AC 2011-354: THE RIGHT TO EDUCATION FOR FEMALE ENGINEERING STUDENTS IN MEXICO. CULTURAL CONSIDERATIONS IN THEIR RETENTION

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The Right to Education for Female Engineering Students in Mexico. Cultural Considerations in their Retention

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Introduction and Statement of the Problem

In past decades, particularly the 1970's and 1980's, female participation in higher education in Mexico was very low. This phenomenon was associated with socio-cultural stereotypes that established Mexican women as mothers and wives and identified them as emotional and affective, and therefore not ―fit‖ for schooling; this ultimately has kept them from paid work and formal education. Historically the characteristics of Mexican educational institutions have not only affected the experiences of female students, but also have stressed traditional roles of women and thus present challenges for women who venture into non-traditional fields[1]. Despite this, participation of women in higher education in Mexico has increased substantially in the last three decades and has nearly achieved balance with male participation[2]. However, the increased enrollment of women in higher education in Mexico does not mean that the division between traditionally "male" and "female" academic programs has disappeared. For instance, in 2006, in traditionally "female" programs such as education, women represent 66% of students, and in traditionally "male" programs such as metallurgy engineering, enrollment of women barely reaches 3%[2]. According to Bustos[3], enrollment in traditional "feminine" programs is due in part to the domestic functions associated in society as women's roles, and the possibilities of participants in these professions to balance work and family. This not only reinforces stereotypes about women's roles, but also undermines women's welfare because traditionally "feminine" fields have less social prestige and offer lower salaries[3].

As part of a larger study examining the experiences of female engineering students in Mexico, the purpose of this study, was to explore how cultural considerations shape the experiences of women college students that have persisted in engineering programs in Mexico. Culture shapes the experiences of women students in engineering colleges in Mexico; the percentage of women students in engineering is 24%; this percentage is still low compared to the percentage of women enrolled in higher education institutions in general which accounts for nearly 50%[2]. It is thus important to understand how the cultural factors among others shape the experiences and impact the retention of female college students in engineering programs.

Theoretical Framework

A supportive environment is important for optimal achievement in any college field. The climate of engineering for women has been raised as one important aspect of women's experiences. Several studies[4,5,6] have explored how women's educational experiences differ significantly from their male peers. A study that explored gender and achievement-related beliefs argued that female engineering students face a social climate that contains negative stereotypes about women

in technical fields. When female students know they are being judged in terms of stereotypes, this can cause them to question whether they belong to the field of engineering[7].

Research has shown that social integration is a pillar in the retention process for college students[8,9]. Astin and Oseguera[10] proposed that students who show a propensity to become involved in the social and academic life of the institution have better chances of finishing college. Women as minorities often feel isolated in engineering. One theoretical foundation for student retention contends that students "learned by becoming involved" [11](p. 50). This theory is based on the notion that student involvement is achieved with investment of psychological and physical energy in tasks and activities. If students do not feel connected and involved within their environment, it is likely they will not be retained[12]. In recent years, engineering educators have tried to engage students through learning communities, team projects, and cooperative education[5,12].

Although most female engineering students experience a male-oriented environment, many have succeeded in this environment. Some studies address female engineering students' experiences in college; however, little attention has been focused on determining the elements that facilitate success in this environment, especially the role of the culture in their retention.

Methods and Procedures

The methodology used in this study was exploratory and descriptive with the intent to identify and describe how cultural considerations shape the experiences of college women students that have persisted in engineering programs in Mexico. To address this concern a qualitative method of inquiry was used. Qualitative research offered the most appropriate approach for this study because in this project we sought to understand the particular experiences of female students in engineering colleges in Mexico.

The methodology of this research is described in the following order: participants, data collection, procedures, data analyses, validity and trustworthiness. Finally, since the research was done in an international setting, a short discussion on culture and translation for cross-cultural research is included[13].

Participants

Participants in this study were female engineering students enrolled in selected colleges of engineering in Mexico. The students selected for this study were at least in their third year of college, which we used as evidence that they have decided to stay in their programs. Twenty respondents from two private and two public universities and from different engineering programs were interviewed. The sample was chosen based on the context, expecting that it would provide rich data.

