering students by employing a qualitative research design is a helpful and arguably much-needed approach to gain a more profound understanding of the ways in which gender is involved in decisions to pursue a degree and career in engineering.

Qualitative Inquiry

In the social sciences, qualitative inquiry draws from philosophical assumptions that address questions of ontology and epistemology (Patton et al., 2016). Ontology examines the nature of reality and rather than a single understanding, qualitative researchers believe in conducting inquiry by “embracing the idea of multiple realities” (Creswell, 2012, p. 16). Reality is socially constructed and through a multiplicity of voice and perspective (Patton et al., 2016). The epistemological assumption then describes how the inquirer comes to understand the phenomenon under study. For the qualitative researcher, inquiry is an endeavor to connect with participants in a meaningful and authentic way (Patton et al., 2016), which includes the attempt “to minimize the distance or ‘objective separateness’” between researcher and subject (Creswell, 2012, p. 18).

Qualitative inquiry posits knowledge and reality as bound to context, as situational, and personal: “Qualitative research seeks to probe deeply into the research setting to obtain in-depth understandings about the way things are, why they are that way, and how the participants in the context perceive them” (Mills & Gay, 2016, p. 14). Creswell (2012) characterized qualitative methodology as inductive and emerging, as opposed to deductive inquiry that follows a logic handed down from theory. Qualitative inquiry distinctly shapes the questions researchers ask, how they ask them, and the outcomes they seek in the quest for highly nuanced and in-depth data that includes “the intricate details about phenomena such as feelings, thought processes, and emotions that are difficult to extract or learn about through more conventional research methods" (Strauss & Corbin, 1998, p. 11).

Choice of Qualitative Research and Rationale

According to Creswell (2012), qualitative researchers have already made up their minds about philosophical assumptions, a statement which holds true for this study. A paradigm of naturalistic inquiry and qualitative methods were adopted because the epistemological and ontological assumptions seamlessly aligned with this study's research purpose to capture and better understand the multiplicity of women's perspectives and the complexity of their lived experiences as engineering students. In other words, this choice easily made sense as it was naturally inclined towards supporting the study's purpose. Further, this study assumes multiple realities and the interrelatedness of their parts, the belief that there is no optimal distance between researcher and respondent and that they are in fact interrelated, the replacement of truth statements with those that offer the best fit, an emphasis on differences being just as important as similarities in understanding phenomena, and a preference for theory to be grounded in the data (Guba, 1981).

Grounded theory. This study used a grounded theory methodology, in preference of "a set of general principles, guidelines, strategies, and heuristic devices rather than formulaic prescriptions" (Charmaz, 2014, p. 3). The reasons for this decision are sustained by the literature. Strauss and Corbin (1998) argued that grounded theory offers a distinct approach to thinking about and viewing the world that serves to enrich research. As a way to make sense of and conceptualize data, grounded theory conducts inquiry and constructs theory through “a systematic, inductive, and comparative approach” (Bryant & Charmaz, 2007, p. 1). Grounded theory is systematic, yet flexible, and constructs theory from the bottom up, or “‘grounded’ in the data themselves” via methods of data analysis that reflect the intent to not miss out on important elements and meanings (Charmaz, 2006, p. 2).

In grounded theory, collecting and analyzing rich data to construct theory—rich, dense, and textured in concepts—is the intent and the difference: “Gathering rich data will give you solid material for building a significant analysis. Rich data are detailed, focused, and full. They reveal participants’ views, feelings, intentions, and actions as well as the contexts and structures of their lives” (Charmaz, 2006, p. 14). By collecting rich data and constructing concepts through the emergent analysis of those data (Charmaz, 2006), grounded theories “are likely to offer insight, enhance understanding, and provide a meaningful guide to action” (Strauss & Corbin, 1998, p. 12).

Glaser and Holton (2007) suggested that grounded theory is intended to take the researcher from the field directly to a finished theory; doing social research and generating theory become one and the same process (Strauss & Corbin, 1994). As such, the intention of this grounded theory case study was to generate a mid-level theory that is conceptually dense in order to understand the phenomenon in question (Strauss & Corbin, 1994). According to Strauss and Corbin (1994), “theory consists of *plausible* relationships proposed among *concepts* and *sets of concepts”* (p. 278). Concepts, sets of concepts, and plausible relationships will be diagrammatically represented and visualized via a model grounded in the research of this study. Furthermore, concepts and conceptual relationships are the scaffolding of theory and scientific understanding, and though mid-level theory is grounded in context and case, or substantive area, it may serve as a strategic link to the development of higher-level formal theory (Strauss & Corbin, 1994).

Strauss and Corbin (1998) defined the characteristics of a grounded theorist, which are the ability to step back and engage in critical analysis, the ability to recognize bias, the ability for abstraction, the ability to be flexible and open to constructive critique, sensitivity towards participants, and devotion to the work process. In grounded theory, concepts and conceptual relationships are developed inclusive of the multiple perspectives of those who have experienced the phenomenon of interest (Strauss & Corbin, 1994). Theory emerges from the data, and hence conceptualizations of women's lives can emerge from their perspectives. Experiences are not absorbed and assimilated into dominant theoretical frameworks. Grounded theory's coding procedures and emergent analysis are conducive to generating rich conceptualizations and constructing dense substantive theory (Strauss & Corbin, 1994). In this study, women's voices and lived experiences were destined to become the building blocks of theory—and conceive of realities excluded from male-dominated versions (Oleson, 1994). Theories grounded in voice and experience, with the researcher's hope that analysis of that data would shed light on the conditions that have produced those experiences, may also serve as mode of recourse and social criticism (Oleson, 1994).

Grounded theory *case study.* Another layer was added to the research design through a case study approach. According to Stake (1994), a *case* is a bounded system in which certain features can be recognized, and which contains patterned behavior, consistency, and sequentialness. In this study, the case was bounded by a particular mechatronics engineering program at a small private university in Ecuador. The target phenomenon of focus was the lived experiences of women, who were enrolled full-time in this program. Further, Stake (1994) distinguished between two forms of case study: *intrinsic* and *instrumental* case studies. This qualitative research is based on the latter, in which the case of women studying mechatronics engineering at a small private university in Ecuador is studied "to provide insight into an issue or refinement of theory. The case is of secondary interest; it plays a supportive role, facilitating our understanding of something else. The case is often looked at in depth, its contexts scrutinized, its ordinary activities detailed, but because this helps us pursue the external interest" (Stake, 1994, p. 237).

The particular site and sample were chosen to conduct this grounded theory case study because they were representative of the phenomenon and problem in question. Women comprise approximately 10% of the students enrolled in the mechatronics program at the subject university. The absence of women in the mechatronics engineering program at the subject university represents what is a general trait and problem: gender disparity and women's minority status in engineering. As such, this case is representative of gender disparity in engineering; it illustrates the problem and allows for the complexities of these problematic circumstances to be studied in depth so as to provide insight to the phenomenon in question (Stake, 1994).

Target Setting and Population

The target setting is a private university in Ecuador. The subject university comprises a main campus and three branch campuses in distinct regions of the country. The main campus of the university, where the study was conducted, has a student body of approximately two thousand students. The bulk of its students are drawn from the surrounding metropolitan area and, like the vast majority of universities in Ecuador, the subject university is a commuter institution. The specific context of interest was the undergraduate program in mechatronics engineering, offered only at the main campus of the subject university. Thus the target sample was drawn from the undergraduate adult population of women studying mechatronics engineering.

Mechatronics is a relatively new academic discipline, initiating at premier universities in Europe, for example, mainly during the nineties (Grimheden & Hanson, 2005). It has evolved from overlapping engineering paradigms due to the rapid pace of change in technology, and is described as a "synergistic combination of precision mechanical engineering, electronic control and systems thinking in the design of products and manufacturing processes" (Grimheden & Hanson, 2005, p. 180). At the subject university, the program began in 2006. The dean of the mechatronics program is male, and, at the time of conducting this study, the academic faculty of seven professors was composed of four men and three women.

Like all public and private institutions of higher education in Ecuador, the university operates within a context of state regulated accreditation and quality assurance. Of note to this study due to its focus on gender are accreditation standards that promote women's access and equitable participation as faculty members in the process of tenure. Accreditation standards stipulate that institutions have policies and mechanisms in place to promote these norms, whereby compliance is measured by the proportion of female professors, which should reflect 40–60 percent of total faculty members in the process of tenure at the institution under evaluation (Council for Evaluation, Accreditation, and Quality Assurance of Higher Education [CEAACES], 2015).

At the time this study was conducted, a total of 96 students were enrolled in the university's undergraduate ten-semester program, which includes a propaedeutic semester; from these students, only ten were women. It is important to add that, as women studying engineering, not only are these students severely underrepresented in the mechatronics program, but they have experienced consecutive courses and semesters in which they have been the *only* woman in the class. Indeed they are often alone and without other women as classmates.

These ten women represent the population from which the sample was taken. They were undergraduate students in distinct semesters and as such represented a diversity and range of experiences. A freshman student in the stage of adjustment and adaptation to university was likely to share distinct perspectives and narratives than a student close to graduation and contemplating the transition to the workforce or graduate studies—and *all* of these experiences proved crucial in helping to understand the underrepresentation of women studying engineering.

This grounded theory case study of women mechatronics students at a small private university in Ecuador is designed to explore how women experience the engineering environment. It provides the venue for *their* voices to be heard and for those voices to be validated through the methods of scientific inquiry (Mills & Gay, 2016). Sense is made of the phenomena and theory emerges from the meanings women attach to them through their stories. The choice of a qualitative approach that employs a grounded theory methodology was one in favor of searching for in-depth understanding, via the experiences themselves, to serve as an instrument of empowerment that contributes to consciousness-raising and social change.

Significance of the Study: Implications for Practice, Research, and Policy

The first step towards good practice and policy is a solid research base and this study intends to add to the research in two important ways. First, as a qualitative study exploring the lived experiences of women engineering students it addresses a gap in the literature. Research of positivist orientations abound, but qualitative studies that allow students to express their perceptions in detail are scarce. The findings will be of great benefit to strategic initiatives to create inclusive and supportive environments in engineering, as well as open gateways to new and innovative research orientations. It is important to reiterate that while women have become the majority on university campuses, and numerous fields have enjoyed an influx of women who successfully graduate from their programs, engineering has remained stubbornly resistant to these trends. Arguably, there is something about engineering that has yet to be substantiated through research. Women's continued underrepresentation in the field is indicative of the need to dismantle engineering's traditional male-centric model for it to become an enabling and encouraging environment. This process of deconstruction to reconstruct, however, needs to be carried out through the perspectives and voices of women who have experienced the phenomenon, and the visions of informed researchers who can unearth a bounty of data through effective interviewing—for answers can only come through questions—and data analysis to discover the critical elements in those textured descriptions that have gone missing thus far.

Second, this research contributes a qualitative study about women in engineering in Ecuador. As explained earlier, the choice of sample and site is representative of the phenomenon and problem in question. In this sense, the study is transcendental of context and nationality. At the same time, however, the study's examination of local context and sample supports the growth of research by extending its reach to include a site and population that is rare to find in the literature. As such, the study adds diversity and richness of data to the body of research that examines gender disparity in engineering. More than 20 years ago, Altuna Muñoz and Weaver (1997) employed a questionnaire and interviews to gauge the experiences and attitudes of students at Ecuador's National Polytechnic University, the country's premiere technical university, and found that professors' and male students' *machista* attitudes had resulted in hostile experiences for women who often perceived the university as an alien environment. Two decades later, women in engineering in Ecuadorian higher education continue to be severely underrepresented, symptomatic of an environment persistent in its culture of exclusion. As a study representative of women's underrepresentation as engineering students, this research aims to identify the determinants of gender disparity, contribute to the literature, and motivate strategies to create enabling and inclusive environments for women.

Chapter 2: Literature Review

With the intent to improve understanding of the factors and processes that help and hinder women who study engineering, this study employed a grounded theory methodology to explore the lived experiences of women engineering students. This chapter will begin with a discussion of the background and context of the research problem and will then review the relevant theoretical and empirical literature. As theories that focus on gender development and differentiation and how these relate to academic and career choice, social cognitive and social cognitive career theory provide the conceptual lens and guiding framework for this study.

Background

Around the world, engineering is the area where women are consistently least represented (Huyer, 2015). During the 1990s, a global demographic shift occurred in which women's enrollment in higher education outpaced that of men (UN, 2015). Today, in most regions of the world, women generally outnumber men in higher education—but their participation varies significantly according to field of study (UN, 2015). In its 2015 science report, the United Nations Educational, Scientific and Cultural Organization (UNESCO) highlighted women's disproportionate representation across the fields of tertiary science education, noting that women now dominate the fields broadly designated as health and welfare, but "are least likely to figure among engineering graduates" (Huyer, 2015, p. 91). Indeed, engineering has earned a description of being "the most sex-segregated nonmilitary profession in the world" (Corbett & Hill, 2015, p. 8).

In the United States, since the 1990s, women have earned 57% of all bachelors degrees (NSF, 2017). Their participation in higher education is notable whilst the lens is focused on disciplines such as psychology and the social sciences, but in engineering, women at all levels of higher education—bachelor's, master's, and doctoral—respectively represent less than 20% of the student population (NSF, 2017). And in Ecuador, which provides the setting and sample for this grounded theory case study, the picture is similar: Women's enrollment in higher education reached parity in the 1990s and has since grown to represent approximately 55% of the student population (Troya, 2016). However, as noted by Sylva Charvet (2015), higher education in Ecuador has experienced both a "feminization" of access and a "masculinization" of vocation (p. 9). Women are overrepresented in the areas of education, social sciences, and health/social services, and severely underrepresented in engineering, where approximately only 5% of women choose to enroll (Troya, 2016). Seen from this perspective and the need to disaggregate data to capture the realities of academic and career choice, Ecuadorian higher education presents a system of feminine and masculine disciplines (Acosta, 2016); academic and career choice are gendered, oriented toward traditional and sanctioned sex roles, and, arguably, are not indicative of real change (Goetschel, 2015).

The gender gap is an indication "that the engineering pipeline may be especially intimidating for women" (Vogt, Hocevar, & Hagedorn, 2007, p. 338). Indeed, in light of the historical progress women have made in participation and graduation rates in higher education—reaching parity and beyond in many fields—"the persistent underrepresentation of women in engineering is puzzling" (Cosentino de Cohen & Deterding, 2009, p. 211). The research has noted that "something happens along the way that prompts women to believe that they cannot or do not want to continue in STEM courses, majors, or careers, yet there is no obvious reason why this would occur for women more than men since innate abilities do not differ between men and women" (Fouad et al., 2010, p. 361). Engineering is overwhelmingly male and a man's domain (Hill et al., 2010); gender parity in participation and degree attainment remains elusive and the absence thereof constitutes a troubling phenomenon.

An understanding of and explanation for women's underrepresentation in engineering has often usurped biological differences as determinants of abilities and interests: Women are thought to "naturally" excel in languages while men's biology results in a "natural" competence in mathematics (Hill et al., 2010). These assumptions point to the importance and influence of culture and learning environments and how these are imbued with biases and stereotypes—*socialized* gender differences—creating environments of discrimination that discourage women's participation in engineering (Hill et al., 2010). In engineering, women are a minority made to confront a "gendered" and "predominantly male-oriented" culture (Chesler & Chesler, 2002, p. 50).

Why does engineering continue to lag behind other fields in women's participation? Why do women *not* choose to study engineering? The research evidences that women decide against enrolling in these majors though they are well prepared. Hill et al. (2010) identified the transition period between high school and college as a critical moment when young women turn away from career pathways in STEM, even though the research shows that girls are no longer lagging behind in high school math and, in subjects like algebra, pre-calculus, and chemistry, are actually graduating with more credits (National Center for Education Statistics, 2015). Gender differences no longer mark results on standardized tests of math abilities (Drury et al., 2011); yet, regardless of this progress, girls still reject the option of studying engineering. And when women *do* choose to study engineering and successfully graduate from their programs—in representation of the approximately 20% of engineering graduates in the United States—the representation of women in the engineering occupation and workforce then decreases to 14.5% (NSF, 2017). Indeed, at the critical junctures, when education and career are being contemplated, gender has a significant role to play (Powell et al., 2012).

Smith and Gayles (2018) posed the question of why women don't choose or depart from engineering majors and careers and examined women's gendered experiences in engineering's academic and workplace environments. Their research noted the gaps that continue to persist in the understanding of women's experiences in STEM, and particularly in engineering, where gender disparity is acute: "Understanding this disparity and the unique experiences of women in these areas is particularly critical to reducing the chilly climates and creating more culturally inclusive environments to increase women's persistence, representation, and success in male-dominated fields" (Smith & Gayles, 2018, p. 2).

Theoretical Foundations and Empirical Literature

In discussion of the factors and processes that influence women's participation in studying engineering, this study will present relevant literature from social cognitive and social cognitive career theory. Insights from these interrelated bodies of research provide the conceptual framework for this study. Furthermore, other perspectives have been included in this section's discussion of theory and empiricism, and though these are not explicitly drawn from the social cognitive tradition, they have been integrated to enrich the analysis.

The socialization of gender. Gender socialization is the "process whereby individuals develop, refine and learn to 'do' gender through internalizing gender norms and roles as they interact with key agents of socialization, such as their family, social networks and other social institutions" (John, Stoebenau, Ritter, Edmeades, & Balving, 2017, p. 2). According to John et al. (2017), gender socialization is influenced by factors at the structural level, including patriarchal structures and global media; the social-interactional level, such as family and social institutions; and the individual level, including cognition, motivation, and self-efficacy. These factors influence each other, they interact and reciprocate to produce and reproduce the norms, roles, and identities differentiated according to gender (John et al., 2017).

The gender socialization of competencies. Socialized differentiation on the basis of gender produces sanctioned roles and normative behavior that influence decisions in regard to academic and career choice (Powell et al., 2012). Social norms and values result in the beliefs and biases that decide the gender of competencies: Men are thought to be more competent in mathematics and women more competent in English (Jagacinski, 2013). These beliefs advocate a discrete categorization, a binary of ability according to man or woman; they promote the idea of being or not being a "numbers" person, which leads into theories of fixed levels of intelligence and science and math competencies, which demotivate students (Rattan, Good, & Dweck, 2011). STEM fields are typically perceived as masculine and thus at odds with the female gender role (Drury et al., 2011). Engineering, in particular, is believed a masculine domain (Powell et al., 2012), and these beliefs discourage women and decrease their sense of belonging (Drury et al., 2011). In sum, the idea persists that women don't belong in engineering because it is a "man's" vocation.

Social cognitive theory. Social cognitive theory is concerned with how society socializes individuals into gender roles. Bussey and Bandura (1999) argued that "human differentiation on the basis of gender is a fundamental phenomenon that affects virtually every aspect of people's daily lives" (p. 676). Gender is a powerful organizing principle of society (Patton et al., 2016) and a primary category for differentiating people (Bussey & Bandura, 1999). Deferring from a primary focus on cognitions, social cognitive theory adds the environment and social influences in asserting that gender is neither a discrete identity that emerges from "a knowable unique self" nor "an innate essence to be gradually revealed"; rather, it is a social product, constructed through interactions between the self and the environment (Gill et al., 2008, p. 6).

Unique to social cognitive theory is the model of triadic reciprocal causation, in which personal, behavioral, and environmental factors interact as determinants that influence each other bidirectionally (Wood & Bandura, 1989). Personal factors are gender-related conceptions or cognitions, behavioral and judgmental standards, and self-regulatory influences such as thoughts, evaluations, and decision-making; behavioral factors refer to patterns of behavior or overt actions linked to gender; and environmental factors are the broad network of social influences individuals experience on an everyday basis (Bussey & Bandura, 1999). Because influence is reciprocal and bidirectional "people are both products and producers of their environment" (Wood & Bandura, 1989, p. 362). People both shape the world they are in and are shaped by it (Gill et al., 2008).

This model emphasizes the importance of environmental influences and argues that gender roles and conduct are acquired through environmental determinants and mechanisms (Bussey & Bandura, 1999). These are not isolated outcomes. Indeed, cognitions or experiences of the self and gendered behavior are dependent on "the particular constellation of environmental influences operating in a given situation" (Bussey & Bandura, 1999, p. 685). The powerful influence of contextual variables, for example, is why Hill et al. (2010) argued in favor of creating environments of encouragement that dismantle the barriers that girls and women encounter in the science and engineering fields.