Data Collection and Analysis

For this qualitative study, the investigators were the primary data-gathering instrument, in accordance with the constructivist methodology that states "The researcher, by necessity,

engages in a dialectic and responsive process with the subjects under study"[14] (p. 44-45). We collected data for this study mainly by interviewing students individually, and secondarily by collecting observational data in selected universities. In addition, we reviewed institutional documents describing the background of the students, enrollment, and attrition rates. Data were collected during the Spring and Summer of 2007.

The data collected in this study was primarily analyzed using the constant comparative method as described by Strauss and Corbin[15], and also found in Creswell[16]. After transcribing the data and reading each interview many times, the data were unitized giving each unit a code which consists of the pseudonym of the participant and a consecutive number. The second step in the constant comparative method is called axial coding and consists of relating categories to their subcategories to form more precise explanations of the phenomena; the term axial is used because coding occurs around the axis of a category[16]. Initial categories were formed based on the connections between the students' perception of the Mexican culture and the engineering environment. The final process of coding consists in interrelating categories, or the process of integrating and refining categories at a higher level of abstraction[16].

Validity/Trustworthiness

To assess credibility, different methods to collect data for this study were used: interviews, observations, and documents. Interviews constituted the main source of data collection and allowed the researchers to direct the questioning. In addition, and referring to Lincoln and Guba[14], persistent observation adds salience to a study; it helps the researcher to identify relevancies and atypical cases. Students were observed in their institutional settings and in two engineering classes. Lastly, documents were reviewed at each institution that helped the researchers understand the experiences of the female students.

In addition, peer debriefing was used to provide an external check of the inquiry process, to discover our own biases, clarify interpretations, and discuss possible future directions. Finally, the respondents had the opportunity to review their transcripts and provide or refine the information. This member checking technique is described by Lincoln and Guba[14] as the most important in establishing credibility.

Working bilingual data: A note on cross-cultural research

This research studied the experiences of female engineering students in Mexico. The results of this research are addressed to two different audiences, the English speaking academic community and the Mexican Spanish-speaking college community from which the data were collected. González y González and Lincoln[13] suggested that the researcher should provide both audiences with an understanding of the data.

One of the most important challenges in conducting cross-cultural studies is the accuracy of the translations. González y González and Lincoln[13], explained how "the translation of the language needs to include the translation of the contexts and cultures." (p. 194) The participants of this research, female students in engineering colleges in Mexico, frequently used colloquial language which gives the reader a sense of their youth, culture, and feelings that a Spanish-speaker reader

could not capture with just an English presentation of the data. The data is presented in both languages in order to keep its cultural richness.

We intend in this paper to present different layers where the culture of engineering, women's roles, and Mexican cultures intertwined and combined themselves in a cultural representation of what the college students participant in the study are facing and challenging in order to succeed.

Results

Education has proven to contest unequal opportunities, however in some cases it has also contributed to the reproduction of social inequalities based on class, race and gender. While analyzing the dimensions of the context where education takes place -the institutions and the social and historical conditions- cultural questions are raised about whose interests are been served, who has access to these programs, who holds the power to make changes, and how the learning opportunities are structured[17].

Results focusing in the cultural and social impact in the retention of women engineering in their colleges are presented next. In this context, participants were able to find sources of support and use strategies that helped them remain in their majors. To present the findings, we divide the section in two parts. First, we include the different manifestations of the Mexican culture shared by the participants, and then we present how these manifestations permeate and influence the environment of engineering colleges in Mexico.

Mexican Culture

The masculine culture that dominates Mexican society became visible to participants in different ways and has contributed to a culture of gender discrimination in colleges of engineering[18]. Participants identified women's roles and stereotyping of women as manifestations of this culture. Participants in this study expect more equity and view themselves as professional engineers.

a) Women Roles
Participants identified women's roles as a manifestation of the Mexican culture in three dimensions –society, family, and themselves. They discussed how their own perceptions of gender roles differ substantially from society's and from their families'.

Society
Participants described their perception of how Mexican society has conceptualized the role of women in society. They described how common it is for Mexican society to expect women to take care of the house and for men to work outside of the home. In addition, they described the roles assigned to women as mothers, care-givers and mainly responsible for children. For instance, Gaby stated,

> …there is still a lot of machismo. If someone's a man, he's supposed to go to work and the woman is supposed to be at home. We are accustomed to women doing everything, being the one who takes care of us, understands us—it's a tendency of Mexican society.

[… hay mucho machismo, es como si el hombre es para trabajar y la mujer para la casa. Estamos acostumbrados a que la mujer haga todo, la que nos cuida, nos entiende, es como una tendencia de la sociedad mexicana]

Challenging traditional gender roles was more important for participants when they mentioned life choices. When they referred to their future life, they talked about balancing work and family responsibilities and finding time for having and raising children. They recognized the pressure Mexican society puts on professional women engineers, and stated that working women are negatively perceived and judged by Mexican society, which holds stereotypical views of women and expectations about their roles in the family and the workplace. Ana illustrated these perceptions:

> Women in Mexico are kind of rejected in some ways. I think it is cultural. Whatever you do it will be wrong [according to society]. If you work, they'll say and "What about your children?" and if you don't work they will say "What a waste!" Engineering is very demanding; and you need to balance work and family [*Las mujeres en México son como rechazadas. Yo creo que es cultural. Lo que hagas está mal. Si trabajas dicen ¿y los niños? Y si no trabajas dicen ¡Que desperdicio! Ingeniería es muy demandante y tienes que balancear el trabajo con la familia*].

In this quote Ana recognized that she will have to negotiate within two culturally imposed impulses within herself—rejecting traditional norms by being willing to work outside the house while at the same time embracing them by raising her family.

Family
Although participants in this study stated they felt greatly supported by their families, they also revealed that their families often upheld traditional, stereotypical ideas about gender roles. Participants also believed that perceptions of gender roles are shaped strongly by Mexican families. Yolanda, for instance, shared that while living with her family she started to feel that her role as a female was different than her brother's. She also stated that her family transmitted to her the perception that she could not participate in activities that were "just for men":

> I think everything starts like that, it's not like a problem that can be solved superficially, it starts in the family when they start separating you, telling you "you do this because you are a little woman." [*Pues yo creo que todo empieza así, no es así como un problema que se pueda resolver superficialmente sino desde la familia, la familia desde que en tu casa te empiezan a separar de "tú haces esto porque eres "mujercita"*].

In this quote Yolanda uses the term "*mujercita*" [little woman], which is very common in Mexican society. Although "*mujercita*" can also be translated as "young lady", we decided to use the first translation, "little woman" to emphasize how it is often used in a patronizing way, as it associates the female gender with inferiority.

Nevertheless, what is common among the students interviewed is the support they all have from their immediate families. Families play a big role in the Mexican culture as they are seen as a motivating force and a source of support[19]. Participants agreed that their families played a large

role in their persistence in college. The support they felt from their families ranged from supporting the idea that they wanted to study engineering, to encouraging them to leave home to pursue their studies.

Mothers are mentioned by the participants as their main support; participants stated that their mothers encouraged them to continue, trusted them, and supported the decisions they made. It is important to note that some mothers were not able to go to school for a variety of reasons, including getting married and having to play the traditional role of homemaker, not having the opportunity, or not having the support of their own parents. Participants' mothers who did not have any higher education were more concerned about their daughter's independence and well being. Often feeling regret about their choices, these mothers advised their daughters about life and the importance of being self-sufficient. For instance, Gaby stated

> [my mother] saw the problems this limitation posed to her, maybe the opportunities for looking for a job or to work in something were limited because she didn't go to college, that is why since we were little she made us …like…committed [to school] [*[mi mamá] vio los problemas que le causaron tener estas limitantes que a lo mejor pues las oportunidades para buscar un empleo o para dedicarse a cierta cosa se veían limitadas por no tener una carrera, ella por eso nos hizo desde chiquitos ...como… muy dedicados*].

Themselves

In contrast to their parents, participants in this study did not embrace strictly traditional gender stereotypes. Participants stated, that work needed to be divided according to ability, not according to gender. As Fernanda said,

> It [work] needs to be balanced, men and women should cooperate, yes we have different capabilities and abilities, but we can make a team, like a couple or a family. I don't believe in stereotypes [*Debe ser un equilibrio, tanto hombres como mujeres cooperen, debemos encontrar un equilibrio, si, tenemos diferentes capacidades y habilidades podemos hacer como un equipo, como una pareja o una familia, yo no creo en estereotipos*].