Social cognitive theory highlights a *multifaceted social transmission model* in arguing that gender conceptions and roles are learned through various social influences that operate interdependently (Bussey & Bandura, 1999). A crucial mode for conveying and learning gendered information is modeling, referring to the parents and peers, the significant individuals in social, educational, and occupational contexts, and the mass media, which model and convey gendered information and rules of conduct, and are a key influence in the development of knowledge and competencies (Bussey & Bandura, 1999). In other words, modeling helps us understand how gendered behavior, knowledge, and perceptions are observed and learned, and how these processes are tied to self-regulatory behavior of conduct, motivation, and self-beliefs about capabilities (Bussey & Bandura, 1999).

Self-efficacy. Self-efficacy is a cognitive construct and is defined as the "beliefs to organize and execute the courses of action required to manage prospective situations" (Bandura, as cited in Pajares, 1996, p. 544). Bussey and Bandura (1999) argued that self-efficacy beliefs form the foundation of human agency—how individuals exercise control of their thought processes, motivation, affect, and actions. Beliefs of self-efficacy both determine and predict the levels of achievement individuals attain (Pajares, 1996). Self-efficacy is sensitive to contextual factors (Pajares, 1996), and acts as a cognitive mediator of the different types of social influences individuals receive to affect the pathways they choose throughout their lives (Bussey & Bandura, 1999). The power of self-efficacy to affect the selection of pathways is most apparent when studying academic and career choice (Bussey & Bandura, 1999). Pajares (1996) detailed the many ways that beliefs of personal competence affect behavior:

> They influence the choices individuals make and the courses of action they pursue. People engage in tasks in which they feel competent and confident and avoid those in which they do not …. efficacy beliefs help determine how much effort people will expend on an activity, how long they will persevere when confronting obstacles, and how resilient they will prove in the face of adverse situations—the higher the sense of efficacy, the greater the effort, persistence, and resilience. (p. 544)

In an analysis of academic motivation, Zimmerman (2000) also affirmed the influence of self-efficacy: "Self-efficacious students participate more readily, work harder, persist longer and have fewer adverse emotional reactions when they encounter difficulties than do those who doubt their capabilities" (p. 860). In their research on Chinese students, Ma, Zeng, and Ye (2015) established the role of self-efficacy in managing stress and coping with adaptation, arguing that high levels of self-efficacy were conducive to subjective well-being. Self-efficacy influences perseverance and success in course work (Zimmerman, 2000), and, in a meta-analysis of data from various European countries, self-efficacy was found to be a key influence and predictor of academic achievement (Vantieghem & Van Houtte, 2015). For all these aforementioned reasons, self-efficacy may be a crucial determinant of gender disparity in engineering.

Self-efficacy beliefs are socially rooted and operate within social systems (Pajares, 1996): "Women's beliefs about their capabilities and their career aspirations are shaped by undermining social practices within the family, the educational system, peer relationships, the mass media, the occupational system, and the culture at large" (Bussey & Bandura, 1999, p. 692). Research has established the influence of self-efficacy on women's choice to study and pursue a career in a non-traditional field such as engineering (Johnson & Muse, 2016; Marra, Rodgers, Shen, & Bogue, 2009). When women's judgments of their personal competence are low, when they believe they are not capable or able to compete, they are unlikely to pursue a mathematics-related academic and career choice or persevere in these traditionally male-configured environments (Zeldin & Pajares, 2000). Women's self-efficacy beliefs become an instrumental deterrent to their participation in these fields (Zeldin & Pajares, 2000).

Social cognitive career theory (SCCT). Why do women choose to *not* pursue particular careers? Johnson and Muse (2016) contemplated this question in their research of determinants of choice of academic major and asked why women continue to overlook professions with better employment and wage prospects, such as engineering. If by 2020, labor markets in the United States and Europe will be facing an increased shortage of highly skilled professionals such as engineers (Shortman, 2013) and women outperform men in college enrollment, persistence, and degree attainment (Johnson & Muse, 2016), why do women not choose a career in engineering?

This question has received considerable treatment within the literature identified as social cognitive career theory (Miller et al., 2015; Fouad et al., 2010; Peña-Calvo et al., 2016). SCCT takes from social cognitive theory the model of triadic, complex, and reciprocal interplay between person, behavioral, and environmental variables, which interact and influence individuals' academic and career choices: SCCT attempts to understand the processes related to interests, choices, and outcomes along the pathway of educational and career pursuits (Lent et al., 2000). SCCT looks at how individuals assert agency in their own development, and how cognitions interact with person and contextual variables to influence academic and career development (Lent et al., 2001). Central to the model are self-efficacy beliefs and the analysis of environmental socialization experiences on women's self-efficacy, particularly in non-traditional areas for women like engineering (Fouad et al., 2010). Contextual factors have been found to relate to goals, choice actions, and persistence behavior through the mediating variable of self-efficacy (Lent et al., 2003).

Contextual variables are significant in their influence on the career choice process (Lent et al., 2001). Contextual variables are the environmental factors that individuals perceive as supporting or hindering their academic and career development and goals (Peña-Calvo et al., 2016). An example of these are the stereotypes and biases women often encounter in their environments, which discourage them from participating in STEM activities (Fouad et al., 2010). Lent et al. (2000) made the case for increased efforts to conceptually distinguish between person and contextual factors and to strengthen the analysis of the environmental factors that influence career development. The support and barriers constructs emerged as “a useful conceptual schema for understanding behavior and career-related choices” and ultimately provides a framework to examine the effect of environmental influences on women’s participation in STEM (Fouad et al., 2010, p. 362). SCCT explicitly conceptualizes and integrates environmental factors into the literature and addresses the importance of contextual influences on career development (Fouad et al., 2010). Research by Peña-Calvo et al. (2016) serves as an example of applying this framework to better understand the influence of perceived supports and barriers on the career development of STEM students.

In SCCT, the construct of barriers refers to negative contextual influences (Lent et al., 2000). Identifying barriers within a model of reciprocating influences is an important task because it aids understanding of the processes through which contextual barriers, such as gender bias, become internalized and affect the choices women make; furthermore, by identifying barriers, appropriate developmental and social advocacy strategies can intervene to counteract negative influences (Lent et al., 2000). SCCT also conceptualizes contextual supports or support systems, which are the “environmental variables that can facilitate the formation and pursuit of individuals’ career choices” (Lent et al., 2000, p. 42). Lent et al. (2000) argued that environmental supports have been understudied and underexplored in light of the focus on barriers, but the natural complement to understanding what hinders choice is the study of those environmental factors that facilitate choice and development. Thus, instead of asking only what hinders women, the questions seek to understand the influences that enable women. It is important to note that "support is not simply the absence of barriers, or leaving the individual alone. In other words, support is not a neutral condition; rather, it involves factors that actively promote career behavior" (Lent et al., 2000, p. 42). Environmental supports might include positive family and teacher influences, which enable women to pursue nontraditional careers such as engineering (Lent et al., 2000).

The conceptualization of supports and barriers is unique to SCCT. These constructs, in interaction with cognitions and perceptions, provide a useful way to navigate understanding of women's underrepresentation in engineering. In support of the need for improved understanding, Fouad et al. (2010) argued in favor of further research that focuses *not* on women's "deficits" related to STEM areas, but on the salient supports and barriers that encourage or discourage women to participate in these fields. In support of their own call for action, Fouad et al. (2010) conducted research, from which emerged a taxonomy of the barriers and supports perceived by students: The domains identified include parental/family, specific influences such as encouragement and role models; institutional/school, which presented influences such as teacher guidance and teaching methods; financial/environmental, which shed light on the impact of factors like financial disruptions and gender role stereotypes; and social, which identified influences such as minority status and lack of peer support. Peña-Calvo et al. (2016) conducted research on student perceptions of supports and barriers and highlighted the key influence of teaching staff supports and barriers in career development for STEM students. They looked specifically at the effects of parental, teaching staff, and peer supports and barriers. Their research found empirical evidence for the hypothesis that the presence of teaching staff supports was more important than family support for determining academic and career interests. Lent et al. (2003) concluded that further research on the role of contextual supports and barriers in relation to choice and persistence in engineering was needed.

Self-efficacy and coping efficacy. SCCT research has established the influence of contextual variables upon self-efficacy, which in turn filters academic and career choice (Cadaret et al., 2017). In looking at self-efficacy beliefs, the cognitive conversion of interests to goals and goals to actions is less likely when barriers are perceived as difficult to overcome (Inda et al., 2013). Inda et al. (2013) concluded that increasing graduation rates in science and technology required focused interventions to encourage high self-efficacy, especially among women. Low self-efficacy was identified as a risk factor to the optimal career development of girls (Inda et al., 2013). Perceptions of barriers negatively affect positive self-beliefs, but supports and self-efficacy have a distinct correlation: Self-beliefs are enhanced when students perceive the absence of social barriers and the presence of support within their social environments (Lent et al., 2003). In addition to personal efficacy, the SCCT literature has discussed the significance of coping efficacy. Defined as the “beliefs regarding one’s capabilities to negotiate particular environmental obstacles,” coping efficacy is considered influential in determining whether an individual will persevere toward their goals when faced with obstructions in the environment (Lent et al., 2000, p. 46). People’s perceptions of their abilities to overcome hurdles also moderates how they perceive barriers: When coping efficacy is high, perceptions of barriers may not hinder their academic- and career-related behavior and choices (Lent et al., 2000).

Social cognitive and social cognitive career theory and research have examined the contextual and cognitive variables that result in a gender gap in engineering, but mainly through quantitative methodology. Recommendations in this area of research point toward qualitative approaches to ask the questions and elicit more detailed information useful in understanding the gendered experiences of engineering students (Miller et al., 2015). Inda et al. (2013) also recommended qualitative research to capture the rich detail of individual experiences and gain a deeper understanding of the influence of social supports and barriers and gender on career choices.

Gender stereotypes and stereotype threat. Cadaret et al.'s (2017) research contributed to the barrier framework within SCCT by examining stereotype threat as an educational barrier in engineering. Bussey and Bandura (1999) argued that stereotypes of occupational orientations abound in homes and classrooms, and that "the tendency to stereotype by gender is so deeply ingrained that even minimal disembodied gender cues activate stereotypically gendered evaluative judgments" (p. 702). Stereotypes are closely linked to self-efficacy and influence self-beliefs about competencies (Bussey & Bandura, 1999). In SCCT, stereotypes are treated as contextual barriers, which, via their influence on self-efficacy, form and activate career-related attitudes and choices (Deemer, Thoman, Chase, & Smith, 2014).

Steele's (1997) seminal work examined academic achievement through the lens of societal stereotypes and how these affect performance outcomes and identification with an academic domain. His study evaluated African Americans and women in math and sciences, two groups typically associated with achievement barriers due to discrimination. He found that racial and gender stereotypes greatly influence academic performance and identification. According to Steele (1997), stereotypes have two forms of adverse effects: First, they can become internalized, resulting in feelings of inadequacy, lack of confidence, inferiority anxiety, low expectations, diminished self-efficacy, and demotivation. In the second form, they result in *stereotype threat,* in which the affected individual experiences alienation from the domain with which they identify: "As for the woman who spends considerable time in a competitive, male-oriented math environment, it can pressure *disidentification,* a reconceptualization of the self and of one's values so as to remove the domain as a self-identity, as a basis of self-evaluation" (Steele, 1997, p. 614).

Academic achievement depends on identifying with the school; in other words, success in college requires that the student identify with the school and his or her domain of learning (Steele, 1997). In order to identify with college, Steele (1997) argued that a student needs positive self-esteem, "a self-perception of adaptive and moral adequacy" (p. 616). The self-beliefs that students have are key in establishing self-confidence (Steele, 1997). In STEM fields, negative stereotypes expressed by peers and faculty are related to diminished academic confidence and a reinforced sense of not belonging in these majors (Johnson, 2012). Girls and women are vulnerable to negative stereotypes disseminated in the broader culture: Explicit gender bias, such as that contained in stereotypes of innate biological differences that inevitably lead to men's aptitude in math and women's lack thereof, have been shown to negatively affect women's academic performance (Good et al., 2008). Further, the research has shown that girls and women perform better when stereotypes are not activated or are nullified by other environmental influences, but "when negative stereotypes are activated and left unchecked, they trigger a number of disruptive psychological processes that undermine test performance" (Good et al., 2008, p. 18).

Stereotype "exemption." Those affected by stereotype threat try to overcome it by disproving the stereotype; in the academic domain, this would translate into the need to outperform others and gain a "personal exemption" from the stereotypes (Steele, 1997, p. 618). The need to outperform is supported by Dingle (2006), who concluded that women and men have gendered learning experiences in the science classroom: Stereotypes enhance male attitudes of authority and numerical predominance and increase pressure on women to perform well and get good grades. Jagacinski (2013) defined this approach as adopting performance goals that define competence in terms of how well an individual can compete in comparison to others, and, as a result, feelings of competence derive from outperforming others. In situations where competition and comparison predominate, this approach is more likely to be adopted (Jagacinski, 2013).

The "chilly" culture and climate of engineering. Rattan et al. (2012) noted that a sense of belonging to an academic domain is a key factor to fitting in and engendering the feeling that one's contributions are important. Hurtado and Ponjuan (2005) studied the influence of racial dynamics and campus climate on Latino educational outcomes. They argued that individual perceptions of discrimination or environments adverse to interactions and intergroup relations affect educational outcomes: "In short, students are educated in dynamic racialized contexts, and their responses to group stereotypes and individual instances of discrimination are necessary to examine if we wish to create optimal conditions for learning environments" (Hurtado & Ponjuan, 2005, p. 237). Distinct groups, depending upon their numbers, representation, and status on campus, perceive and experience the campus environment differently (Hurtado, & Ponjuan, 2005). Though not directly addressing women in engineering, the study is helpful in understanding this problematic and the need to improve gender diversity in the engineering classroom. The disproportionate male/female ratio in engineering is comparable to the Hurtado and Ponjuan's (2005) study of minorities in predominantly White settings.

Engineering educational environments are predominantly male (Johnson, 2012), which has led to the description of the "chilly" climate of engineering, characterized by "male-normed classrooms" in "competitive, weed-out systems" (Vogt et al., 2007, p. 339). Women in male-dominated engineering environments encounter structural and cultural barriers that negatively affect their success and persistence (Smith & Gayles, 2018). The gender discrimination in these settings has been shown to have negative effects on women's self-perceptions of their abilities (Smith & Gayles, 2018). Women's interpretations of classroom climate influence their self-perceptions (Vogt et al., 2007). In their comparison of cognitively equal men and women studying engineering, Vogt et al. (2007) endeavored to determine the effects of an unfriendly academic environment on students' perceptions of self. Their research established a relation between lower perceived discrimination and increased self-efficacy. Further, the women in the study reported greater perceived discrimination, and the effects of positive self-efficacy on help-seeking, effort, and critical thinking were greater for women (Vogt et al., 2007). The classroom environment was thus significant in determining students' performance; recommendations included targeted efforts to improve the engineering environment and interventions to promote heightened self-efficacy, also as strategies to address the gender disparity in engineering (Vogt et al., 2007).

Recent work by Smith and Gayles (2018) explored the academic and workplace experiences of senior women engineering students. As a constructivist case study, their research highlighted the gendered barriers that women experience in male-dominated settings. The unique role of gender in these environments places power dynamics and male privilege at the center of analysis (Smith & Gayles, 2018). Differentiation on the basis of gender heavily influences relations and interactions in these environments, which can be unfriendly and even hostile towards women (Smith & Gayles, 2018). Smith and Gayles' (2018) study found that power disparities characterized the engineering academic and workplace settings and was manifest in the implicit bias, sexism, and sexual harassment women engineering students experienced in these environments. Powell et al. (2009) also examined the gender-related barriers women experience in male-dominated environments. Their qualitative analysis explored how women engineering students perform gender, that is interact and play out socially constructed gender roles in environments characterized by cultures of dominant masculinity (Powell et al., 2009). The findings indicated behaviors and attitudes of adaptation and fitting in to be accepted and "women's implicit and explicit devaluing and rejection of femaleness" (Powell et al., 2009, p. 17). These findings aligned with Smith and Gayles (2018) who also noted that the women engineering students in their study "were expected to adapt to male-dominated, unfriendly, and, often, sexist environments in both academia and the workplace" (p. 18). Powell et al. (2009) further concluded that "in 'doing' engineering, women have 'undone' their gender"; women's enculturation challenges neither masculine hegemony nor the gender inequality it entrenches (p. 17).

"Undoing" gender. Hurtado and Ponjuan (2005) found that perceptions of a hostile campus climate discouraged students' academic, social, and emotional adjustment to college. Adverse climates, permeated by stereotypes and discrimination, can undermine students' academic performance (Hurtado & Ponjuan, 2005). On the other hand, an inclusive and encouraging campus climate and diverse student interactions are associated with positive educational outcomes (Hurtado & Ponjuan, 2005). Whereas the perception of privilege for dominant male cultures diminishes women's sense of belonging in STEM (Johnson, 2012), an engaging climate of positive interactions fosters a sense of belonging, which then influences students' motivation and achievement in STEM (Metevier, Seagroves, Shaw, & Hunter, 2015). Steps to eliminate barriers and support women's representation and success in engineering might glean valuable insight from Chandler's (1996) "feminist algorithm." The four steps of reconfiguration she ascribed to improve the climate and community for women in STEM fields begin with identifying and documenting the disparities women face due to traditional gender roles and stereotypes; the second step is encouraging an open dialogue about individual experiences in and feedback on the environmental culture; the third pertains to communicating concerns and improving support systems; and all of these culminate in the final step of activism, the stage of enacting the strategies and programs initiating that will create a diverse environment and commitment to it.

Chapter 3: Methods

Study Purpose

The persistent underrepresentation of women studying engineering establishes the need for further research into women's lived experiences as engineering students. Specifically, from their perspectives, what are the factors and processes that support women who study engineering? From their perspectives, what are the factors and processes that hinder women who study engineering? And how do women who study engineering overcome challenges?

Data Collection

The mechatronics engineering program of the university site in Ecuador represents the bounded system, which housed the phenomenon of interest (Stake, 1998). Within this bounded system, purposeful sampling was used to collect data-rich cases of individuals who had experienced the phenomenon under study (Creswell, 2012) and thus garner insight into the questions being explored (Patton, 1990). More specifically, criterion sampling was applied at the site for sample selection, and participants were identified who met the defined criteria (Mills & Gay, 2016). Because the phenomenon of interest is the underrepresentation of women studying engineering, the selection criteria for the sample were female gender, active enrollment in the mechatronics program, and a minimum age of 18 years. Representing the full range of potential participants for the study, all of the women enrolled as mechatronics students at the site university were invited to participate. Demographics such as race and income were not variables nor conceptualizations integral to the study, nor was the semester in which the women were enrolled. However, it was thought that they would serve as contextual factors to add variance and variety to the narratives and offer what Stake (1994) called "opportunity to learn" (p. 243).

Prior to initiating the study, approval and authorization to conduct the study was obtained from the site university and the Internal Review Board of the University of Miami. The researcher also contacted the Dean of Mechatronics Engineering to request the names and email addresses of students who met the sampling criteria. The students were recruited by the researcher via email (Appendix A) and, upon the interviewee's interest, enlisted to participate in a semi-structured, confidential interview, the duration of which varied from 30 to 60 minutes. These interviews were conducted after participants had reviewed and signed informed consent forms (Appendix B). So as to encourage participation, information was made available in both English and Spanish.

To generate data, the interviews followed Charmaz's (2014) principles of intensive interviewing to create an interactional space that would encourage participants to share their ideas and experiences and to co-construct the interview between researcher and participant. According to Charmaz (2014), intensive interviewing is characterized by the selection of participants with first-hand experience of the research topic, the in-depth exploration of those experiences, open-ended questions, the objective of obtaining detailed responses, an emphasis on understanding participants' perspectives, meanings, and experiences, and a practice of following up on ideas and views expressed by the participant. These suggestions were followed so as to encourage participants' interpretation of their experiences "in ways that seldom occur in everyday life" (Charmaz, 2014, p. 58).

The interviews incorporated a set of open-ended questions to orient the conversation (Appendix C). Furthermore, in using techniques described by Charmaz (2014), additional questions were integrated as follow-up to unanticipated ideas and issues as the interview proceeded, to invite greater detail and deeper understanding of the phenomenon of interest. Indeed there were numerous times when the participants made unexpected and intriguing remarks—not following up would have resulted in the loss of important data. The interviews were conducted in English and/or Spanish, according to the preference of each participant and were audio recorded with the participants' permission. Though English was not the native language for any of the participants, some preferred to conduct the interview in English. As a resident of Ecuador for over 21 years, engaged in Spanish on a daily basis in my professional and personal life, I felt comfortable in either language and the interviews proceeded without language barriers.

Participants were informed that they were not obligated to answer the questions and could stop the interview at any time if they wished. The interviews were subsequently transcribed verbatim in preparation for data analysis. In order to protect the participants' identities and in following the approved protocol, upon transcribing the interviews, the participants were assigned pseudonyms, all identifying information was removed, and the audio recordings were subsequently permanently deleted from the devices where they'd been stored.

Data Analysis Tools and Procedures

According to Punch (2009), "methods for the analysis of data need to be systematic, disciplined, and able to be seen (and to be seen through, as in "transparent") and described" (p. 171). In the attempt to adhere to these guidelines, the following section will describe the grounded theory methods used in this qualitative study to analyze the data collected during the interviews.

The intended outcome of the study was to discover a grounded theory, or concepts and conceptual relationships that can explain what is central in the data (Punch, 2009). Glaser and Holton (2007) identified the conceptualization of data through coding as the foundation of grounded theory development. Charmaz (2014) characterized coding as a process in which segments of data are named and given labels to categorize, summarize, and account for each piece of data so as to create "an interpretive rendering that begins with coding and illuminates studied life" (p. 111). Miles, Huberman, and Saldaña (2014) described the process as one of connecting discrete facts into groups of more abstract patterns and thereby "moving up progressively from the empirical trenches to a more conceptual overview of the landscape" (p. 292).

According to Charmaz (2014), grounded theory coding is carried out in at least two steps: initial and focused. This first stage of coding entails "'fracturing' or 'breaking open' the data" so as to "open up the theoretical possibilities in the data" (Punch, 2009, p. 183). In practice, initial coding meant organizing the data into tables. In following Charmaz (2014), the unit of data I chose to use for this first round of analysis was line-by-line coding, which meant naming each line of data. Charmaz (2014) recommended line-by-line coding as a method to help researchers approach data with an open mind, as well as examine data closely to detect the nuances and explicit and implicit meanings.

Furthermore, in contemplation of the possible effects of acquaintance with the literature and researcher biases, line-by-line coding was also selected as a strategy and corrective to prevent an analysis based on the imposition of preconceived ideas (Charmaz, 2014).

The next phase of data analysis was focused coding, which entailed reanalyzing and reorganizing the data so as to discover the analytic scheme that made sense of the data (Saldaña, 2009). Charmaz (2014) described focused codes as appearing more frequently or being more significant than others and the process of focused coding as involving decisions about which codes make most sense to categorize the data. During this stage, initial codes were analyzed to see if they represented the higher-level conceptualizations and categories that highlighted what had emerged as important (Charmaz, 2014).

As recommended by the literature, two principle activities accompanied the process of coding. The first was making comparisons; different pieces of data and codes were constantly compared so as to identify and explore the codes that eventually became categories (Charmaz, 2014). According to Glaser and Holton (2007), the purpose of constant comparison "is theoretical elaboration, saturation and verification of concepts, densification of concepts by developing their properties and generation of further concepts" (p. 60). Miles et al. (2014) described constant comparison as a conceptual and theoretical process of iteratively moving between units of data and data and categories to develop categories that become saturated with detail and meaning.

The second activity that accompanied the elaboration of categories was the process of questioning. Questioning was about trying to make sense of the data, ask what each piece of data represents, and what category it indicates (Punch, 2009). The importance of questioning is substantiated by Glaser and Holton (2007) who asserted that questions “keep the analyst theoretically sensitive and transcending when analyzing, collecting and coding the data. They force him/her to focus on patterns among incidents that yield codes and to rise conceptually above detailed description of incidents” (p. 59). Key to coding, theoretical sensitivity is “the ability to understand and define phenomena in abstract terms and to demonstrate abstract relationships between studied phenomena,” and allows grounded theorists to develop the concepts that represent analytic patterns and are also substantiated by empirical data (Charmaz, 2014, p. 161). In sum, both constant comparison and questioning helped to find the codes to “best fit the data” and capture key ideas and meanings (Charmaz, 2014, p. 117).

Focusing coding was about enhancing conceptual accuracy, and thus merging codes because of their conceptual likeness or dropping them because they didn’t add to the analysis (Saldaña, 2009, p. 149). Decisions were made about which codes had “more theoretical reach, direction, and centrality” so as to “trim away the excess” (Charmaz, 2014, p. 141) and solidify the emergent conceptualization into a parsimonious theory (Glaser & Holton, 2007). The objective was to produce a theory that would emphasize understanding, multiplicity of reality, and present a narrative that integrated experiences and diversity of meaning (Creswell, 2012).

Trustworthiness

Naturalistic inquiry assumes that there are multiple realities and that research must capture this social and behavioral complexity. In evaluating and ensuring the accuracy of qualitative data to gauge the phenomenon of interest, the researcher seeks to establish trustworthiness according to the exigencies of specific criteria. Guba’s (1981) constructs for evaluating trustworthiness have become predominant in the field of qualitative inquiry. To assess trustworthiness, he established four criteria: credibility, transferability, dependability, and confirmability.

Credibility. "Naturalists wish to take account of the bewildering array of interlocking factor patterns that confront them and pose formidable problems of interpretation" (Guba, 1981, p. 84). The complexity inherent in qualitative inquiry presents challenges to demonstrating credibility, or the attempt to take into account these complexities (Mills & Gay, 2016) and present a true picture of the phenomenon of interest (Shenton, 2004). Guba (1981) and Shenton (2004) defined provisions researchers can adopt to instill confidence that the phenomena have been accurately recorded.

A criterion pertinent to building credibility is the use of well established research methods; the specific procedures used to collect and analyze data should be grounded in the literature, their successful use evidenced in previous comparable projects (Shenton, 2004). In line with this criterion, the research methods for this grounded theory case study have been drawn from the literature, their application detailed and documented throughout the chapters.

The second procedure applicable to this study is familiarity with the culture of the organization before initiating data collection (Shenton, 2004). Guba (1981) recommended prolonged engagement at a site to overcome the distortions and biases that may be caused by the presence of the researcher. Shenton (2004) concluded that prolonged engagement would promote understanding of the organization and establish trust between the researcher and participants. Prolonged engagement and familiarity is granted through the researcher's role as employee at the subject university. This role includes administrative and teaching responsibilities and daily interaction with faculty, administrative staff, and students. In this case and for the purpose of this study, the presence of the researcher is neither a distortion nor conspicuous, but is part of the routine affairs and operation of the site university.

Shenton (2004) also described methods to ensure honesty in participant responses. Following these guidelines, opportunity to refuse participation was provided to each person approached so that data collection involved participants who were genuinely interested and prepared to contribute; participants were encouraged to be frank; it was communicated that there are no right answers; lastly, coercion was not involved by making clear that the participants did not have to divulge information and had the right to withdraw at any time during the study (Shenton, 2004).

Transferability. In qualitative research, samples tend to be smaller and specific to particular environments. The social and behavioral phenomena studied is context bound, which makes it impossible to develop truth statements applicable to other situations and populations (Guba, 1981; Shenton, 2004). And though generalization is not possible, Shenton (2004) presented the counterargument that each unique case is an example of a broader group and thus transferability is possible. Transferability was applied in this study by providing descriptive data that permits comparisons between the research context and other contexts that might be similar and thus transferability possible (Guba, 1981). Following Shenton's (2004) recommendation, thick description of the phenomenon of interest was provided to facilitate the readers' understanding of it and allow them to make comparisons with situations of their own. Detailed information was supplied through the participants' narratives, as well as description relating to the specific context, including geographical and institutional setting.

Dependability. Dependability refers to the stability of the data; this correlates to reliability in positivist techniques, and addresses the question of whether the same results would be obtained if the study were repeated under similar conditions (Shenton, 2004). Dependability in qualitative research is problematic because of the changing nature of the studied phenomena (Shenton, 2004), the instabilities that arise due to the different and multiple realities being investigated, and due to the role of the researcher as investigative instrument (Guba, 1981). Instrumental changes may occur as researchers develop insights during the research process (Guba, 1981). Credibility and dependability work in close alliance; much of the information given to satisfy credibility also supports dependability (Shenton, 2004). In line with Guba's (1981) recommendation, an audit trail was established. The processes by which data were collected, analyzed, and interpreted are reported in detail, which enables readers and other researchers to examine and evaluate if proper research methods were followed (Guba, 1981; Shenton, 2004). In-depth reporting of research design, data collection, and data analysis is included to meet dependability criteria (Shenton, 2004).

Confirmability. Confirmability refers to the neutrality or objectivity of the data that have been collected. This criterion requires measures to help ensure that the study's findings truly reflect participant experiences and not the researchers' preferences (Shenton, 2004). To meet this criterion, Shenton (2004) recommended a confirmability audit trail, which allows the observer to trace the individual decisions and procedures involved in the research process. For this purpose, a description of methods and the rationale underpinning selected procedures and decisions are provided in detail throughout this study.

Furthermore, reflexivity was adopted as an additional step to ensure that the participants' voices were accurately reflected in the data rather than these mirroring the researcher's impositions and biases (Guba, 1981; Shenton, 2004). Guba (1981) and Shenton (2004) recommended that researchers meet the exigencies of confirmability by engaging in reflexivity, or an ongoing reflective commentary, by disclosing underlying epistemological assumptions, biases, and predispositions. To fulfill this criterion, a reflective commentary is initiated and predispositions discussed in the section that follows below. Furthermore, member checking was used in this study to check and confirm the data (Birt, Scott, Cavers, Campbell, & Walter, 2016). After transcription and an initial analysis of the interviews, the participants were invited back to review, confirm, and clarify the data (Birt et al., 2016). Conferring with the participants also provided the opportunity to share the study's conclusions (Lincoln & Guba, 1989).

Researcher Stance

"Just as the methods we choose influence what we see, what we bring to the study also influences what we *can* see" (Charmaz, 2014, p. 27). In reflecting upon what I bring to this research, it must be noted that this study is informed by prior theoretical perspectives, which may impose limitations. In revealing my position in relation to the research setting, the participants, and the data analysis, it is important to clarify that, for several years, I have been an employee of the university and research site, in a role that involves both administrative and teaching responsibilities. My time spent in the classroom as an instructor has brought me into contact with students from diverse faculties, including mechatronics engineering. This classroom interaction and the conversations that surface before, during, and after class have often caught my attention.

One such remark came from a mechatronics student, whom I will call Elizabeth. On the first day of class, I had told the students to introduce themselves and to make sure to include a remarkable fact. Some talked about their sports activities, others mentioned their travels, and when it was Elizabeth's turn, she paused to contemplate what was remarkable for her, and then suddenly told us that this was the only class she had with other women, and that none of the students in her core classes were women. I didn't expect this answer. I was truly astonished—as were the other students—and I immediately began to wonder what that felt like. After that, I couldn't stop thinking about Elizabeth's comment and the implications of being the only woman in the classroom. Upon running into another female mechatronics student (who had been a student of mine) in the hallway, I asked her if she had gone through the same experience. She was puzzled by my question, for I was asking the obvious, and confirmed with *Of course.*

I come from a family of engineers. I can count my father, uncle, brother, sister-in-law as engineers; my oldest daughter is now in her third year of environmental engineering at a German university specialized in the engineering sciences. So I began listening more intently when my daughter told me that she had applied for a room in a residential building of the university, and that her roommates, by default, would be men, because men constituted the majority of the student body. Or when my sister-in-law, who had studied electrical engineering at Canada's premier engineering university, reminisced about the one other woman in her classrooms. And I thought about my daughter's decision to study engineering—a surprise for both me and her father—the result of my brother's mentoring, his counseling very different from what I now realize were my own stereotypes and assumptions. The day that Elizabeth disclosed her minority status in the classroom, the invisible started to become visible to me.

Researcher biases are present in this study and must be acknowledged: First, I am in favor of supporting women to study engineering and believe that it is desirable to have women in the engineering pipeline, as present, active, and contributing members. Second, I believe that women's underrepresentation in engineering represents a chronic malfunction and loss to society. My conversations with the participants have evidenced that women feel that their perspectives have been excluded, and that their ways of thinking are distinct and deserving of a place front row and center so as to change the culture of engineering. I further believe that the obstacles that prevent or hinder women's participation are social constructs. Gendered socialization and even the canons of scientific research have historically put women at odds with math and sciences, imparting reductionist views of women's capacities as biologically, innately determined—and ill-suited to the study of and success in engineering. And somehow, this socialized version has become a "truth"—one of incredible obstinacy, which I hope this study will help to discredit. And so, another crucial conviction: Though feminist research is characterized by heterogeneity and differentiation, it does share the belief, as do I, that gender is an underlying and organizing principle—and problematic—of society (Patton et al., 2016) and that women's voices, reports and descriptions of experience can be the focus of research and should be because they have long been excluded due to androcentric versions of reality (Olesen, 1994).

And I would extend my views into the belief, and arguments of other feminists, who react to criticisms of bias inherent in qualitative research by saying that "bias is a misplaced term" (Oleson, 1994, p. 165). Shepherd-Hughes (as cited in Oleson, 1994) wrote: "We cannot rid ourselves of the cultural self we bring with us into the field any more than we can disown the eyes, ears and skin through which we take in our intuitive perceptions about the new and strange world we have entered" (p. 165). Biases are omnipresent; they very much belong to each one of us.

The interpretive nature of qualitative research has compelled the recognition of these biases via the process of reflexivity, the internal auditing of views, thinking, and behavior, to act as counterweight to biases (Oleson, 1994). As the researcher engages in reflexivity, greater diversity, creativity, and sensitivity might be inspired—and thus biases, as feminist researchers would argue, can also be resources (Oleson, 1994). Would I not possess these biases and claim these convictions, the study that was conducted would have suffered zero impetus and beginning—the *Why* compelling it would have never initiated. My biases are resources that have motivated and sustained this study.

Chapter 4: Results

The focus of this study was on understanding and describing the lived experiences of women engineering students. More specifically, the research questions were: (1) What are the factors and processes that have supported women who study engineering?; (2) What are the factors and processes that have hindered women who study engineering?; and (3) How have women who study engineering overcome challenges? A total of seven participants were interviewed. In responding to the interview questions, the participants' voices as women studying engineering were constructed into what Charmaz (2014) has called a body of theoretical logic of self-conceptualizations linked to perspective and experience. In this chapter, the findings have been organized as the central themes and corresponding categories that emerged in following a grounded theory methodology. In order to improve understanding of the underrepresentation of women studying engineering, the study was guided by a central, overarching question: What are the lived experiences of women engineering students?

A total of seven participants were interviewed who represented an age range of 18 to 23. They were enrolled in various semesters of the program, spanning first to eighth semester; within this range, all semesters except for fifth semester enrollment were represented. These factors added diversity to their perspectives as it became apparent that time was playing a role in influencing and creating the context of their experiences. For example, more advanced students often remarked on the change and improvements they had perceived in the program since their first semesters; *now* and *I wish that* were words spoken in their assessments of the past and strategies for the future. The newer students were in a unique position to benefit from these lessons learned and changes made. In this sense, the participants' experiences were time embedded—*and* they recognized that factors and processes are moving elements. However, in concurrence and significant, was the evidence of pervasive challenges and barriers resistant to the influences of time and change.

The experiences of the women interviewed illuminate the factors and processes that have helped and hindered them as students of engineering, as well as the ways in which they have overcome challenges. The study findings were organized into themes, the dimensions of each captured in analytic categories that address the layers of complexity that construct lived experiences. In the attempt to supply an understanding of the factors and processes that influence women who study engineering, the following themes will be discussed: (a) The outer environment, (b) The core environment, (c) The individual "I", and (d) Dismantling barriers and creating the enabling environment. Themes and categories are discussed in detail within each section, and they have also been organized into a table at the end of this chapter (see Table 1). Excerpts from the interviews have been included in amplitude—for interpretation is often a poor and misaligned replacement for the poignancy of the voices themselves.

Theme 1: The Outer Environment

The outer environment contains the broader structural factors and processes that influence women in their academic and career pursuits. This category provides the context and an overarching framework of analysis. It exemplifies how differentiation on the basis of gender affects women—filtering and shaping academic and career choice—long before they approach the higher education environment and, for the purpose of this study, the core engineering environment. The outer environment includes influences such as a society's values, beliefs, and practices, and how these feed into, for example, the gendered segregation of fields of study. To enrich the analysis of this theme, the following categories will be discussed: (a) Society as overarching social structure; (b) The hegemony of machismo; (c) Gender socialization and gendered norms; (d) The gender identity of engineering: "A career for men"; and (e) *Knowing* and the fear of *being* the only woman.

Society as overarching social structure. Throughout the interviews, the participants referenced society as a fundamental barrier to women's representation in engineering. The conversations conveyed a sense of society as ubiquitous, powerful, and abstract, which gave the impression that they were powerless to stop it. Within this context, the conversations revealed the idea that society acts as an overarching social structure of influence. Carmen explained that women choose to not study engineering, not necessarily because of someone specific stopping them from doing so, but "because one just goes with the culture, with society." Her words touched upon society as context—furthermore imbued with normative properties and the ability to regulate conduct according to gender.

Society exerts pressure on women to engage in gender normative conduct, working in favor of prescribed roles and responsibilities—and against those that are non-conforming. Zara remarked that "society, in general, …. wants to make us [women] look bad so that everyone can see that there should not be women engineers." In response to why so few women study engineering, Catia identified society as being the fundamental problem "because it doesn't permit it." She explained that society doesn't allow women to oppose their historically assigned roles as caretakers and mothers, view themselves distinctly, and follow their dreams into non-traditional roles: "Because just imagine that a woman walk into a place, all dressed up in uniform, wearing a helmet and safety glasses, welding, just imagine it …. it's just not common to see."

Engaging in non-conforming behavior, however, is disruptive and brings about challenges. In explaining that society makes women think they can't study engineering, and for which reason they choose to not study it, Christina's remarks highlighted how opposing societal pressure and gender norms results in dissonance: "It's not like [my male classmates] are making me feel that I can't, but I think that's already involved because of society's ideas that make you think that you can't, and you have to prove yourself, that you're better or maybe at the same level as [men]."

The hegemony of machismo. In exploring perceptions of gender relations, machismo emerged as a conceptual frame for the gender inequality the participants experienced. They referred to machismo often and constructed definitions of it in ways that highlighted power and privilege, and how these were unevenly distributed according to gender.

Christina invoked the conversation about machismo in saying that "society has this way of thinking … I think society is still *machista,* and they still think men are better than women." Carmen explained machismo as predicated on restrictions and men and women not being able to do the same things. She contemplated her academic and career choice and felt that machismo, for example, was about not receiving support and being obligated to study something one didn't want, or being forced into the role of housewife, cooking and cleaning. The conversations further revealed that restrictions were also related to perceptions of "danger" and notions of the world, the streets, going out at night, or having male friends as being dangerous for women. Machismo thus included the necessity that women be protected through restrictions—even though, as Zara said, "a woman is capable of taking care of herself."

In further constructing an understanding of machismo, Zara defined it as

> [women] feeling helpless, feeling the patriarchy, of the father having all the power, of the man being the one who decides … I see it as a way in which a man imposes himself upon a woman and tells her that what he says is what she has to do. This happens everywhere, in the workplace, at home, in cities, countries, in general. So that's what I see as machismo, to impose, when instead you can arrive at decisions together without any problem.

Machismo is not restricted to men and is not strictly a male attitude or practice. Within their families, participants highlighted the influence of their mothers in perpetuating machismo. They underscored the relation between society's machista ways of thinking and how these were manifest in, for example, as Christina said, her mother's "old thinking." The conversations were often steered towards the conflict the participants experienced as response to their mothers' enforcement of the restrictions and impositions they considered machista. In addition, neither is machismo perceived only as negative. The participants described experiences of chivalry, machismo as also characterized by the ideal of gentleman, and the feeling of being protected. To this point, Catia talked about feeling protected by her male classmates and said that this experience was "like having her own bodyguards" and made her feel good. The difference here is how feeling protected conveyed a sense of support rather than restriction.