Participants shared how they experienced contradictory forces. On one hand, the students enrolled in engineering colleges, thus rejecting and challenging traditional gender roles. They believe that higher education, especially engineering studies would allow them to find a job outside the house and have a professional life. On the other hand, the female students also described the tension they experience as they think about the negotiating the demands of their professional lives and their roles as family caregivers. Thus participants were constantly negotiating between rejecting traditional gender norms and upholding the norms that are so deeply engrained in Mexican society.

In addition to women roles, participants were aware of other cultural stereotypes that affect women students in engineering colleges, as we describe in detail in the next section.

b) Cultural Stereotypes of Women in Engineering

Cultural stereotypes are the second manifestation of the Mexican masculine culture described by the participants. In this section, we first describe how female students have an extra burden dealing with the possibility that their performance might confirm the stereotype of female inferiority and that they may be judged according to that stereotype. In addition, they also must deal with cultural stereotypes about women's inferior math and science aptitude and superior ability to take care of the house and children. We then continue explaining how female students deal with the stereotype of being perceived as "unfeminine" and the "least attractive" students of the university. Finally, we close this section with a discussion about how these stereotypes create extra stress and contribute to the social pressure experienced by the participants in this study.

Female inferiority and less natural ability for math and science
Participants recognized attitudes grounded in and reinforced by Mexican cultural stereotypes, which perceived women as weaker than men. Evelyn, for instance, stated:

> …[I think] it is a society behavior and finally there is always the belief that girls are less strong, for example when they say that women can't drive, it is like [we are] below them [male-students] … then they feel displaced or they feel that you are taking their place [*porque es un comportamiento de la sociedad y finalmente siempre es una perspectiva de que las niñas siempre tienen menor fuerza, por ejemplo cuando dicen que las mujeres no saben manejar, ...como que es un poco debajo de ellos, entonces como que se sienten desplazados o como que se sienten que les ganan el lugar*].

Similarly, participants shared how women are perceived in society as having less natural aptitude for math and science, and consequently for engineering. Female students in engineering are still faced with stereotypes, as Ana stated:

> [People] tell you, 'Engineering? You? A woman?' Yes, I think society plays a role. It is strange and, of course, it can affect you. It is like a culture; engineering is difficult and in this culture it is seen as difficult for you [as a woman] to succeed. [*Y te dicen, ¿ingeniería tu?, ¿una mujer? Sí, yo creo que la sociedad juega un rol importante. Es raro por supuesto, y puede afectarte. Es como una cultura, que ingeniería es difícil y ven difícil que [como mujer] la puedas hacer*].

Participants stated that society's expectations of young women who decide to study engineering were different from those of young men.

Unfeminine, unattractive
For Mexican society, engineering, as stated before, is still seen as a profession unsuitable for women. Participants perceived social barriers to becoming engineers, and stated that often female engineering students are seen as "tomboys." Congruent with the literature[20], participants described how they were portrayed as masculine or unfeminine by their peers and by society at large. Olivia shared her experience,

> I like engineering a lot, but sometimes they say women should not [study engineering]. A former boyfriend told me that if you study engineering you are a tomboy. He said, "What, do you like women?" Not everybody understands. [*A mí me gusta mucho la ingeniería,*

pero bueno a veces dicen que algunas mujeres no deberíamos hacer eso. Un novio me dijo si estudias ingeniería eres machorra ¿Qué, te gustan las mujeres? No toda la gente entiende].

These cultural stereotypes pervade universities in Mexico, as well, as they embrace an image of female students in engineering as being physically unattractive. All participants agreed that in their universities there was an image of female engineering students as the least appealing of all female students across the campus. The stereotype of women in engineering is described by participants as the typical girl who has glasses, does not take care of herself, and does not have a social life. The students agreed that related to the "ugly" image there is also the "*ñoña*" image which portrays female engineering students as not having a social life, being shy, and being introverted. Paola, for instance stated:

> It's like she is someone who goes to the library. [People] think she is a bookworm, and people start thinking that if you are at the library and you have a scholarship, well, you're boring. And if you're boring you're not pretty, as generally pretty persons are seen as more cheerful. [*Es como si alguien que va a la biblioteca es así como que ¡uy! Un ratón [de biblioteca] y ahí empiezan a creer que si estás en la biblioteca y si tienes una beca, pues eres aburrida y eso también ser aburrido no es de una persona guapa, generalmente las personas bonitas son más alegres*].