Gender socialization and gendered norms. Gendered socialization carries negative influences that are particularly harmful for women in engineering. The participants highlighted how gender socialization constructs normative influences, and, from an early age, establishes what is considered gender-appropriate behavior. Isabel identified gender norms as being restrictive and prohibitive. Using the example that boys are told to play with cars and girls with dolls, she talked about children, from very early ages, being socialized according to limitations: "Since they are little, [children] are taught that there are limits to do one thing or another. Then they get older and they've been barred from the opportunities to become something more, to be an engineer or an astronaut."

The participants also expressed how gender norms result in the negative outcome of gender-bound competencies. The comparison Erica provided highlighted the gender normative attitudes expressed to socialize and influence the students' abilities and knowledge. She compared her education at an all-girls school with her brother's experience at an all-boys school:

> Like at my school as I told you it was an only girl school, and it's funny because there is another school very near to mine … that's only male. In the girl school, the teachers and the way it is … it kind of tried to convince, not convince, but show girls that they will like more languages and economics …. in school, the authorities they don't give much attention, in the girl school, for science and for math. I once participated in a math contest and the authorities didn't care so much, and even though I got a very good place, they didn't give it like a recognition, but when it's about languages and when it's about history, they give it more recognition. In the male school, like my brother was in that school that is only male, only boys, in that they would put more emphasis on science and on math …. so I think that since school, they kind of give girls the idea that they are not good for that area, they should stay in areas that normally girls are good at, and boys should stay in the area they are good at. So I think that since school they kind of separate things …. like I think it's mostly that, that girls since they are little they kind of have the idea that they are not going to be good at science, because that's what normally people think.

The gender identity of engineering: "A career for men." The broader process of gender socialization foments biases and stereotypes that construct and reinforce the gendered identity and resulting segregation of disciplines. Maria talked about the harmful effects of stereotypes that promote the negative belief that engineering is not for women—but for men only. The pervasiveness of this stereotype and the biased differentiation it entrenches stop women from even contemplating engineering as a possible academic and career choice. Indeed, engineering is profoundly embedded in a normative framework that promulgates the belief that women are not made for engineering. The participants shared their experiences with confronting this barrier. During Christina's interview, she said: "I think people in general make you think like, no, girls should study other things and not engineering, or hard things, because those are for men."

Engineering as a masculine discipline and "man's world" is a pervasive belief that deters women. The participants overwhelmingly shared experiencing the doubts and questions that came with their decisions to study engineering. Isabel said: "When someone, like a classmate, would ask me what I wanted to study and I would answer mechatronics engineering, they would just stand there and be like *Why do you want to study that?* No one understood." Maria also shared her father's hesitations and her mother's initial resistance to her academic and career choice because of their beliefs that engineering is for men. Christina spoke of having to confront her mother's questioning and defend her choice of studying "a career for men."

The male identity of engineering was also manifest in the sense of it as masculine and non-inclusive of the feminine. The exclusivity of the masculine provoked gendered reactions that pressure women: Zara expressed her experience that the perception of women who study engineering is one of "woman as *una machona* [a butch]." This perception was also explicitly addressed by Isabel, an eighteen-year-old student, fresh out of high school, who had just begun her first semester. She described herself, referring to her way of dressing as an example, and high school classmates' view of her "as not very feminine." She talked about the reaction of her high school classmates after telling them about her decision to study mechatronics engineering: "So, because [my classmates] didn't see me as very feminine or anything like that, they said *Ah, of course* and things like that." Carmen contributed to this point by describing an experience in first semester, a female classmate who dropped out after only a week: "She looked like she wasn't made for the program, that is she was concerned about being made up and things and parties."

***Knowing* and the fear of *being* the only woman.** The participants spoke of knowing, of having heard and being aware that they would be one of few women studying engineering. Zara said: "Yes, from the beginning, you know in general that there are no women in engineering. It's very rare to see a woman in civil engineering, mechanical or electrical engineering, but [mechatronics engineering] is a combination of both, so you know that it's going to be even more difficult to find women."

Just knowing that women are not to be found in engineering acts as a structural barrier—and detour sign, which turns women away from engineering and in other directions. "Knowing" and women's scarcity in engineering as widespread truth and common knowledge invokes a fear of the consequences of being that only woman. Maria described her mother's initial *No* and opposition to her choice of studying mechatronics engineering by her mother asking, *How are you going to feel if you are the only woman?*

The fear of being alone was also linked to the fear of sexual harassment. Being alone meant to be on your own, without help and support, and fall prey to predatory intentions. Participants shared vicarious experiences of incidents in which professors had sexually harassed female engineering students. Zara, for example, talked about a friend who was studying engineering at another university, and had been asked for sexual favors in return for better grades from a professor "who had never had women in his class." Erica also related the experience of a friend who had studied elsewhere and decided to drop out after a professor tried coercing her into having drinks with him by offering his "help" in the subject. Expressing indignation about the abuse of power sexual harassment represented, Zara described the knowledge of sexual harassment as invoking fear and acting as a principal reason to deter women from studying engineering. "I believe that because of that fear of being abused, [women] prefer to study something where they know they'll be with more women who will support each other."

Theme 2: The Core Environment

The core is the social and academic environment of immediate interaction within the setting of engineering. The core environment describes engineering's culture and climate and examines key interpersonal relationships. This is where the women who study engineering live their daily lives and interact with the people and processes that help and hinder them. Understanding the core environment includes an analysis of the following categories: (a) Weeding out the unwanted; (b) Engineering as practical and hands on: Physical strength as a male advantage; (c) Losing the "privilege" of being feminine; (d) Bearing the double standard of gendered expectations; (e) The culture shock of engineering: Being *that* only woman; (f) Lacking the female network; (g) Guy talk; (h) Acculturating into the boy's club; and (i) Interpersonal relationships: Conflicting overtly with family.

Weeding out the unwanted. Engineering has a notorious reputation for promoting a weed-out culture, which sets up immense obstacles that, as participants described, often led to moments of profound doubt and emotional crises. The extensive filtering of students is typically considered a rite of passage to reward those who are the best and the brightest and thus deserve to continue, leaving those who are academically unfit, the "unwanted," to fall by the wayside. Zara was made acutely aware of this thinking from the very beginning: "The first memory I have of the faculty was the first class with the dean, who told us *Okay, right now there are thirty of you, but next semester, don't worry, there will only be ten."*

The weed-out culture creates a high-pressure environment stoked by the academic difficulty of the courses and course load. Participants spoke of engineering as being "complicated" and feeling academically unprepared upon entering the program. Maria felt that high school had not given her the academic foundation she needed to succeed in university. Carmen said that, since high school, she'd always liked math and that numbers were her thing—indeed, an aptitude test had directed her towards studying engineering, but "never did I imagine that it would be so hard …. when I entered the program, in fact, it was very difficult, and there are subjects that cost me so much to learn. There were two times that I wanted to drop out, because I couldn't take it anymore, it's so hard." Catia, a student in second semester, also described the crisis she experienced:

> I will tell you about an experience I had in [first semester], the last week. The workload, the amount of projects … it was over, but the [next semester] was coming. It was terrible. I thought about dropping out of the program …. that last week I said do I want this for 5 years until I graduate, to be stressed, not sleep …. is it worth it?

Also adding to the pressures of the weed-out culture were competitive attitudes that led to the fear of asking questions and of "looking stupid." Carmen related her experience of a previous class in which she didn't understand the subject: "You could tell how everyone was super competitive, because no one helped each other. If I would ask them something, they'd be like *No, I'm busy, I have stuff to do.* It was really hard, and because I didn't have the confidence to ask the professors …. I just kind of left it." Leaving it resulted in Carmen failing the course.

For the participants, their gender added a crucial dimension in defining and understanding what was "unwanted." They spoke of being targeted in the classroom and experiencing the machista and explicitly hostile attitudes of faculty. Erica described classroom interactions with male professors, some of which she repeatedly described as "weird." Upon prodding for an explanation, she explained that "weird" for her was the professor who made machista jokes in the classroom or would pick on the female students: "For example, there was a teacher that used to [question] the girls more, like he [would explain] something and then [question] the girl, and if you didn't know, he would [make a] joke and kind of make you feel embarrassed."

Being the target of machista attitudes was highlighted by Maria's example of being automatically designated class secretary to take care of tasks like student attendance, because she was *the* woman in the class and, as the professor said, "women are more organized." The machista attitudes of faculty also led to the participants being mocked and harassed in the classroom and feeling helpless to do anything about it. They felt powerless and also feared retribution. Erica described the incident of a machista joke made by a professor:

> He and like all the class started laughing, like everyone was like *hahaha,* and I was just like, I didn't laugh. I just know that I was red and they were laughing also because of that. And I said nothing, because there is not much that you can do … and also because you don't want to get in trouble with teachers, like it's better just to continue with your life and not have bigger problems because of that.

Zara talked about the difficulties of her initial semesters: "There were a lot of machista professors, who didn't like to see women here, who always tried to make us stumble, and wanted to get rid of us." She reflected upon a particular incident with a professor whom she felt had treated her unfairly, and failing a subject because of it. Obligated to repeat the subject, with the same professor, she felt that again he was trying to undermine her: "I felt that he was trying to make me fail again, but this time he couldn't. We were now two women in the class. Before I had been the only one." Carmen also described a professor who picked on her in the classroom, creating problems for everything, grading her unfairly, and causing her to fail the subject "because I am a woman and so I told the dean, and it was like nothing could be done, so I had to repeat the subject and since then that professor is after me …. and it was the same with another classmate who is a woman."

Engineering as practical and hands on: Physical strength as a male advantage. The interviews highlighted how the study of an engineering discipline entails specific activities and obligations that are overlooked in the literature. The research has not explicitly explored what it actually means to be a student of engineering, and to be engaged in daily activities that are not solely classroom or computer based—and that have implications for women.

The participants' experiences converged around a description of engineering as "very practical" and one that "you learn by doing." Though theoretical in the classroom, the program was also about “getting into the lab,” where the participants were involved in “hands on” investigation and projects, like building robots, circuits, and mechanisms. These were the activities that had served to attract them to the program in the first place, and the participants described these moments as opportunities to create and be creative. These projects also involve tasks such as sawing, welding, maneuvering heavy machinery, and carrying heavy mechanisms, activities that are significant because describing them formed part of responses to the question if men have advantages over women in engineering. There was a confluence around physical strength as an advantage men possessed. For example, Zara said: “Strength. Maneuvering machines is sometimes very difficult. So, yes, for [men], their natural strength helps them more … for me it has been difficult.” The lack of physical strength presented an impediment not only for maneuvering machinery—bruises, cuts, and burns were part and parcel of working in the lab and the participants were very cognizant of the lack of physical strength as presenting heightened potential for personal injury.

Men’s advantage of physical strength is the flip side of women’s disadvantage in the lab, project-based environment. This challenge implied that the participants are obligated to ask for help and rely on the goodwill of male classmates who are the only help available to them. In talking about this situation, Erica described her relationship with male classmates, repeating “good” and “good guys,” a choice of words that piqued a need for further explanation. Upon asking, she defined “good” as being respectful and helpful:

> They are more respectful …. I think that’s the biggest difference. There is a friend, and I don’t have classes with him anymore … but he was very respectful with me …. for example, sometimes we have to carry big things … and he would say like wait here, stay here, I will help you …. he goes, he

> leaves his things and he will help me to carry when I have to take something that's heavy …. that's what I mean about a good guy, because there are some other guys that are like, she has to handle it alone.

A student in seventh semester, Erica added to the conversation the description of a change in herself, in talking about getting "a little bit more comfortable asking for help," but it became clear from her response and those of other participants that lacking strength and, in consequence, having to ask for help is a demand that hinders women and contributes to a sense of discomfort and unease in their learning environment.

Losing the "privilege" of being feminine. The amount of courses, assignments, and projects the program requires impose strict time constraints on the participants' daily schedules, to the point that they talked about not having time to even bathe or brush their hair. The lack of time, in combination with the safety requirements and practical considerations of working in the lab, had a significant impact on the participants' dress and grooming, relevant to what they described as "feeling feminine." Zara talked about not dressing in her best clothes, or doing her hair or nails, because they would get ruined or even pose dangers when working with machinery: "So I don't see much sense in being perfectly made up all the time, perfectly impeccable, because my thing is machines. I have to get in there and work with them, and understand that my hair can completely ruin a project if it happens to get in the way."

The participants reflected upon how studying engineering had obligated them to sacrifice certain feminine qualities and the ability to express their femininity. Catia's perspectives elaborated on this point. In response to asking about her experiences as a woman studying engineering, she talked about the "drastic change" she'd gone through, one that her friends and family had noticed, and described her appearance as completely different from one semester ago. She emphasized how the demands and practicalities of her studies had led to the sacrifice of feminine "privileges" like wearing earrings or painting her nails: "We [women] just can't …. for example, yesterday I was welding and my hair got burned, a big chunk of hair. Really, you just can't work with your hair loose …. for the time being, you lose some of those privileges."

Bearing the double standard of gendered expectations. The requirements and practicalities involved in the engineering environment obligated the participants to forsake feminine privileges. Accompanying this sacrifice was a feeling of indignation about a double standard of gendered expectations. Participants voiced indignation about societal standards of feminine beauty. Zara talked about feeling judged and questioned for not doing her hair, or painting her nails, or wearing makeup: "Society expects women to be made up. Even beauty products, there are many more beauty products for women than for men, and for [men] it is secondary. On the other hand, a woman, regardless of what she studies, always has to be made up."

Men, on the other hand, didn't have to be concerned about and weren't judged on their appearance, particularly for looking unkempt, part of everyday circumstances of the program's demanding schedule. Zara qualified the freedom from being concerned about these expectations as a principal advantage men possessed. Gendered expectations translated into two sets of standards—feminine ideals of beauty for women and "whatever pants and shirt" and "some gel in their hair" for men. The double standard of gendered expectations was then further linked to appraisal of competence. The evaluation of men's competence in engineering did not factor in appearance and dress—it didn't matter how they looked—whereas it was decisive for women and acted as precursor "to be taken into account." In other words, men are considered competent "by nature," because they are men: "[Men] are always made up. So they're always going to stand out because [people] see a man …. this is something men don't have to think about."

The culture shock of engineering: Being *that* only woman. The participants spoke of having heard and knowing that there'd be few women in engineering, but the difference between knowing and being that only woman (or one of very few) marked an experience participants described as "shocking." Christina, now in fourth semester, described always being alone: "Since I've been here, I am the only woman …. Sometimes, when I have to repeat a subject, I have some classes with another girl, but we are the only ones …. and the rest is just men."

Illustrative of the scarcity of women in the program was the surprising ability of the participants to count and know the names of every woman, out of close to 100 students, enrolled in all semesters of the mechatronics engineering program. (Surely, men would not have been able to do the same.) Carmen said that though she had heard and been told, she never imagined there would be *so* few women: "Literally, we were two. We were three, but one girl lasted a week." And in referring to her classmates, Catia always used the Spanish masculine form of *compañeros,* because "literally they are men."

Upon initiating the program, the experience encountered by the participants could be described as culture shock in response to entering a foreign social environment. The participants became acutely aware of the differences between the old culture (of high school) and the new culture of the male-configured engineering environment. This moment marked initial awareness of the dominance of male culture in the engineering classroom. Carmen described her first semester as “strange,” having been used to being with boys *and* girls in high school and *everyone* sharing activities. In describing the huge change she experienced, Catia said:

> I come from a mixed school, men and women. So landing in the extreme of only men was hard. [In high school], because we were half-half, there was no difference, because we would all work on the same things. But being here, now, I’ve realized a big difference because [men] are extreme, they’re full extreme.

The “full extreme” of cultural differences included men being more competitive in the classroom, their style of conversation being terse, colder, and direct to the point, their work style being “careless” while women were perfection- and detail-oriented. She felt that women were more sentimental, an attribute she felt men perceived as “exaggerated.” Erica highlighted gender differences in talking about the shock of going from an all-girls school to first semester at university, with only two other women as classmates. For her, important differences related to classroom behavior and topics of interest and conversation. Women were more calm and quiet in the classroom while men talked and joked around. She spoke of the change from having lots to talk about and activities to share with her friends in high school to not sharing the same interests as her male classmates and thus interacting very little with them.

Lacking the female network. Being the only woman meant the absence of a female network, and thus the influence of another woman in the classroom, which also acted as support. This absence was accompanied by loneliness and feeling isolated from the rest of the group. Upon asking her if, in the classroom, men interacted differently than women, Maria talked about her natural shyness and the impact of being the only woman in her cohort:

> Well, [the guys], unlike me, I just didn't ask [questions], but they asked freely. Maybe it was my fear, but if they had doubts, they asked. If they wanted to talk, they talked. I'm really timid so I would just be quiet. I don't know if the other women are like this, but because I was the only woman in the cohort, I was really quiet because I had no one to talk to.

Maria further commented on feeling isolated because there are no women in class to talk about "women's stuff," an experience also shared by Catia: "Sometimes it feels a bit ugly, because you need another girl with whom to share stuff. You can't tell a man 100 percent everything." The lack of a female network and support was also linked to feelings of disorientation, particularly in the beginning. Erica shared her experience of feeling insecure and nervous when she started university and needing someone to turn to and ask questions—and finding that only men were around: "Because sometimes … when you just come to university, you are like shy and you don't know if you can ask someone, you usually just ask the person that gets close to you, which are like usually boys, not girls."

Guy talk. Throughout the conversations, the negative effects of being an underrepresented minority in a male-configured classroom were conveyed through repeated mention of "guy talk," referring to the topics men typically shared:

> They chat usually like look at this girl, look at her butt or something like that, or look at that girl there … and I'm a bit like *Come on, I'm here.* They always, they always talk about things like that. Like girls, we talk about several topics, about movies, but they always talk about girls and their bodies, so I feel that is a little bit like not so nice to hear all day …. also like, I, for example, I don't have as many girlfriends here, but here I cannot talk with many boys. I just talk about classes, about homework, but I don't feel like talking also about football, that is their topic also. So I don't like football, I don't like sports, so I don't talk too much with them.

Guy talk offended the participants and made them feel very uncomfortable, yet being outnumbered meant the male culture of engineering prevailed. Erica further mentioned that

> but like now I can feel that boys are like very comfortable around me, and I feel like sometimes bad when they start talking about their topics and girls and all that, and I'm like, *I am here,* you shouldn't be saying those things. But they are used to it, because now they feel comfortable and since there are more boys than girls, they feel that they can be like just with boys.

Erica went on to say that feeling uncomfortable around guy talk had made her less communicative than when she was in high school. She described preferring to stay away from the guys and their conversations and, in consequence, keeping more to herself. Maria also expressed feeling alienated "because they [classmates] are guys and they talk about their stuff." When Catia responded to the question if she felt that she had ever been treated differently as a woman studying engineering, she too focused on her experiences with guy talk: "There are times when they [male classmates] start talking about their stuff between them, talking bad words … and that is what a woman doesn't like." Guy talk caused the participants to feel socially excluded, and, in the process, protect themselves from offense and discomfort by withdrawing from their environments.

Acculturating into the boy's club. Significant for Erica was not having other women to talk to and feeling alienated by the conversations of her male classmates, so when the topic was further explored, her experiences unearthed a more complex process of change: "Yes, I think I had to get used to that, because I cannot change them [men] so I am the one who is getting used to it." Erica voiced the requirement of women who study engineering to adapt to and assimilate into a distinct culture—the dominant male culture, in stark opposition to female and feminine culture.

Catia's remarks were poignant about women's process of acculturation into the boy's club: "As time goes by, it's like we become one of the guys, relating as part of a single group. Yes, it was difficult to adapt, to get familiar with this new way of living amongst men only and that *they* trust in us." And her reflections also shed light on the more profound effects of acculturation: "We've now gotten to trust, that they tell us their stuff, which normally doesn't happen, so that now we're part of their team."