Engineering Environment

Different engineering programs in Mexico have different percentages of women students. Although ability and interest in math and basic sciences drive the selection of an engineering major, some types of engineering are considered more female-oriented, for example computer science or industrial engineering, where woman participation can achieve 30%[2]. The colleges of engineering in this study had an average of 20% female students in 2006. However, some of the students interviewed for this study, especially mechanical engineering students, were the only female in their class. The situation for women in this context dominated by men is complex. The college of engineering environment is perceived by participants as very challenging. This challenge has two dimensions: academic and social. Nevertheless, participants in this study have a strong desire to finish college and have learned to develop confidence in their abilities. In addition, they described the strategies that helped them deal with these challenges and stay in their programs.

    a) **Challenging the Academic Environment and Students' Responses to the Challenge**
The first dimension of the challenging engineering environment identified by the participants is academic. Students are faced with subjects that are difficult to learn and they realized early in the program that they needed to study hard. Academic challenge is documented in the literature as one of the main causes for college student attrition, and is also one of the most discouraging factors in pursuing an engineering career[21]. It played a big role in the doubts participants experienced about their academic abilities and their "sense of belongingness" to the program in their first years of college. Uncertainty is cited in literature as a difficulty for women in general[22], who often doubt their ability to succeed in school. Participants shared that when they started their programs they tended to self-disqualify when they made bad grades. They also stated that bad

grades were perceived differently by men than by women in engineering programs. Participants explained that if male students got bad grades they tended to blame it on the teacher or test. However, when women got bad grades they tended to question themselves. As Maria described,

> … [For women] it is like a need to prove that you are good for engineering. [The male students] have more confidence, like if they know they are going to graduate…. I was more affected by bad grades than men, maybe because we women are more sensitive and because the society says it is harder for [women] [… *[Para las mujeres] es como una necesidad de probar que eres buena para ingeniería. Ellos tienen más confianza, es como si ellos supieran que se van a graduar… A mí me afectaban mas las calificaciones bajas, a lo mejor porque las mujeres somos más sensibles o porque la sociedad dice que es más difícil para ti [como mujer]*].

In contrast with previous studies that suggest that beliefs about abilities tend to be associated with unwillingness to persist in the face of obstacles[7] and in agreement with Dweck's[23] theory on motivation, participants in this study believed that when encountering difficult subjects what was important was the effort they put in to studying and the interest they have in the subjects. Students believed that working hard allowed them to fully use their abilities. In addition, participants agreed that abilities can be developed and learned, as Yolanda stated,

> … in any subject while you keep trying and if you try hard, do your homework and study for the exams [you will do fine] [… *[en] cualquier materia mientras trates, te esfuerces y entregues las tareas, estudies para los exámenes [puedes salir bien]*].

Furthermore, students' beliefs that abilities can be developed helped them decouple gender from math and engineering ability. These perceptions were used by the students as a strategy to fight cultural stereotypes. As Paty explained,

> Intelligence and abilities can be developed; it is not like what you are born with. No! [Abilities] can be developed and school helps. [*La inteligencia y las habilidades se pueden desarrollar, no es como si naciste con ellas. ¡No!, se pueden desarrollar y la escuela ayuda*].

b) Challenging the Social Environment and Students' Responses to the Challenge
The second dimension of the challenging engineering environment identified by students is social. Female students in engineering stated that they face an environment that is competitive, individualistic, and isolating. Additionally, students perceived that their workload led them to have less time for social life than students in other majors. Cultural values also reinforced this perception, since engineering students are perceived as nerds who have no social life[24].

Engineering faculty and society in general have the elitist notion that engineering is superior to other professions. Several of the participants shared how they constantly receive admiration of friends outside the college. However, the strict and competitive environment described by participants can be a challenge for women who can feel isolated in this environment.