Having grown up as the only girl amongst a large group of cousins, Zara described being "just another guy in her family," with the effect that entering mechatronics engineering and being the only woman wasn't cause for shock: "So I was already used to being around men. I wasn't surprised by the jokes … maybe the *patanadas* [rude, uncouth things] that they at times start talking about …. when I got here, I think it was more shocking for the guys to find out that they could speak like guys and that I wasn't affected by it." Zara's words suggest that the ease and familiarity with which she transitioned and interacted with her environment came from being assimilated into male culture since childhood.

The interviews pointed out the other end of the process of acculturation into the boy's club, when women are assimilated into the male culture, and even begin to reject female culture, perceiving it as foreign and jarring. "For me, to start hanging out again with women, it's a bit complicated." Catia said. Carmen talked about getting used to being around men only: "Over time I adapted to it and now I've realized that it's way better to be with guys than girls. Because in other subjects that we take with students from other programs, it's really weird, like the girls are problematic …. I like working with guys better." As an additional dimension, the participants also voiced having a greater affinity with men than women—indeed, the participants often talked about not getting along with, in the case that there were any, female classmates. Informing this point, and in response to asking about her experiences as a woman studying mechatronics engineering, Christina said: “I like it, because when you have men friends, it’s not as complicated as women friends, because, I don’t know, I think men are better friends, there is no like envy or drama over everything. I had that environment in high school so I feel better having [men] around.”

Interpersonal relationships: Conflicting overtly with family. Family members acted as agents of gender socialization, and transmitted norms, values and expectations to the participants. They were key influencers in the participants’ immediate environment of interaction and often triggered a range of conflict, from a minimum of doubt to disruptive moments of emotional crisis. From childhood memories to more current reflections, the participants frequently spoke about their families and the barriers they’d encountered. Catia expressed receiving 100 percent support from her parents, but, at the same time, the difficulties and sacrifice the program had demanded also caused her parents to question her choice. She explained having to work through her parents’ doubts, and that it has been difficult for the rest of her family to assimilate and accept that she is studying mechatronics engineering. Carmen described how her family responded with disbelief and forewarnings after she told them about her decision to study mechatronics engineering: “You’ll see that it’s really hard, that you really have to think about what you want to study … you’ll see that it’s complicated.”

The most persistently described, however, and troubling relationship was Christina's tumultuous relationship with her mother. Often close to tears as she spoke, she identified her mother as the biggest challenge she faced as an engineering student:

> It's always the same problem with my mom. Every time, each semester, and the start of the year, she's like, why don't you change your career or university, or something like that, and I'm like, no, I want to study this …. she has the old thinking, that girls should study easy things …. it's always been this way. Because I also [practiced] taekwondo, and I remember, and she always does it like that, she's like why do you do that, this is for men. And I'm like why can't I do that if I like it …. it's always been this problem with my mom. We have different ways of thinking …. my mom, no, she's never supported me in this decision.

Theme 3: The Individual "I"

This theme explores the individual attitudes, preferences, and strategies the participants manifested and employed as women studying engineering. It focuses on the participants' sense of self and how this was negotiated to maneuver within the gendered differentiation and power relations inherent in the academic and social environment. Wanting to be an engineer, asserting preferences and aptitude, and contesting the challenges—via attitudinal and support-seeking strategies—of pursuing a male-configured academic and career choice defined the participants' experiences. The categories presented in this section are: (a) Getting into and through engineering: Aptitude, preferences—and passion; (b) Proving *them* wrong; (c) Feeling the pressure to perform successfully across multiple roles; (d) Relationships that matter: "A push to move forward"; and (e) Acquiring resilience through life goals and dreams.

Getting into and through engineering: Aptitude, preferences—and passion. Regardless of the odds and barriers, the participants' pathway into mechatronics engineering was prompted by their liking and aptitude for science and math, as well as an affinity for mechanical pursuits like building and taking things apart. Being good at and getting the best grades in math and physics, as well as the sense of a natural ability and ease with these subjects in high school encouraged their interest in studying engineering:

> *Catia:* So I started thinking about, since I was little, the subjects that weren't at all difficult for me, and these were numbers, physics … all physics laws and theories. All that was not difficult for me and I liked it.
>
> *Isabel:* At some time, between the age of 6 and 8, I started taking my toys apart, and the blender, which was not a good idea. One of grandmother's sisters had lent her a blender and they left me alone with it. There was a screwdriver and when they got back it was already too late …. from that moment on I loved everything that was technology, mechanisms, everything.
>
> *Erica:* In school, I always liked math classes. I always used to get the best grades. So when someone is the best in something, like you want to continue in that and that was maths and physics …. I started investigating careers that involve both subjects and I found one that is mechatronics. And it's like a complete engineering because you have electronics, you have mechanics, you can program, and I also like to do things with my hands.

If their passion and aptitude got them into engineering, it also sustained them as students and was significant in how the participants identified and positioned themselves in relation to the challenges they faced. In spite of the doubts and questions, from friends and family, that typically came their way, the participants saw themselves as achieving and laying claim to their rights to pursue what they wanted. Reacting to the habitual *Are you sure?* and *Why are you studying that?* was Isabel's succinct response: "Because I like it, because it is my life." Catia spoke of being

> 100 percent sure. [My family] has to understand what the career is really about. They shouldn't talk prematurely, if they don't understand what I'm experiencing, because it's something unforgettable …. the classes, they are extraordinary …. what we are experiencing, to see each phenomenon, as, for example, how a car moves, acceleration, how a computer works internally, the codification, it's amazing.

Proving *them* wrong. Reacting to gender biases and discrimination by disproving the prejudices and those who transmitted them was an attitude and strategy adopted by the participants. Proving them wrong meant working harder than the rest, investing monumental effort into their studies, and becoming more competitive. The participants did not back off from perceived challenges and threats. Working harder to "show them" was an attitude and strategy of resilience that mobilized their motivation to overcome gendered prejudices and keep on going. Isabel spoke of responding to the biases of her high school classmates "by not listening to anyone, and I showed them by *sacándome la madre* [working my tail off] …. and striving to get over every hurdle and every thing." Maria also shared her reaction to being questioned about her choice to study engineering: "I was really questioned, as if to say a woman doesn't know much about engineering, and so, this makes me want to show them that a woman can, that a woman knows." In describing her experience with machista professors during first semester, Zara said:

[They] demanded more from us [women] …. if you had doubts, they would respond as if it were something way too simple and that I shouldn't be asking it. So I studied and worked even harder."

Feeling the pressure to perform successfully across multiple roles. Zara described herself as an adept multitasker, an ability she attributed to being a woman. Part of her multitasking included the responsibilities she felt to take on the role of nurturer and caretaker for her younger sister. She spoke of demanding far more of herself so as to "perfectly" take on these additional responsibilities. Disliking the accumulation of tasks, working harder than everyone to make sure all her work was done by the weekend, she also confessed to the pressure she often felt she was imposing on herself. "Why am I killing myself,*"* she said in questioning that pressure. She believed that women demand more of themselves and provided the example of her mother who worked harder during the week to make sure she had time on the weekend to dedicate to her family. Zara asserted that she demanded more of herself "for knowing that I am a woman."

Relationships that matter: "A push to move forward." Relational interactions with family, peers, faculty, and student affairs professionals represented crucial support systems for the participants. These were the relationships that mattered, especially in moments of crisis, like, for example, what Maria experienced as an "existential crisis." Though at times relationships acted as triggers of conflict, such as the case of Christina's turbulent relationship with her mother, they also worked as support systems that, at a minimum, neutralized the effect of negative interactions and also served to motivate the participants when they most needed it. The participants sought counsel, advice, and inspiration from the people they trusted and that became trusted because of their role in providing guidance and support.

The support Maria received from her parents at a key moment illustrates the importance of these relationships. Upon asking her if she had ever felt discouraged, she responded the following:

> This semester that happened a lot. There was a moment when I felt I just couldn't understand a subject, and I was really wondering if this career is really for me, because that subject was really complicating things. So I had this problem, thinking that maybe this isn't for me, maybe I was wrong, and I lost my motivation. I think I even got depressed, and there my parents helped me, they told me, *Yes, you can. We've seen how much effort you've put into this. Maybe it's gotten difficult, but just go and ask*. So that was a motivation, a push to move forward, to ask for help from the professor. And with the professor's help, I was able to move forward."

Maria’s words show that the motivation that comes from receiving support through one relationship can lead to seeking support from others. The “push to move forward” had a multiplying effect and gave Maria the confidence she needed to work through and overcome the crisis she experienced.

Relationships and interactions with faculty were key influencers and determinants of motivation. Maria related another experience with a female professor, who helped her get through an exam that was particularly important to passing the course: “She took me aside and told me that I believe in you. I know that you can do it.” Important to add to this experience is how Maria continued to cherish these words, which were just a few words—but enough: “That last comment … motivated me to move forward and stay motivated.”

Relationships with peers were also significant. For Christina, peer support was the counterweight to the conflict she persistently encountered with her mother: “It’s always the same problem with my mom. Every semester and the start of the year she’s like, why don’t you change your career or university, or something like that, and I’m like no, I want to study this.” In response to being asked how she overcame the discouragement she experienced as a result of the relationship with her mother, Christina responded that

> At first it was very hard. I wanted to listen to her, and just change and do whatever she wanted, but I always asked her like What do you want me to study then, tell me, and she’s like No, I don’t know, just something easier. But she doesn’t tell me what. And, sometimes, I just want to do what she wants …. but then my friends they tell me why are you going to do that if you want to study this, and you know you can. So that’s what keeps me here.

Overwhelmed by the demands of the program and envisioning the future, Catia described “a guardian angel” moment:

> I imagined myself being stressed like this for 5 years. It was a moment of crisis and I didn’t know how to confront it. In fact, I was going to drop out that week. And it was like a guardian angel moment …. with the guys that are about to graduate, it was like we went through that, do not give up like that … they told me to not give up, that we will help you, we know that you will overcome it, and, look, now I am already finishing another semester.

Another source of support and motivation, particularly in dealing with troublesome interactions with faculty members, came from student affairs professionals. The participants expressed a positive view of the department of student affairs and the feeling that it provided impartial counsel and mediation to deal with the discriminatory attitudes and behaviors of professors in the classroom. The participants felt they could talk openly with student affairs without being blamed and without fear of retribution.

Renewing the sense of self. Participants did not only talk about the challenges they’ve confronted, but also the impact of overcoming them. Making it through difficult moments led to enhanced and positive self-perceptions. Their sense of achievement inspired confidence and increased autonomy, and was also related to renewed energy and motivation. Confronting problems via timely and proactive help-seeking strategies was an important outcome of overcoming challenges. In describing her experience, Carmen said:

> In the beginning, I just let things slip, but now when I see that a subject is difficult, I look for books, I search for tutorials on the internet, I ask the professors, because now I have more confidence, now I know all the professors …. I think that now things are going better for me, that is I am more confident and I see things … I see more than just problems, I see the solutions, and I try to search wherever for solutions to help me … and though there’s never time, you just have to find help and organize yourself, and everything turns out fine. Yes, now I think I’m doing better.

For Maria, the sense of academic accomplishment was translated into passion for what she was studying: “So, yes, in the beginning, it was hard because I didn’t have the foundation, but then I loved it more than when I was first sure that I wanted to study [mechatronics engineering], more than when I first entered the program. I became much more passionate about it.” And in Zara’s case, a renewed sense of self came after overcoming academic difficulties due to a machista professor whom she felt had treated her unfairly. A sense of justice and vindication accompanied her experience: “I felt better when I saw that I had support, that my peers supported me. I felt even better when I saw that the teacher began to [change] …. I felt really good when he realized that I was not what he thought was, but much more.”

Acquiring resilience through life goals and dreams. Despite the problems they’ve experienced, the participants can be described as persistent and autonomous women, who are confident in their abilities to succeed. The ambitions and dreams they shared of the future were sustenance for and a reflection of their resilience. Attitudes of resilience were closely linked to life goals and dreams. For example, Catia’s motto to “never give up” was tied into her dream of graduating:

> If you don’t realize your dreams, you stop living. I think I have that very clear in my mind. And envisioning myself graduating from mechatronics engineering feels so great. Just knowing that, imagining it, putting myself in that place with my diploma … it feels so great.

The life goals and dreams that sustained the participants were also examples of setting new standards, pushing boundaries, and a mindset of enterprising and entrepreneurial vision:

> *Catia:* Where do I see myself [after graduating]? I see myself in a big company, literally with amazing machines, searching for codes, with huge programs, with immense machines. I see myself programming, developing products, benefits, optimizing, that's how I see myself.
>
> *Zara:* I plan on traveling. I want to do a Master's …. one day I want to have my own business. And not more than 15 years from now. In 15 years, I plan on having my own company, but I also plan on studying. I want to know why Ecuadorian engineering is different from engineering in other countries. I don't think [Ecuadorian engineering] is enough. So I want to travel, work in various places …. I want to give myself the opportunity to get to know, to fill myself with knowledge, to inform myself about everything possible, so that I can come up with solutions …. and then I'll come back. What I most want is to potentiate technology here because there's no support for it.
>
> *Maria:* My plan is to do a Master's abroad and then come back and create a company together with my sisters. My older sister is studying architecture, and my younger sister, I think, is going to study medicine, so we were thinking that my older sister would build hospitals, or something like that, and I could equip them with technology …. it would be a family business.

Theme 4: Dismantling Barriers and Creating the Enabling Environment

This section describes the factors and processes the participants identified as helping women to enter and study engineering. The categories emphasize the participants' views on gender equality, are solution-oriented, and contemplate the ways in which the negative outcomes of gender-based differentiation can be replaced with positive and encouraging support systems. The categories discussed in this section include: (a) Redefining the meaning of strength; (b) Making women visible in engineering: "Creating a chain of influence"; (c) Institutional action to promote support and student success; (e) Early re-socialization; and (f) Including women's perspectives.

Redefining the gender of competence and capacity. During the interviews, the participants expressed their awareness of gender-based competencies as a negative outcome of gendered socialization. Competence and capacity as male is manifest in the stereotype that "hard" subjects like math are for men and "easy" subjects for women. The participants expressed assertive attitudes of resisting the socialized meaning of competence. They were clear about drawing the line of male advantage at physical strength and establishing their rights as, at a minimum, intellectual equals:

> *Carmen:* I think that women and men have the same capabilities and that we can, that is with effort and hard work, we can reach the same goal.
>
> *What advantages do men have over women in engineering?*
>
> *Isabel:* I think none …. no, because we both learn, we can both build circuits, we can both do the same things, so I don't think [men] have anything that is superior in engineering. It may be physical strength … but otherwise nothing …. I believe that intellectually we are the same.

Making women visible in engineering: "Creating a chain of influence." None of the women interviewed attributed their choice of studying engineering to the influence of a woman role model or woman engineer. Participants talked about "stumbling into the career" because of early predilection for numbers and math and technical projects. The importance of making women visible in engineering surfaced as the participants reflected upon the positive impact seeing a woman engineer or speaking to one in high school might have effected—had it occurred.

Women's invisibility in engineering is a primary reason for being unaware of it, and not even considering it as an academic and career choice. Erica shared her belief that women who are engineers should go to schools and share their experiences, and "incentivize girls and make them realize that it's not too difficult for them, they can." Participants recommended talks by female engineers, so that "others see them," so that "it's not like everyone says" and believed that had they been able to talk to a woman engineer, confusion might have been prevented and choices and clarity established. When girls are contemplating their university studies and careers, role models and mentoring are potentially effective and influential strategies for recruitment. In support of this point, Zara talked about women's visibility as a strategy to potentiate the recruitment of women into engineering:

> I believe that if I had seen a woman in an engineering program, I would have decided much earlier on. But always, always, whenever I would go to the university fairs, those who would explain the physics, or engineering programs were men, who know, who you could tell knew, and I would think I want to know like them, but why was there never a girl who you could tell knew so that I could realize that if I entered that program, I would have someone to support me, I would have that friend with whom to converse.

The interviews established a solid case for the importance of mentoring to build confidence, promote achievements, rewire attitudes—and ultimately get girls into engineering. Zara radiated pride as she spoke of her younger sister and her friends and the influence she was having on this upcoming generation of women:

> I like going to my sister's school because I feel that her friends see me as an influence …. my sister tells her friends that I study mechatronics, that I have a scholarship, and that I'm going to study abroad. And [her friends] say, *And that can be done?* Yes, it can …. so when I'm there, these girls ask me how it's done, how I did it, and all I tell them is to study and be themselves …. so I feel that, at least with them, that I am changing their mentality of *If my father says I have to do this, then I have to do it* …. I believe it is cultural change that I'd like to provoke. It's going to take a lot of time, but if I can influence someone, then that person will influence someone else, and that will create a chain of influence to change more than just a little.

Visibility was also related to the recruitment and hiring of women faculty members. Zara talked about the significance of women faculty: "Having women faculty has helped, because it gives us the motivation that we [women] can do it. There are women engineers that know, and that know a lot, and can compete side-by-side with male faculty." These comments contributed information that the presence of women faculty provided role models and motivation to the classroom experience.

Institutional action to promote support and student success. Participants lamented that at the institutional level, the university was not doing enough to help women who study mechatronics engineering. No explicit strategies or programs were in place to recruit and retain women—and they also felt that, generally speaking, no baseline awareness existed that the scarcity of women studying engineering was even a problem.

At the departmental level, participants noted the adjustments that had taken place in the program to reconfigure actions toward academic support and weeding out the weed-out mentality. Rather than adhere to and inculcate competitive conduct akin to survival of the fittest, Zara voiced the importance of creating a culture that supported effort and rewarded curiosity in the student for learning. Her comments noted the change in her program away from the pressure that was alienating students, both women and men, and towards support, encouragement, and incentivizing interest. The positive change she noted meant "no longer looking for the 'best' but for those who like it, because those who like it, are going to be the best …. the one who tries the hardest, the one who likes it the most, the one whose curiosity is provoked by a professor … is the one who stays."

An important part of action for positive change was a departmental initiative to promote peer and faculty interaction. The introduction of a weekly cultural event was now providing opportunities for the participants to interact and integrate with peers and faculty. The advanced students lamented how this event hadn't existed when they started their studies, and, as Carmen mentioned, the only meeting they'd had was at the end of the first semester, when "it didn't matter anymore, so it would have been nice to talk and be given some tips to know what to do." Participants felt that the event provided the opportunity to socialize, ask questions, get advice from older students, as well as become familiar with faculty members, thereby establishing rapport and confidence, and helping to overcome fear in approaching faculty and asking for help. Knowing what the beginning had been like for her, Carmen said that she used this time to mentor and counsel the new students, giving them suggestions she called "survival advice for the program."

Clarity of expectations and instructions, as well as qualified tutoring, were also perceived as key forms of academic support. Carmen synthesized the importance of these factors with the example of a first-semester group project:

> We had to make a robot, four classmates, me and three guys, and we had a fourth-semester student as tutor, but he didn't know anything … afterwards [faculty] realized that it wasn't good to have students trying to do something if they could barely take care of their own stuff … so they decided that professors had to be tutors, and now there is a system of guidelines about how to do the projects …. we have formats for making blueprints …. we have tutorials every week.

Early re-socialization. Also evident from the interviews is the importance of the early re-socialization of girls to correct for gendered misconfigurations. Catia talked about motivating and familiarizing school-age girls with math and sciences so as to help them enter "this world"—one that is unknown because of the influences of gendered socialization: "If I had the necessary resources, I imagine I would start in high school and in elementary school, because education is where your mind develops, to integrate robotics, mechanics, numbers, but also aimed at women." As a strategy to educate at an early age and create awareness and choice was the summer camp for young children the mechatronics department offered. Maria felt that her experience as a camp leader had given her the opportunity to be a role model, inspire small children, and show both girls *and* boys that women can be engineers. In response to asking her if these kinds of programs would help young girls, she said: “If I had been in one of these, I would have known much earlier what I wanted to study.”

Including women’s perspectives. If the male culture of engineering is predicated on the precepts of male exclusivity, one dominant perspective, then creating a welcoming environment and a participative culture for women in engineering depends on a shift towards the inclusion and integration of their perspectives. Participants advocated for alternatives to the typical discarding of women’s perspectives because of the assumption that “women don’t know.” They reflected upon their experiences in the classroom and lab and asserted that women have unique views and problem-solving skills that have much to add to engineering. Maria said that “I have seen that many women put in more effort than men, and because we have different perspectives, [looking] from many angles, we can see good solutions.” Erica supported this view in saying that

> I think we are very good in this, in engineering, because we girls usually we can see everything …. when we start a project, we are thinking about how we are going to do this part, and we are thinking about everything about the project from the beginning, while boys, they think about it and they don’t realize like they should have done something different, and they just realize it at the end. We girls, we can see the projects from another perspective … so we know before we get to the end what we should take into consideration. So that is why I think most of the girls that are studying engineering, I have noticed they are very good, they have better grades than the boys, so I think it’s because of that.

Including women’s perspectives also related to the presence of women faculty as important for integrating distinct attitudes and perspectives to effect cultural change. During the interviews, participants described male professors, who were used to being in a male-dominated environment, as awkward, as rigid in thinking, and as keeping knowledge to themselves. To the contrary, Zara felt that women professors added a distinct approach, one that challenged traditional notions, was collaborative and based on sharing knowledge: "One person contributes this, another one that … that is what the world is about, sharing knowledge and not keeping it for yourself. So, yes, the presence of women faculty has helped a lot."

Engineering as an Ecosystem of Gendered Differentiation

The ecosystem model of gendered differentiation, as shown below in Figure 1, is an attempt to synthesize layers of data into a conceptual and visual representation of the themes and categories that expand understanding of the factors and processes related to the underrepresentation of women studying engineering. An ecosystem is a complex of interconnected components. Both the components and the whole exert influences; both the parts and the single unit are significant. For this study of women in engineering, the components were overwhelmingly barriers, contextual and core, which interacted to create a whole, a single unit working to keep women out of engineering.

The outer environment contains the broader, contextual influences that shape women's academic and career pursuits. As the participants noted, these influences begin early and create hurdles that filter girls' choices away from consideration of engineering as an option. The core environment is the social and academic setting of immediate interaction within engineering. For this study, it is the environment where the women who study engineering live their daily lives and interact with the people, culture, and climate of engineering. A thick line circles the core environment to represent the obstinacy of its hermetic and unwelcoming male culture. For this study, its influences were predominantly negative and pressuring women to leave. And despite the problems, the stereotypes, the hostility, the discrimination, and harassment, women occupy the individual "I" environment, where their attitudes, passion, and aptitudes have forged strategies of survival and resilience. This is the origin of the ray of light that runs through the ecosystem, that represents the participants' persistence and their success in overcoming barriers. Finally, the enabling environment contains the factors and processes the participants identified as enabling women to enter and study engineering. Often, these were elements they felt would have made a difference to them, to their journey into and through engineering. In the model, the enabling environment is illustrated as a distinct shape, a deconstruction of the ecosystem of gendered differentiation, in order to dismantle the barriers and create the components and the single unit of support.

Table 1

Themes and Categories

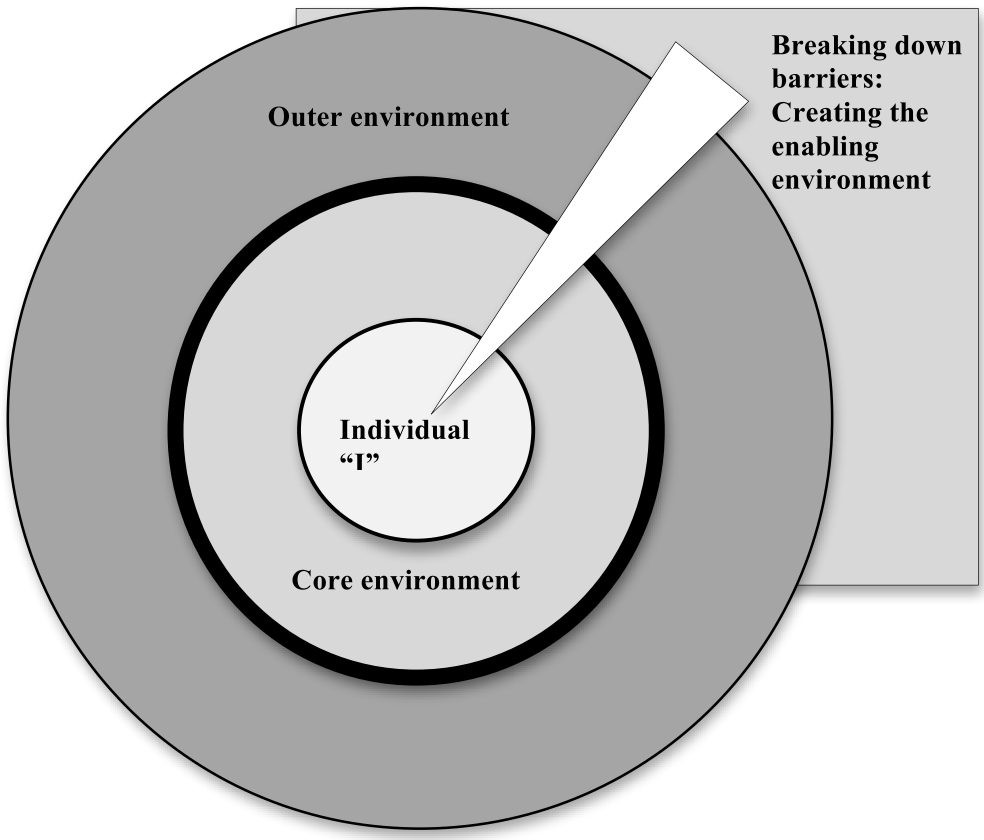
The Outer Environment	
Society as overarching social structure	*Society, in general, …. wants to make us [women] look bad so that everyone can see that there should not be women engineers.*
The hegemony of machismo	*I think society is still machista, and they still think men are better than women.*
Gender socialization and gender norms	*Since they are little, [children] are taught that there are limits to doing one thing or another. Then they get older and they've been barred from the opportunities to become something more, to be an engineer or an astronaut.*
The gender identity of engineering: "A career for men"	*I think people in general make you think like, no, girls should study other things and not engineering, or hard things, because those are for men.*
Knowing and the fear of *being* the only woman	*How are you going to feel if you are the only woman?*

The Core Environment	
Weeding out the unwanted	*The first memory I have of the faculty was the first class with the dean, who told us Okay, right now there are thirty of you, but next semester, don't worry, there will only be ten.*
Engineering as practical and hands on: Physical strength as a male advantage	*Maneuvering machines is sometimes very difficult. So, yes, for [men], their natural strength helps them more … for me it has been difficult.*
Losing the "privilege" of being feminine	*We [women] just can't …. You just can't work with your hair loose …. for the time being, you lose some of those privileges.*
Bearing the double standard of gendered expectations	*[Men] are always made up. So they're always going to stand out because [people] see a man …. this is something men don't have to think about.*
The culture shock of engineering: Being *that* only woman	*I come from a mixed school, men and women. So landing in the extreme of only men was hard.*
Lacking the female network	*Sometimes it feels a bit ugly, because you need another girl with whom to share stuff. You can't tell a man 100 percent everything.*
Guy talk	*They are times when they [male classmates] start talking about their stuff between them, talking bad words … and that is what a woman doesn't like.*
Acculturating into the boy's club	*Yes, I think I had to get used to that [guy talk], because I cannot change them [men] so I am the one who is getting used to it.*
Interpersonal relationships: Conflicting overtly with family	*It's always been this problem with my mom. We have different ways of thinking …. my mom, no, she's never supported me in this decision.*
The Individual "I"	
Getting into and through engineering: Aptitude, preferences—and passion	*In school, I always liked math classes. I always used to get the best grades. So when someone is the best in something, like you want to continue in that, and that was math and physics.*
Proving *them* wrong	*I was really questioned, as if to say a woman doesn't know much about engineering, and so, this makes me want to show them that a woman can, that a woman knows.*
Feeling the pressure to perform successfully across multiple roles	*I demand more from myself for knowing that I am a woman.*
Relationships that matter: "A push to move forward"	*So I had this problem, thinking that maybe this isn't for me … and I lost my motivation … and there my parents helped me …. so that was a motivation, a push to move forward.*

Renewing the sense of self	*I think that now things are going better for me, that is I am more confident and I see things … I see more than just problems, I see the solutions, and I try to search wherever for solutions to help me.*
Acquiring resilience through life goals and dreams	*If you don't realize your dreams, you stop living …. and just envisioning myself graduating … feels so great.*
Dismantling Barriers and Creating the Enabling Environment	
Redefining the gender of competence and capacity	*I don't think [men] have anything that is superior in engineering. It may be physical strength … but otherwise nothing.*
Making women visible in engineering: "Creating a chain of influence"	*I believe that if I had seen a woman in an engineering program, I would have decided much earlier on …. why was there never a girl … so I could realize that if I entered the program, I would have someone to support me.*
Institutional action to promote support and student success	*[Change] is no longer looking for the 'best' but for those who like [mechatronics], because those who like it, are going to be the best …. the one who tries the hardest, the one who likes it the most, the one whose curiosity is provoked by a professor … is the one who stays.*
Early re-socialization	*If I had the necessary resources, I imagine I would start in high school and in elementary school, because education is where your mind develops, to integrate robotics, mechanics, numbers, but also aimed at women.*
Including women's perspectives	*I have seen that many women put in more effort than men, and because we have different perspectives, [looking] from many angles, we can see good solutions.*

Figure 1

The Ecosystem of Gendered Differentiation



Chapter 5: Discussion

Rooted in the philosophical assumptions of qualitative inquiry, this grounded theory case study explored the lived experiences of seven women studying mechatronics engineering at a small private university in Ecuador. The research problem and phenomenon of interest was the persistent gender disparity among engineering students, which motivated the need for further research into women's lived experiences as engineering students, so as to identify the factors and processes that help and hinder women in pursing a degree and career in engineering, as well as how women who study engineering overcome challenges. In following Patton's (2002) understanding of lived experience, this study honed focus on women's perspectives, perceptions, descriptions, feelings, memories, and ways of making sense of their experiences. The interviews imparted the "rich data … for building a significant analysis," and in deliberating over the essential questions of grounded theory, asking what the data represent and suggest, four overarching themes and 25 categories emerged (Charmaz, 2014, p. 14). The categories made sense as autonomous units that could and needed to stand on their own; integrating them into broader conceptualizations would have subsumed their details, would have submerged the participants' voices. At the same time, the categories and complexity of detail coalesced into broader fields of abstraction in order to contextualize understanding and forge a cohesive entity and whole, represented by the ecosystem model of gendered differentiation.

Summary of Findings and Links to Theory and Research

The results derived from the participants' lived experiences are presented in the previous chapter (see Table 1 and Figure 1). This study's analysis of the factors and processes that help and hinder women who study engineering aligns with SCCT's focus on the effects of environmental socialization upon women's choices in regard to STEM fields (Fouad et al., 2010). The constructs of supports and barriers, the positive or negative environmental influences that impede or support women's participation in engineering, are conceptually consistent with the categories that emerged (Fouad et al., 2010).

The results showed a prevalence of barriers and a paucity of supports in the lived experiences of the women interviewed. How the participants perceived the characteristics of these supports and barriers were found to correspond to two environments: the outer and the core. Lent et al. (2000) conceived of the multilayered environment as including the larger societal context and the immediate proximal environment, which encircles the person. The results of the study were congruent with this view of the environment as "a series of embedded layers" (Lent et al., 2000, p. 45). The results identified an outer environment and defined it as providing the societal framework and containing the broader contextual factors and processes. The outer environment exemplifies how socialized gender differentiation shapes women's academic and career choices in relation to engineering. As it demonstrates the numerous barriers girls and women confront as they contemplate their future careers, it also imparts plausible understanding of why so few women actually choose to study engineering.

For the women who do study engineering, the core represents their immediate environment of social and academic interaction. In this study, the core manifests the culture and climate of engineering; it is where the participants carry out their daily lives and engage with the key influences that support them or set up obstacles to their progress.

The core environment is also the place and setting where “knowing of” suddenly becomes “being,” as barriers move from a larger, more abstract location to the immediate environment where interactions with them are more concrete and personal. Women are challenged to personally deal with and overcome gendered barriers. Fouad et al. (2010) developed a comprehensive taxonomy of supports and barriers that influence academic and career development. For this study, a qualitative approach and grounded theory methods allowed for detailed exploration, which aided in the identification of additional environmental influences. Perspectives from other research have also been integrated so as to expand the theoretical conceptualization of these constructs.

Barriers in the outer environment. In answering the question of what hinders women who study engineering, the participants spoke frequently and in significant ways about perceived barriers. As an overarching framework of negative influence, society was identified as a fundamental barrier. Descriptions and mention of society resonated with emphasis on the abstract and ubiquitous. Society was context and its influences proscriptive of women’s dreams and ambitions into non-traditional sectors like engineering. Participants described society as pressuring women to assume traditional prescriptive roles and identified the dissonance that results from pursuing a non-traditional, non-conforming academic and career choice.

Machismo emerged as a descriptor and conceptual frame for how the participants perceived Ecuadorian society and its culture. It was the name and diagnosis for the behaviors and attitudes of gender inequality they experienced. Smith and Gayles (2018) identified sexism as a form of systematic privilege and power of men, one that was prominent in the workplace experiences of their study’s participants. A term particular to

Latin America, machismo is how participants in this study referred to sexism in Ecuador. In examining conceptions of masculinity, Goicolea, Coe, and Ohman (2014) also identified machismo as the form of hegemonic masculinity and systemic oppression in Ecuador. In this study, the participants' descriptions of machismo created a thread and ultimately a collectively constructed definition. At the core of meaning was a gender hierarchy that institutionalized male power and privilege in Ecuadorian society. Machismo was also related to notions of the world, warnings, and perceptions of danger, which the participants felt worked to confine women, restrict their movement, and view them as helpless and in need of protection. It was also highlighted as the negative antithesis of participants' ideals of social interaction and decision making between men and women. Participants explicitly contested machismo's exclusive hold on power and resulting imposition, when collaboration was a possibility to arrive at decisions together. Furthermore, the machismo made in society was the source of machista attitudes that were not necessarily limited to men nor to objective "others"; indeed interactions with family members and mothers proved most challenging.

Gender-bound competencies as a negative outcome of gender socialization also emerged as a category in this study. The biases and stereotypes embedded in gender socialization reinforce the segregation of disciplines and the male identity of engineering. Hill et al. (2010) also noted the detrimental effect of stereotypes and biases in sustaining a discriminatory culture of gender-bound abilities and interests, and the pervasive belief that engineering is male and a "man's domain." The participants overwhelmingly shared their experiences of social disapproval and doubt in reaction to their decisions to study "a career for men." These experiences began in high school, as the participants contemplated and announced their academic and career choice to friends and family, and even continued throughout university. As the interviews revealed, persisting in university did not necessarily put an end to this form of discouragement. Furthermore, participants experienced stereotypes that described women who study engineering as masculine and even "butch." These findings add dimension to the cultural image of engineering as a masculine profession, its culture and ethos "extremely male," which reinforces perceptions that engineering is not for women (Powell et al., 2009, p. 6). Hill et al. (2010) argued that a critical examination of cultural biases and stereotypes was essential to diversifying the gender of STEM fields. In this study, participants identified these negative influences as prevalent in Ecuadorian society and culture and as deterring women from even considering engineering as a possible academic and career choice.

Knowledge of women's scarcity in engineering, as well as others' experiences of sexual harassment in the engineering classroom, invoked the fear of being the only woman. This category gains insight from Lent et al.'s (2000) discussion of objective and perceived barriers in the larger, societal environment and how individuals are likely to differentiate the effect of these; observing and learning about other people's experiences is distinct from beliefs about how these "affect the self, should they be encountered directly" (p. 45). The participants spoke of knowing, of hearing, and being aware that they would be one of few women studying engineering. They also shared vicarious experiences of sexual harassment of female engineering students at other institutions of higher education. Perceptions of being that only woman, not having help and support from other women, and being a target in the classroom were personal barriers. The awareness of being that only woman translated into a fear that turned most women away from engineering—and represented a specific challenge for the participants in the form of intense questioning and doubts from family and friends.

Barriers in the core environment. Within the core environment, participants' reflections of their experiences identified the weed-out culture of engineering. Characterized in the literature as the "chilly" climate of the male-normed classroom, the weed-out culture is competitive, impersonal, and hierarchically structured (Vogt et al., 2007). Participant experiences highlighted interactions with faculty who expressed pride from filtering students in the pursuit of academic excellence. This category is in line with Vogt et al. (2007) who noted that these characteristics of the traditional engineering classroom are associated with doubt and uncertainty about self-competencies in women. In this study, the participants remarked upon their choice of engineering as the outcome of aptitude and preference for math and science in high school. The high-pressure, competitive environment they encountered, however, was intimidating and made them feel academically unprepared and insecure.

Furthermore, and crucial, was the added dimension of gender as a defining attribute of the weed-out culture. Experiences of differential treatment were recently documented by Smith and Gayles (2018). In the classroom and group projects, women were subject to pervasive biases, such as "being underestimated constantly" because of their gender (Smith & Gayles, 2018, p. 9). In this study, and congruent with other research that places outright sexism in the academic setting, participants shared their "war stories" of interactions with faculty who were explicit about making them feel unwanted in the classroom because of their gender (Vogt et al., 2007). They described faculty attitudes and comments that affirmed stereotypes, were hostile, and machista. Often being the only woman, participants found themselves targeted and picked on by professors, instances that led to academic difficulties and even failing courses. Feelings of indignation were compounded by a sense of helplessness and a fear of retribution. As a result, participants described going through moments of crisis, and even depression, as they doubted their abilities and questioned whether or not they had made the right choice and belonged in engineering. The participants' gendered experiences of harassment and discrimination are consistent with previous research that identified how women's engineering identities are de-emphasized in comparison to their gender identities (Smith & Gayles, 2018). In other words, gender identity is emphasized and women are more harshly judged based on the biases and stereotypes that claim women are unsuited for engineering (Smith & Gayles, 2018). Thus women's competence in engineering is judged as a matter of gender and not innately as a matter of ability.

The entrenched nature of engineering's masculine culture emerged via the contrast it presented with feminine culture and participant experiences of the loss thereof. They spoke of having to sacrifice "feminine privileges," such as wearing earrings and doing their hair, in order to pursue their academic and career choice. The masculinity of engineering was at odds with and opposed to women's expressions of femininity. This finding supports Powell et al.'s (2009) discussion of the dualism of masculinity and femininity and the hierarchy associated with this binary opposition. Women's gendered experiences in the male-dominated environment affirm the differential status of maleness/masculinity and femaleness/femininity (Powell et al., 2009). A process of binary opposition in these settings affirms masculinity at the expense of femininity

(Powell et al., 2009). This idea is congruent with this study's finding that the decision to study engineering and participate in the core environment obligated a negation of femininity. This finding relates to another, that is expectations of dress and grooming, embedded in broader societal ideals of feminine beauty, which were linked to appraisals of competence. Men were granted freedom from these requirements: Being a man was enough to be considered competent in engineering, whereas appearance was factored in and decisive for women to be judged competent and to be taken seriously. This finding confirms women's experiences of "managing and building gender" in male-dominant environments and how these processes are "characterized by contradictions and double-bind situations" (Powell et al., 2009, p. 5). Smith and Gayles (2018) described this as the paradoxes women face in these settings. In the case of the participants' experiences, the requirement to de-feminize was accompanied by a simultaneous expectation of feminine ideals in dress and appearance. Important is how gender creates a complicated dynamic women are obligated to manage, and how gender, rather than ability, defines competence.

The literature focuses on the engineering classroom and what participants called the theoretical part; however, it omits the discussion of engineering as a field that "you learn by doing." Participants were clear to differentiate between theory and project-based learning, for which the mechatronics lab was the setting, and in which they were involved in practical and "hands-on" activities, such as sawing, welding, and maneuvering heavy machinery. Tying theory to practice through hands-on learning and problem solving in the project-based environment has been discussed as favorable to breaking down barriers and eliminating the fear associated with learning complex theoretical topics (Loftus, 2013). Project-based learning is considered crucial to recruiting and retaining more engineering students, including women (Loftus, 2013). However, when asked if men had advantages over women in engineering, responses focused on the requirement of physical strength for carrying out projects. Physical strength repeatedly surfaced as men's advantage in engineering and contrasted with the disadvantage it represented for women in the project-based learning environment. This barrier implied that the participants were obligated to ask for help and rely on the goodwill of male classmates who are the only ones available to help them. Participants expressed their discomfort with this form of dependence and having to ask for or negotiate help. For this reason, participant experiences cited the "good" classmates as those who helped spontaneously without having to be asked.