Participants described how they focus on proving that they can do the work, showing an "image of a good student," and obtaining good grades in order to be trusted and recognized by their peers. Paola, shared, for instance,

> At the beginning I didn't pay attention, but the environment created the need to demonstrate that we are equal. First the teams, that's typical, if [male students] do not know you or don't know how you can be useful they don't even consider you, and if they don't consider you, you are like a ghost…. [*Yo al principio me daba igual pero el ambiente fue creando que fuera necesario la demostración de que somos iguales. En primera pues los equipos, eso sí es típico, si ellos no conocen o no saben que puedes ser útil de plano no te consideran y si no te consideran de plano eres como un fantasma…*]

In addition to the intense coursework, and the image of engineering students as "nerds," the low participation of women in engineering programs contributes to the lack of social life experienced by female students in the college. Some students, as stated before, were the only females in their class, and they shared their need for female friendships. As Claudia explains,

> …Yes, and still now I will love to be like my sisters. They have a lot of [female] friends [in college] and it is really cool, and I, in that aspect I feel that I'm more shy, yes I have a lot of [male] friends, but we always need that, your [female] friend, your [female] best friend… [*Sí, yo hasta ahorita me encantaría ser como mis hermanas que tienen un chorro de amigas [en la universidad] y salen y conviven y se llevan súper padre y yo en ese aspecto siento que soy más retraída, sí tengo muchos amigos y todo pero siempre necesitamos eso de tu amiga, tu mejor amiga*].

However, their experiences of isolation tended to disappear when participants found a good working team, which gave them much needed social support. Evelyn shared her experience:

> If I had had the [academic] team that I have now from the beginning maybe my life would have been different [*Si hubiera tenido el equipo de trabajo que he logrado ahorita desde que yo entré al Anexo a lo mejor mi vida hubiera sido distinta*].

Participants shared how they were able to establish good academic working teams, where they could trust each other and how even if these relationships started as academic experiences they became meaningful friendships. Gaby for instance explained,

> … well the friendship I was able to form well I think they were because I was able to relate [to students] in and out the classroom because of the [school] projects; I found classmates with whom I get along not only for the work aspect, but also for personal aspects [*bueno las amistades que formé pues yo creo que fue …[porque] pude convivir tanto afuera como dentro del salón de clases dados los proyectos, encontré compañeros con los que me pude integrar muy bien no solo en el aspecto laboral sino en el personal*].

In this section we described the two dimensions of the challenging environment faced by female students in engineering colleges in Mexico. First, students encountered very demanding academic coursework, and then a competitive and individualistic environment. In this

environment the students were able to find sources of support and strategies to persist in their programs. For example, the students believed that the abilities needed to succeed in their programs can be developed with hard work, they focus on showing an image of "good students" in order to prove to themselves and to others they belong into to the program, and they were able to find good working teams that helped them build trust and friendship.

Conclusion

Mexican Culture

Significant conclusions of this study include the role Mexican culture played in the student experience of the participants as it is described below.

- This masculine culture manifests in the cultural and family values that associate the female gender with inferiority and perceive women as caregivers, mothers, and mainly responsible for the house. Participants in this study describe the pressure they experienced to conform to these traditional roles because, in contrast with their parents, their own perceptions of gender roles differ substantially from society's, as they expect more equity.
- Family support is documented in the literature as very important for the retention of minority students in college[19,25]. Data from this study confirms the literature, as all participants were part of families who encouraged their educational attainment, and participants discussed the important role their families played in their persistence in college, not only supporting them economically, but also encouraging them to be happy and to pursue their dreams.
- Overgeneralizations and assumptions about women have permeated colleges of engineering where women deal with the possibility that their performance might confirm the stereotype of women's low aptitude for math and science. These perceptions led participants to feel social pressure and caused them to work hard against the discrimination they experienced and the cultural constraints within the college, through focusing on proving they can do the work and by obtaining good grades. Participants used this strategy of proving to themselves and to others that they can succeed in order to resist the cultural pressures that push many women away from engineering, even though this strategy has serious limitations because women feel the pressure to always look smart. In addition, findings showed how female students navigate through a system of male privilege that is dependent on social and cultural factors. Female students recognized popular beliefs about women's inferiority in science, and tried to break these stereotypes and engage in engineering, in order to challenge existing power and become active agents in defying the cultural values.
- Female engineering students in Mexico must deal with the stereotype of being perceived as unfeminine, nerds, and the least attractive students across any university campus. These stereotypes are rooted in Mexican cultural values and social constructions of gender that stress engineering as masculine and that consequently position female students in engineering as unfeminine. However, there is an interesting tension between the culture of engineering and the Mexican culture. On one hand female students learn to navigate the engineering environment where they are seen as unattractive by denying the