The male centrism of engineering culture was identified as reason to understand why women engineers feel alienated and depart from the engineering profession (Fouad, 2014). In the ecosystem of gendered differentiation, a thick line circles the core environment in representation of its male-dominated climate and culture that is unwelcoming and configured to keep women out—or push them out. The culture shock participants experienced upon initiating their studies was the first point of negative contact—when participants realized they were surrounded by men, had only men with whom to interact and ask questions, and had become *that* only woman. Being the only woman became *their* experience upon realizing they'd entered a "full extreme" male-dominated environment. In the classroom, participants noted differences such as men being more competitive and talkative, asking questions and not holding back. Vogt et al. (2007) noted how the male-dominated environment, competitive "alpha-male" and discriminatory peer and professor attitudes, may affect women's interactions and performance in the classroom. In this study, participants were on their own and lacked a female network and support system. Participant narratives of not asking questions and being quiet "because I had no one to talk to" conveyed their feelings of intimidation and lack of confidence, leading to social isolation from the rest of the group. Asking questions is an important part of learning and understanding the complex theory taught in the engineering classroom, yet women did not perceive the opportunities to interact with and learn from professors and their classmates (Vogt et al., 2007).

Participating in the core environment obligated change and adjustment. Negating femininity was a prelude to a more complex requirement that women who study engineering adapt to and assimilate the dominant male culture. Participant experiences described this process as one of acculturating into the boy's club, or becoming "one of the guys." Powell et al.'s (2009) study validates and describes this process as women's enculturation into engineering, resulting in women engaging in behaviors and attitudes so as to fit in and be accepted by the male-dominant culture. Reactions to and outcomes of this process were varied and also depended on participants' pre-university experiences. Women who had been socialized around a male majority, male cousins for instance, were already acculturated. Others experienced shock upon entering the program and then processes of adaptation and assimilation, with the outcome of preferring to work with men and finding classes, like elective courses, with more women as foreign and strange.

This finding is supported by Smith and Gayles (2018) who noted that women in STEM environments align and show solidarity with the dominant masculine culture by adopting behaviors that distance and differentiate themselves from other women and demonstrations of femininity. Further, a finding that emerged in Powell et al. (2009) was the “anti-woman approach,” which found evidence for women “performing masculine gender by conforming to dominant, hegemonic masculinity and by rejecting femininity” (p. 11). Other participant experiences described having to get used to male culture, but negotiating it by toeing the line, selecting and dealing with only the necessary to get by. Regardless of these variations, however, the pressure to conform was clear and so was the necessity of women to “manage” their gender in order to persist in the engineering environment (Powell et al., 2009). The male culture of engineering did not adapt to them.

In the SCCT taxonomy of barriers and supports, Fouad et al. (2010) identified minority status, lack of peer support, and little to no social integration as social barriers perceived by STEM students. In support of this research, the category of “guy talk” emerged in this study, which adds depth to the analysis of these barriers. Guy talk was the category assigned to participants’ repeated experiences with men’s topics of conversation, such as sports and most often women’s bodies. The conversations revealed the prevalence of guy talk and brought attention to participant reactions of feeling offended and uncomfortable. Their minority status was the equivalent of being invisible, for the guy talk prevailed regardless of their presence, which heightened awareness of a dominant male culture and the powerlessness of their scarce numbers to effect any change. Research has shown how women in non-traditional workplace environments are obligated “to permit ‘majority cultural expressions’ in their presence,” which works to reproduce male dominance in the engineering environment (Powell et al., 2009, p. 2). The offense and discomfort caused by guy talk were related to feeling socially excluded, and even strategies of withdrawal—by interacting less and only the necessary—from the immediate environment of interaction, the opposite of the perceived support represented by social integration and peer interaction (Fouad et al., 2010).

Parental/family barriers are identified in the literature and described as little help or encouragement and disengagement or disagreement in career plans (Fouad, 2010). Aligned with other research that identified the importance of the "responses of persons in their immediate social support systems" (Lent et al., 2000), family were key influencers in the participants' immediate environment of interaction. In this study, overt conflict with family emerged as a category and barrier due to the disruptive effects of specific interactions. Conflict with family was frequently mentioned and was experienced in the form of doubts, questioning, and disbelief about the choice to study mechatronics engineering, as well as forewarnings about how difficult the program would prove. Women and mothers included were agents of machista attitudes that questioned their daughters, even relentlessly and to the point that they contemplated dropping out of the program, just to put an end to the pressure and conflict. These relationships were particularly trying and emotionally consuming because they were key influencers and perhaps assumed as the place where support should be provided.

Environmental supports. Supports are the environmental variables that enable individuals' pursuit of academic and career choices (Lent et al., 2000). As a complement to barriers, Lent et al. (2000) asked "What contextual conditions support women's choice of nontraditional careers?" (p. 42). In this study, perceived supports were outnumbered by perceived barriers, which is perhaps associated with the low number of women studying engineering. Why would someone be motivated to pursue an academic and career choice that is perceived to exclude them?

Miller et al. (2015) identified the significance of social support from friends, classmates, family, mentors, and peers in their analysis of the factors that facilitate progress and persistence in engineering. These results are consistent with the findings of this study. Participant experiences highlighted positive relationships and interactions with family, peers, faculty, and student affairs professionals as important support systems. These were the relationships that mattered, especially when the participants most needed help and counsel. They also provided the necessary motivation and confidence to expand their support systems and seek further help by building other relationships. However, it is important to note that participant perceptions of relationships and interactions occupied "opposite poles on a positive-negative continuum" (Lent et al., 2000, p. 42). As the previous section demonstrates, these were at once supports—and barriers, of a very trying nature. The "push to move forward" participants experienced was a reaction within a (–) negative environment. As such, it is fair to speculate about the potential outcomes and positive gains if consistent and proactive support in a neutral environment would be available to women studying engineering.

"Creating a chain of influence" by increasing women's visibility in engineering as faculty members was also identified as a support. This finding aligns with Bussey and Bandura's (1999) articulation of the importance of modeling by significant individuals in, for example, the educational context. In this study, women faculty and the identification of women engineers were a positive influence on how participants' conceived of gender in relation to knowledge and competencies. This finding was particularly relevant for the senior students who had experienced a before-and-after change in the form of a departmental initiative to hire women faculty. Participant experiences reported the motivation women faculty provided as role models, an “if she can do it, so can I” encouragement, and evidence that women can be engineers and compete on the same level and scale as men and male faculty.

Positive modeling of gender-linked information was also identified in the distinct perspectives women professors added to the program. Women professors offered a different approach and teaching style that challenged traditional male norms, was collaborative, and based on a philosophy of contributing knowledge for the purpose of learning and growth. Furthermore, this finding was important also in the sense of role reversal of positive modeling. Students were observers and learners, as well as the significant individuals who impart positive gender information and provide motivation and support. Participant experiences emphasized the pride and motivation they felt from being a positive influence on others, as an older sister or a mechatronics summer camp leader, and the opportunity this role offered to be the starting point of a “chain of influence” that would motivate change.

Miller et al. (2015) identified academic and teaching adjustments as important resources to better cope with hurdles in engineering, and departmental support as a positive influence to facilitate students’ academic progress. Participant experiences cited faculty initiatives to introduce academic change as important supports. These experiences conveyed the sense that small changes could make a significant impact. Participants noted a change in the program’s academic culture toward weeding out the weed-out mentality, which was alienating students, and moving toward encouragement, incentivizing interest, and rewarding curiosity for learning. Clarity of expectations and instructions in assignments and projects, as well as qualified tutoring, were also perceived as key forms of academic support. Increased attention from professors, in the form of extra tutoring hours, and clear guidelines were identified as supports, which align with findings from Miller et al. (2015). Furthermore, a departmental initiative to introduce a weekly social was noted as a positive influence to promote peer and faculty interaction and provide the opportunity to ask questions, get advice from older students, and establish rapport and confidence in interactions with faculty.

How women overcome challenges. Individual attitudes, preferences, and strategies emerged from the analysis of the ways in which women who study engineering overcome challenges. Participants' sense of self and how these self-perceptions changed in response to challenges provide an understanding of the individual, internal resources employed in order to persist in engineering. Miller et al. (2015) approached inquiry of this nature as analysis of coping strategies or "things you do" to deal with challenges (p. 52). Personal resources, such as character qualities, attitudes, and study skills were identified as significant for the majority of participants. In Fouad et al.'s (2010) taxonomy, findings were elaborated into an internal/individual category with sub-categories of supports and barriers, such as high or low self-efficacy, resilience (as willingness to work hard), and self-doubt.

To enrich and expand understanding of the individual and internal, this study's qualitative approach supported findings that add detailed information specific to women in the engineering domain. The findings also, however, point towards a more abstract and conceptual understanding that could be defined as resilience and resistance. It would be fair to stay, as a starting point, that being part of a severely underrepresented minority and persisting nonetheless demonstrates extraordinary resilience. One feature of resilience focuses on aptitude, preference, and passion for science, math, as well as mechanical pursuits. Participant experiences identified these elements, which had led to their interest in and choice to study engineering, as well as sustaining them as students. These elements spurred attitudes of resistance that anchored the self in relation to challenges. They emerged as substance to claim their rights as women who love what they are studying.

Working to disprove explicit gender biases and the agents that socialized them was an attitude and strategy adopted by the participants. This finding aligns with Steele's (1997) conceptualization of stereotype exemption, and Jagacinski (2013) and Dingle (2006), whose research also recognized individuals' need to gain personal exemption from gender biases by outperforming. Indeed the women interviewed responded to these barriers by working harder and becoming more competitive "to show them that a woman can, that a woman knows." Research on the effects of stereotypes has also theorized and demonstrated that chronic exposure to these negative influences results in disidentification and attrition from the domain with which they identify (Steele, 1997; Cadaret et al., 2017), as well as a negative effect on women's academic performance (Good et al., 2008). What is really going on may be more complex. Within SCCT, Cadaret et al. (2017) conceptualized stereotype threat as an environmental barrier that would negatively affect women's academic self-efficacy. Their research showed that coping efficacy or confidence in the ability to overcome barriers protected against and mediated the negative effect of gender stereotypes. Responding to negative expectations from significant others by working to achieve a particular goal might also reflect and be cast as attitudes of perseverance, which "provide a potent source of motivation and self-satisfaction" (Lent et al., 2000, p. 48). These findings suggest that participant experiences of working harder to disprove the biases is not symptomatic of debility or deficiency, but rather demonstrate the resistance and resilience of the individual and internal.

These qualities were also evident in participant voices that asserted equality in competence and capacity to study engineering—not as women subsumed in a man's vocation, but as women who study engineering. The participants drew from their experiences in project-based group work to highlight the benefits of integrating women's perspectives, their distinct views and skills, in affirmation that they are "doing" and that engineering "can be done" their way. Though this study's results supports Powell et al.'s (2009) conclusion that women construct gender in conformance to masculine norms in the male-dominant engineering environment, its results are also indicative of a space made by women's attitudes and behaviors that *do* reflect a critical consciousness and *do* challenge the man-made culture of engineering and that have constructed their persistence and success as students of engineering. This point is often overlooked in the literature; the focus on barriers perhaps denies attention to critical and affirmative elements of social change, which, in this study, constitute the ray of light.

Throughout the interviews, participants shared ambitions and dreams that sustained and reflected their resilience. The life goals and aspirations to which they subscribed demonstrated a collective drive to break the stereotypes, push boundaries, and set new standards of inclusion for women in engineering. Their dreams of getting through the program, graduate studies, traveling the world to amass a diversity of experiences, and create companies in non-traditional sectors for women expressed a mindset of growth and determination, as well as enterprising and entrepreneurial vision.

Bussey and Bandura (1999) were clear in stating that "people are not simply the products of social forces acting on them …. people contribute to their self-development and social change through their agentic actions within the interrelated systems of influence" (p. 704). The category "renewing the sense of self" supports this idea. Overcoming barriers led to enhanced and positive self-perceptions, as well as confidence, increased autonomy, and motivation. Confronted by barriers, the participants looked for support, enacted strategies of human agency, and acted upon negative social influences. The positive outcomes related to their actions further enhanced participants' sense of self and their confidence to engage in agentic action. Negating these achievements would neglect the self-development that has occurred, a process that could be described as women developing attitudes and actions of self-determination to create social change and reconfigure the engineering environment.

Practical Implications

What enables women to study engineering, as noted by Lent et al. (2000), is more than a neutral environment and the absence of barriers. The analysis of what "more" might contemplate is discussed in this section of practical implications. Given the dominance of the male/masculine and the opposition it imposes to women studying engineering, questioning assumptions of masculine hegemony, promoting "learning about other ways of being" (Smith & Gayles, 2018, p. 16), and integrating what women have to offer constitute important steps toward building a positive culture of support and diversity, in which women's lived experiences in engineering are not dominated by their gender. In other words, how do we move beyond gender identity in engineering? The result that women negotiate their gender in the male dominant setting of engineering led Powell et al. (2009) to call for an "alternative initiative that is neither based on the sameness or difference between men and women" (p. 16). An alternative initiative, for example, might benefit from a focus on building and reinforcing women's engineering and leadership identities (Smith & Gayles, 2018). Theoretical and action frameworks that support critical consciousness raising (Cadaret et. al., 2017) and social advocacy strategies might also support an alternative initiative and ultimately improve women's representation as engineering students. These ideas align with Chandler's (1996) four steps of the feminist algorithm: identify disparities, encourage dialogue about individual experiences, communicate concerns, and become an activist—enact the strategies and programs that will create an inclusive environment for women in STEM and steadfast commitment to it. The practical implications of this study draw directly from the voices of the participants themselves, who identified the features of supportive and encouraging environments throughout the interviews.

Getting everyone on board: Institutional research for initiatives and action. Initiatives to reconfigure the engineering environment might begin with individual institutions conducting on-site research to identify barriers and the uneven gender and power dynamics that infuse these settings. Smith and Gayles (2018) recommended that surveys be conducted and data collected and evaluated through institutional research offices so as to identify the active barriers that need to be counteracted by targeted interventions. In this study, participant experiences identified that the university was not doing anything specific to support the recruitment and retention of women engineering students. The lack of awareness and data to understand the problem might help to explain this deficit. As such, research to gauge institutional climate and culture might galvanize a broad base of awareness, which includes faculty members, administration, and university leadership who need to become stakeholders, rather than unconscious bystanders, with an interest and commitment to social and cultural change in the academic environment.

Research that provides detailed and conceptual understanding of barriers in engineering might help to create the urgency and impetus to finally take note and action. In this study, participant experiences identified changes at the departmental level, but these were not embedded in awareness and initiatives at the institutional level, which might provide greater incentive for change, as well as impact in the form of integrated and comprehensive approaches to designing structured interventions.

Smith and Gayles (2018) recommended that organizations review and update their workplace policies to protect employee rights and experiences in line with a commitment to diversity and equality of opportunity. They further discussed the importance of consistent communication of these policies and of resources available to employees designed to support their success and persistence. In the academic setting, the detailed evidence of barriers provided through research might also support the review and revision of university policies to ensure they are in line with current needs to create supportive and diverse environments. However, it is important to note, that what exists in theory or on paper is not necessarily translated into practice or is contradicted through conflicting and divergent communication and action from different institutional agents. For this reason, faculty members, administration, and university leadership need to unify their efforts to eliminate gender discrimination from the academic setting, and provide clear and consistent communication that is proven through a commitment to consistent action. Communication and action need to be aligned and mutually supportive. This study identified the importance of interactions with faculty and student affairs professionals for women who study engineering. Student orientation and initial weeks of classes, for example, are key moments for students to interact with faculty and student affairs professionals, receive positive messages and information about the resources students have available to them, as well as set the standards and expectations that will guide students and other stakeholders throughout the engineering program.

Supportive teaching and learning environment. Given the barriers that pervade engineering's alienating weed-out culture, student-centered models of teaching might help construct supports in the teaching and learning environment. Peña-Calvo et al. (2016) demonstrated the importance of faculty supports and how teaching staff were key influencers in enabling students, in building confidence, and promoting their success. Teaching methods also need to act as supports (Peña-Calvo, 2016). In consonance with recommendations set forth by Miller et al. (2015), the findings of this study identified instruction and advising as important supports. Clear expectations, guidelines, and instructions construct support, as do formalized sessions of extra tutoring. Hill et al. (2010) also recommended clear performance standards and expectations for students in STEM fields, and especially for women. Establishing clarity reduces uncertainty and helps prevent situations in which women assess their performance according to negative environmental influences such as gender stereotypes (Hill et al., 2010). In this sense, clear performance standards and expectations may de-emphasize gender-based evaluations of competencies and emphasize women's engineering identities.

The importance of clarity was also identified in the problems participants associated with having students in advanced semesters, whose experience and levels of competence were inadequate, instruct coursework in the project-based lab environment. Participant experiences noted positive change when faculty took over these roles. However, given the potential benefits of social integration that comes with peer interaction, Miller et al.'s (2015) suggestion to implement formal instructor development programs and teaching skills workshops might be an effective way to promote competent academic advising from senior students *and* peer interaction. Moreover, participant experiences associated support with a weekly social event. As a requirement for all students and faculty of the mechatronics engineering program at the subject university, this event represents a curricular intervention that formalizes support through social integration. It allowed students to share their advice and experiences in the program. Miller et al. (2015) discussed the importance of coping strategies, such as peer advice and learning about the experiences of underrepresented students in engineering, such as women, as ways to provide support. A curricular intervention of social support that accompanies the student throughout the academic life cycle, and particularly in the beginning, might be beneficial in promoting confidence, especially important for women due to the role of confidence in acting as a buffer to negative environmental influences (Cadaret et al., 2017).

Positive modeling in the engineering environment. Hill et al. (2010) noted the importance of sending out a message of inclusion. Bussey and Bandura (1999) identified the influence of modeling in the environment. A message of inclusion can be sent through strategies that promote positive modeling by including women as those significant individuals in the environment who represent and impart positive gender information. This idea further supports the development of women's engineering and leadership identities, and aligns with this study's finding of the importance of women's visibility in engineering to create a chain of positive influence.

Hill et al. (2010) recommended exposure to female role models in STEM as a way to eliminate gendered stereotypes and thus socialized notions of who can do engineering. Again, it must be said that none of the women interviewed attributed their academic and career choice to the mentorship and role model of a woman engineer, yet participants advocated for it as a strategy to enable women to study engineering. Thus seeing, hearing, talking, and interacting with women who have succeeded in engineering is a core component of reconfiguring the engineering environment. In this sense, departmental recruitment and retention of female faculty may also benefit positive modeling and re-socialization in the engineering classroom.

Furthermore, it is important that women not only see female role models but also have the opportunity to be a role model and mentor. From the participants who experienced these opportunities emerged descriptions of positive influence, forward movement, and change for the better. As such, institutions of higher education would benefit from taking the lead and supporting women who study engineering in roles of leadership. For example, advanced students could be designated mentors for first-year students. Smith and Gayles (2018) advocated for leadership development programs in the engineering workplace to increase women's persistence and advancement. In the academic setting, a departmental initiative to integrate women students into nontraditional roles such as teaching assistants and tutors would provide crucial modeling information to break down gendered perceptions of competencies and aid processes of re-socialization towards women as "knowing." Concerted effort to develop women's leadership identities might prove of benefit not only in disrupting negative influences, but also in reconfiguring power and priority to enable the integration of what participants identified as the distinct perspectives and problem-solving approaches women offer to engineering.

Initiatives for educational outreach and recruitment. Women who study engineering should also be present in recruitment efforts, such as high school visits, to engage with girls and young women. Participant experiences identified high school as the moment in which they deliberated, via aptitude tests, conversations with family and peers, and university fairs, about their future academic and career choice. Making a final decision to study mechatronics engineering was often accompanied by confusion and uncertainty due to barriers in their environments, including the invisibility of women in engineering. Miller et al. (2015) advocated for the inclusion of peer role models in the recruitment of engineering students and for the potential of this approach to reach out to underrepresented groups via role models who represent specific minorities. As part of this strategy, information sessions, for example, can be opportunities for peer role models to share their personal experiences and model positive outcomes (Miller et al., 2015). Such initiatives might help girls to overcome the negative feelings of uncertainty and confusion participants cited in regard to pursuing a degree in engineering.

Furthermore, early career outreach programs also have the potential to recruit students into university engineering programs by awakening their interest and curiosity in engineering at a young age. Considering the gender stereotyping that begins early, and which was identified by the participants as part of their life experiences, designing these programs to reach elementary and middle school children might provide a way to re-socialize boys and girls and connect them to women who study engineering. Participant experiences with the mechatronics summer camp for kids was a good example of how women felt empowered as role models for boys and girls and agents of social change. Further, given the findings that identified family as both support and barrier before and throughout university, a family outreach program that initiates in high school and continues to graduation might help to re-socialize family members. Integrating family members through social events might provide opportunity for them to become part of the world of engineering.

Inclusive messaging. Hill et al. (2010) made the recommendation to "spread the word about girls' and women's achievements in math and science" for "the more people hear this kind of information, the harder it becomes for them to believe that boys and men are better in these areas" (p. 90). The communications and marketing departments of higher education institutions could take the lead in promoting an inclusive image and message of diversity in engineering. Redesigning the image of engineering might help to change perceptions that engineers, by default, are men. Putting on a showcase of women's achievements in engineering, for example, could be designed as a multi-purpose event to send out a positive message, recruit new students, and involve family members.

Further, Cadaret et al. (2017) recommended that university-based counseling help women in engineering through exploratory exercises that raise awareness of the gendered influences and power dynamics at work in their environments. The study's findings showed that these were present—not only in the most explicit and hostile forms, but also in male classmates' advantage of physical strength, which created relations of dependence and unequal power relations. Detecting these problems benefits solutions, which, in this case, might include designating lab assistants responsible for helping and/or awareness-raising talks with students that emphasize the importance of values related to collaboration. Positive communication about women's achievement in engineering in concerted effort with consciousness-raising exercises and guidance may prove of great benefit in ensuring that women exclude negative influences as standards to evaluate themselves and/or strategies to resolve difficult situations, but rather find the supports they need for their success.

Limitations

In a lyrical appraisal of the research process, McGrath (1981) stated that "the research process is to be regarded not as a set of problems to be 'solved,' but rather as a set of dilemmas to be 'lived with'; and the series of interlocking choices is to be regarded not as attempts to find the 'right' choices but as efforts to keep from becoming impaled on one or another horn of one or more of these dilemmas" (p. 179). In interpreting this passage as accepting that flaws are inherent in the research process, and thus openly accounting for them can be considered an important part of living with dilemmas, this section provides a way to comply with McGrath's (1981) first rule: "Always face your methodological problems squarely; or Never turn your back on a Horned-Dilemma" (p. 180). Though flaws were considered early in contemplation of the research design, they are built-in nonetheless. In consequence, it is important to "squarely face" and make explicit the limitations of this study.

Firestone (1993) stated that "generalizability is clearly not the strength of qualitative research" (p. 16). Considering the qualitative nature of this study, generalizability does not apply to its results. Because qualitative inquiry is specific to local contexts and individuals, its results are to be understood within the defined context, and cannot be generalized to other populations (Shenton, 2004). The choices made to carry out a case study of the women enrolled in the mechatronics engineering program of a small private university in Ecuador draws a definitive and local context, which represents a limitation of this study. In evaluating, however, the criterion of transferability of this study's results and the initiatives it proposes to other contexts, the reader must determine to what extent the situations are similar enough to be able to make that transfer (Shenton, 2004). According to Shenton (2004), the researcher cannot claim transferability because they are only familiar with the sending or research context. Therefore, it is up to the reader to determine transferability and make judgments about the similarity of contexts (Firestone, 1993). At this point, another observation should be added to the discussion of limitations. Important to mention is that though the gender ratio of faculty members at the subject university was described, and gender affirmative accreditation standards noted, the reader should be cautious about making any kind of inference regarding a relation between these variables. Further inquiry did not accompany this observation to evidence correlation and/or causality. As a grounded theory study of women studying engineering, the importance and influence of women as faculty members was noted through participants' lived experiences.

Fulfilling Guba's (1981) criterion of transferability in qualitative inquiry calls for detailed description of contextual factors, processes, and outcomes so that readers can decide if the situation studied and their own are sufficiently congruent to make comparisons (Firestone, 1993). For this study, the provision of detailed contextual information was ultimately limited by the imperative to protect participant confidentiality and the privacy of each of the women interviewed. However, detailed descriptions of the study's outcomes, along with their relevance to theory, may provide the reader with the opportunities to assess transferability and the usefulness of the results within their specific setting and context.

Another limitation considers the interpretive nature of qualitative inquiry and the biases that can be introduced while analyzing data and constructing grounded theory. McGrath (1981) wrote of the "replication and partitioning choices" a researcher makes at several levels (p. 192). In applying this observation to the tiered process of conceptualization involved in grounded theory, decisions were made about where to aggregate and where to divide data. McGrath (1981) described these choices as arbitrary and tentative: "They are arbitrary because any two observations are really alike in some respects and different in others, and it is up to the investigator to decide which of these 'respects' are to be focused on. They are tentative … because it is often useful to take cases treated alike for one purpose and later partition among them for another purpose"

(p. 193). These words provide an apt description of the stages of initial and focused coding, and the choices made to construct and conceive the final themes and categories. As much as precautions were taken, predispositions disclosed, questions asked to emphasize theoretical sensitivity, and descriptive information provided, this study's final product of mid-level theory mirrors the researcher's decisions and judgment.

Recommendations for Future Research

Additional directions for future research might receive insight from the limitations of this study. Being that it was context specific, potential research could include larger and more diverse samples to analyze perceptions of supports and barriers and validate findings across institutional contexts. In addition, though this study is focused on engineering, future research might gauge the transferability of its results to other fields characterized by gender disparity. Research of these contexts might follow a similar design and purpose to improve understanding of perceived supports and barriers and the interaction of the individual and gender in these environments.

Furthermore, Lent et al. (2003) suggested that future research on students' career paths would be served by exploring the benefits of interventions that construct support and mitigate barriers. Support-building and barrier-coping interventions were noted as having potential for achieving therapeutic effects (Lent et al., 2003). One of the most important conclusions that can be drawn from this study is the need to understand barrier constructs but also refocus and strengthen research on the factors and processes that motivate, support, and enable women to pursue the nontraditional academic and career choice of engineering. This idea pertains to conducting research that will encourage the ray of light to grow and expand. In this respect, benefit and significance for the literature and other higher education institutions might emerge from conducting research to find institutions that have been successful in improving the gender ratios in their engineering programs and to understand the enabling factors and processes at work in these environments.

For educators and administrators in the academic community who care about access and equality in engineering, Chandler's (1996) final step of activism encourages programs and interventions for inclusion and commitment to these processes. Practice benefits from research, and it also has great potential to contribute to it. Concerted effort to implement programs and evaluate their effects will not only add to the literature, but build a body of knowledge and best practices that could be replicated across institutions to support women studying engineering. Theoretical reviews and critiques of SCCT that integrate critical, feminist, and social advocacy approaches may push the literature in innovative directions that add understanding of women's participation in engineering. Finally, given the need to focus on support systems and promoting women's visibility in engineering and the distinct perspectives they add through collaboration and sharing, another promising research direction for SCCT might integrate consonant leadership theory and concepts.

Smith and Gayles (2018) advocated for the integration of leadership development programs in engineering workplace environments so as to build women's leadership and engineering identities. This idea presents innovative ground for future research directions that may look to organizational theory for inspiration. For example, Erazo's (2013) web of inclusion, grounded in feminist theory, identifies the social construction of gender and how processes are gendered and gendering. The web of inclusion is characterized by principles such as inclusion and collaboration, shared power, and communication (Erazo, 2013). Considering the salience of the binary opposition of male/masculine and female/feminine and its interdependence with hierarchy and hegemony in the male-dominated environment (Powell et al., 2009), a reconfiguration of the male-centric, weed-out engineering environment may benefit from values that promote a culture that is connective and relational, rather than driven by power and privilege (Erazo, 2013). In conclusion, if positive influences and support systems are created and converge, the ray of light will grow, and the engineering environment might take new form and course.

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Appendix A

Recruitment scripts (English and Spanish)

Dear Student,

My name is Sandra Gross. I am a doctoral student of the School of Education and Psychological Studies at the University of Miami, under the direction of Professor Debbiesiu Lee, Ph.D. For my dissertation, I am conducting a research study to explore the perspectives and experiences of women who study engineering.

I am inviting women who study mechatronics engineering at the Universidad Internacional del Ecuador to participate in interviews that will take approximately 60-90 minutes. They will be conducted in English or Spanish, according to the preference of the participant. I will also be requesting your permission to audio record the interviews for later transcription.

Additionally, you will be invited to review the content of your interview and provide feedback regarding the results of this project. These supplemental activities are entirely optional. Consenting to the initial interview does not require subsequent participation in any other research activity mentioned.

Your participation in this study is voluntary. If you are interested in participating and/or if you have any questions or concerns regarding the research study, please contact me via phone **(02) 298 5600 ext. 6092 / 099 700 9897** or email at **sig29@miami.edu**.

Thank you!

Recruitment Script (Spanish)

Estimada estudiante:

Mi nombre es Sandra Gross. Soy estudiante de doctorado de la Facultad de Educación y Estudios Psicológicos de la Universidad de Miami, bajo la dirección de la Profesora Debbiesiu Lee, Ph.D. Para mi disertación, estoy realizando una investigación para explorar las perspectivas y experiencias de mujeres que estudian Ingeniería.

Estoy invitando a mujeres que estudian Ingeniería Mecatrónica en la Universidad Internacional del Ecuador a participar en entrevistas que tomarán aproximadamente 60-90 minutos. Las entrevistas se llevarán a cabo en inglés o español, según la preferencia de la estudiante. Las entrevistas serán grabadas, por lo cual solicitaré tu permiso, para su posterior transcripción.

Adicionalmente, se te invitará a revisar el contenido de la entrevista y a proporcionar comentarios sobre los resultados del proyecto. Estas actividades suplementarias son completamente opcionales. El consentimiento para la entrevista inicial no requiere de la participación posterior en ninguna otra actividad de investigación mencionada.

La participación en esta investigación es voluntaria. Si tienes interés en participar y/o alguna pregunta o inquietud con respecto a este estudio de investigación, por favor contactarme al teléfono **(02) 298 5600 ext. 6092 / 099 700 9897** o por correo electrónico **sig29@miami.edu**.

¡Gracias!

Appendix B

Informed consent forms (English and Spanish)

Title of Study: The Underrepresentation of Women in Engineering: A Grounded Theory Case Study **Principal Investigator:** Dr. Debbiesiu Lee
Faculty: Education and Psychological Studies
Phone Number: 305-284-6160
Email Address: debbiesiu@miami.edu
Study Contact Name: Sandra Gross
Study Contact Telephone Number: (02) 298 5600 ext. 6092 / 099 700 9897
Study Contact Email: sig29@miami.edu

Any questions or concerns about your rights as a research subject can also be directed to the **University of Miami's HUMAN SUBJECTS RESEARCH OFFICE (HSRO), tel. 305-243-3195.**

IMPORTANT: The following information describes the research study in which you are being asked to participate. Please read the information carefully to decide if you wish to be in the study. Please ask as many questions as you may need to be sure that you understand what your participation will involve. At the end, you will be asked to sign if you agree to take part.

PURPOSE OF STUDY: The purpose of this study is to better understand the life experiences of women engineering students. You are being asked to be in the study because of your experience as an engineering student.

PROCEDURES: You will be asked to participate in an interview. We will have a conversation in which you will be asked questions about your experiences as a woman studying engineering. The conversation will be audio recorded and then transcribed for analysis. This conversation should take between 60 and 90 minutes. If you do not want to answer a question, you do not have to answer. If you would like to end the conversation at any time, you may do so. You may be contacted later to review your responses or get clarifications on your answers.

RISKS AND/OR DISCOMFORTS: We do not think that you will have any personal risk or discomfort from taking part in this study. You may skip any question you do not wish to answer.

BENEFITS: No direct benefit can be promised to you from your participation in this study. The study is expected to benefit research and society by helping us understand the life experiences of women who study engineering.

INCENTIVES/PAYMENTS TO PARTICIPANTS: You will not be paid for taking part in this study.

CONFIDENTIALITY: Your information will be confidential. All data collected will be stored on password- protected and secured personal computers and servers. After you have participated, *all* identifying information will be deleted from the transcribed documents and replaced by a pseudonym. The analysis and coding of the data will be done by pseudonym. The investigator and collaborator will consider your records confidential to the extent permitted by law. Your records may also be reviewed for audit purposes by authorized University or other agents who will be bound by the same provisions of confidentiality. Finally, the results of this study may be published. However, your identity will remain confidential in all published works. No identifying information will be included in the publication.

RIGHT TO DECLINE OR WITHDRAW: Your participation in this study is voluntary. You are free to refuse to participate in the study or withdraw your consent at any time during the study. You must tell the researcher if you wish to stop taking part in the study. There are no consequences to you or your standing in your program or at this university should you choose to decline to participate withdraw from the study.

AGREEMENT OF DECISION TO PARTICIPATE

You will receive a copy of this signed informed consent form.

I have read this consent, which is printed in English or Spanish (a language which I read and understand). This study has been explained to my satisfaction and all my questions have been answered. If I have any further questions about this study, I should contact the person named above. Based on this information, I voluntarily agree to give permission (consent) for me to take part in this study.

__________________________________ ________________________

Signature of Participant Date

____

Printed Name of Participant

____

Signature of Person Obtaining Consent

____

Printed Name of Person Obtaining Consent

Informed Consent Form (Spanish)

Título del estudio: La subrepresentación de la mujer en ingeniería: un estudio de caso basado en la teoría fundamentada
Investigadora principal: Dra. Debbiesiu Lee
Facultad: Educación y Estudios Psicológicos
Teléfono: 305-284-6160
Dirección de correo electrónico: debbiesiu@miami.edu
Nombre del contacto de la investigación: Sandra Gross
Teléfono del contacto de la investigación: (02) 298 5600 ext. 6092 / 099 700 9897
Correo electrónico del contacto de la investigación: sig29@miami.edu

Para cualquier pregunta o inquietud acerca de sus derechos como sujeto de investigación también puede dirigirse a la **Oficina de Investigación en Sujetos Humanos de la Universidad de Miami, tel. 305-243-3195.**

IMPORTANTE: La siguiente información explica el estudio de investigación en el que se le solicita participar. Por favor, lea cuidadosamente la información para decidir si desea participar en el estudio. Por favor haga tantas preguntas como sea necesario para asegurarse de que entiende lo que su participación implicará. Al final, se le pedirá que firme si está de acuerdo en participar.

OBJETIVO DEL ESTUDIO: El propósito de este estudio de investigación es comprender mejor las experiencias de vida de mujeres que estudian ingeniería. Se le solicita que participe en este estudio debido a su experiencia como estudiante de ingeniería.

PROCEDIMIENTO: Se le pedirá que participe en una entrevista. Tendremos una conversación en la que se le harán preguntas sobre sus experiencias como mujer que estudia ingeniería. La conversación será grabada en audio y posteriormente transcrita para su análisis. Esta conversación tomará entre 60 y 90 minutos. Si no desea responder a una pregunta en particular, no tiene que responder. Si desea terminar la conversación, puede hacerlo en cualquier momento. Es posible que se le contacte después para revisar sus respuestas u obtener aclaraciones sobre sus respuestas.

RIESGOS Y/O INCOMODIDAD: No creemos que habrá algún riesgo o incomodidad personal al participar en este estudio. Puede omitir cualquier pregunta que no desee responder.

BENEFICIOS: No se puede prometer ningún beneficio de su participación en este estudio. Se espera que el estudio beneficie a la investigación y a la sociedad ayudándonos a entender las experiencias de vida de las mujeres que estudian ingeniería.

INCENTIVOS/PAGOS A LOS PARTICIPANTES: No recibirá compensación monetaria por su participación en este estudio.

CONFIDENCIALIDAD: Su información será confidencial. Todos los datos recopilados serán almacenados en computadores personales y servidores protegidos con contraseña. Después de haber participado, toda la información de identificación será borrada de los documentos transcritos y reemplazada por un seudónimo. El análisis y codificación de los datos se realizará mediante pseudónimo. El investigador y el colaborador considerarán sus registros confidenciales en la medida permitida por la ley. Sus registros también pueden ser revisados para fines de auditoría por la Universidad autorizada u otros agentes que estarán sujetos a las mismas disposiciones de confidencialidad. Finalmente, los resultados de este estudio pueden ser publicados. Sin embargo, su identidad permanecerá confidencial en todas las obras publicadas. No se incluirá ninguna información de identificación en la publicación.

DERECHO DE DECLINAR O RETIRO: Su participación en este estudio es voluntaria. Usted es libre de negarse a participar en el estudio o retirar su consentimiento en cualquier momento durante el estudio. Debe informar al investigador si desea dejar de tomar parte en el estudio. No hay consecuencias para usted o su posición en su programa o en esta universidad si decide negarse a participar en este estudio o si decide retirarse.

ACUERDO DE DECISIÓN PARA PARTICIPAR:
Usted recibirá una copia de este documento de consentimiento informado firmado.

He leído este consentimiento, que está impreso en inglés o en español (idioma que leo y entiendo). Este estudio se me ha explicado a mi satisfacción, y todas mis preguntas se me han respondido. Si tengo más preguntas sobre este estudio, debo contactar a la persona apropiada mencionada anteriormente. Basada en esta información, voluntariamente doy mi consentimiento para participar en este estudio.

________________________________ ____________________
Firma del participante Fecha

____
Nombre del participante

____
Firma de la persona que solicita el consentimiento

____
Nombre de la persona que solicita el consentimiento

Appendix C

Interview Questions (English and Spanish)

Target student population: undergraduate women, who are full-time mechatronics engineering students at a private Ecuadorian university

Section 1: Demographics
1. Age
2. GPA
3. Semester

Section 2:
Educational and career choice and persistence:

1. What inspired you to study mechatronics engineering?
2. What has it been like as a woman studying mechatronics engineering?
3. Was engineering the experience you thought it would be?
4. Do you feel that you've ever been treated differently because you are a woman?
5. What have been the greatest challenges for you as a woman matriculated in this program? Describe a time that you felt discouraged. How did you overcome this moment?
6. What advantages do men have over women in engineering?
7. There is a disproportionately low number of women studying engineering. How do you understand this? Why do you think there are so few women studying engineering?
8. Where do you see yourself after graduating? What are your future plans?
9. What advice do you have for women in engineering to succeed?
10. What should universities be doing to support women once they have decided to study engineering?

Interview Questions (Spanish)

Población estudiantil destinataria: mujeres de pregrado, que son estudiantes de ingeniería mecatrónica a tiempo completo en una universidad privada ecuatoriana

Sección 1: Datos demográficos
1. Edad
2. Promedio académico
3. Semestre

Sección 2:
Elección de carrera universitaria y profesional y persistencia estudiantil:

1. ¿Qué te inspiró a estudiar la ingeniería mecatrónica?
2. ¿Cómo ha sido la experiencia de ser mujer que estudia ingeniería mecatrónica?
3. ¿La ingeniería ha sido lo que pensabas que iba a ser?
4. ¿Sientes que alguna vez has sido tratado de manera diferente porque eres mujer?
5. ¿Cuáles han sido los mayores retos para ti como mujer matriculada en este programa? Describa un momento en el que te sentiste desanimada. ¿Cómo superaste ese momento?
6. ¿Qué ventajas tienen los hombres sobre las mujeres en la ingeniería?
7. Hay un número desproporcionadamente bajo de mujeres que estudian ingeniería. ¿Cómo entiendes esto? ¿Por qué crees que hay tan pocas mujeres que estudian ingeniería?
8. ¿Dónde te ves después de graduarte? ¿Cuales son tus planes futuros?
9. ¿Qué consejo tienes para que tengan éxito las mujeres en la ingeniería?
10. ¿Qué deberían hacer las universidades para apoyar a las mujeres una vez que hayan decidido estudiar ingeniería?