value of beauty, while on the other hand participants seemed to experience pressure to conform to Mexican cultural stereotypes that relates femininity with beauty. Data from this study suggest that female students struggle to negotiate the link between being an engineer and appearance. Participants seem to embrace the engineering culture and prove they belong into the field by not paying attention to their personal appearance, while at the same time they embrace the contradictory cultural value that associates femininity with beauty, sharing that they all view themselves as pretty and they like to "dress-up" when they go out, specifically to challenge the "nerdy and ugly" stereotype by showing themselves as both pretty and engineers.

Engineering Environment

In addition to social and cultural values present in Mexican society, there is a culture in engineering colleges that influenced the experiences of participants in this study. Participants shared many difficulties and challenges they experienced in college. It is noteworthy how female students dealt with the difficulties they encountered, and how they interpreted the meanings of those difficulties.

- Participants found college very challenging academically. Of particular interest is that, in contrast with the literature that states that conceptual difficulty is one of the most discouraging factors in pursuing an engineering degree[21], participants in this study stated that they actually *enjoyed* the academic challenge.
- Moreover, findings also suggest that female students see themselves as academically strong and possessing all the intellectual abilities they need to succeed in their engineering programs. In the challenging engineering environment, participants were able to develop the abilities needed to succeed in their programs.
- It is important to note that participants in this study perceived the engineering environment as individualistic and they experienced isolation. Furthermore, literature describes the environment in engineering as not very social[27]. In addition, cultural values reinforce this perception. Although social pressure has been documented in the literature as a cause for girls and women to lose interest in science and math[25,26], participants in this study learned to live in this environment and even reframed the environment into a challenge to overcome. It is noteworthy, that congruent with literature[8,27,28] although participants lived in a male-oriented environment, they valued peer relationships, as they described the friendships and the good work teams they found in college as one of the most important factors in their persistence.
- Literature on women's learning[29] suggests that women's preferences are for learning that is cooperative, and studies on women in engineering[21,24] indicate that a competitive climate has contributed to the attrition of women students in engineering. In addition, cultural values associate femininity with care giving and cooperation. In contrast to this literature, although most participants in this study valued group work and cooperative learning, and shared how peer support was very important for their retention, many of the participants liked competition. Moreover, literature on female attrition in science and engineering[30,31] suggests that faculty promote the elitist idea that engineering is academically very difficult and not for everyone, and expect students to prove themselves. Findings of our study suggest that participants use competition as a way to

prove to themselves and to others that they are good students and equally capable as men, and reinforce their belonginess to the field.

This study illustrates how participants learned to see the hardships and obstacles they experienced as challenges, how they negotiated the cultural expectations of females in Mexico, and how they use resistant strategies like academic success to become accepted in the male-dominated engineering environment.

Educational Importance of the Study

The experiences of the participants in this study offer engineering colleges challenges and opportunities. The dominance of values in the Mexican culture and in the engineering culture presents specific challenges to achieve an environment more supportive of women in Mexican engineering colleges. In addition, institutions need to be proactive and creative in order to help faculty and administrators provide an environment in which female engineering students can be successful.

Pratt[35] discusses how it is common for people who are exposed to a new culture to judge the cultural experience in their own logic. Furthermore, this exposure can help to find ―that which was invisible and taken for granted [in their own culture] (p. 37).‖ Engineering educators in the US can find in this study a basis of comparison where their own perspectives of how culture shapes the experiences and impact the retention of female college students in engineering become visible. This study can help to challenge cultural beliefs and stereotypes to benefit the learning of all students.

Moreover, findings of my study suggest the important role that culture plays in the retention of Mexican female engineering students. Further research might identify the experiences of female engineering students in other countries and cultures analyzing differences and similarities. Of particular interest might be to compare the experiences of Mexican female students with Hispanic students in the United States. The purpose for that study would be to help better understand the role of Latino culture in retention.

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