AC 2008-891: THE IMPACT OF STUDENTS' LIFE EXPERIENCES ON PROGRAM RETENTION. A STUDY OF FEMALE ENGINEERING STUDENTS IN MEXICO.

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Key words: Women engineering students, Mexico, college student retention, international engineering education

Introduction

The purpose of this study was to identify why female students remain in and graduate from engineering schools in Mexico. The study sought to understand and describe the perceptions of women engineering students in Mexico regarding the personal, institutional, and cultural characteristics that help them persist in their programs. To address this concern a qualitative method of inquiry was used in which data were collected using interviews and observations.

Because student experiences differ between countries, we expected that Mexican students would present specific needs dictated by their culture. Furthermore, within any particular country students have different experiences depending on the type of institution and particular engineering program they participate in; we thus chose a range of institutions and programs to examine. The participants in this study were 20 female engineering students enrolled in at least their third year in selected colleges of engineering in Mexico, in both public and private universities, and pursuing a variety of engineering majors.

There is little information about the factors that contribute to the persistence of women in engineering colleges in Mexico. The number of women in engineering is still low compared to the number of women enrolled in higher education institutions in general. It is thus important to identify the factors that contribute to the persistence and graduation of women in engineering programs, which was the focus of this study. Findings from this study can help faculty, advisers, and program planners to better meet the needs of women students and reduce their rate of attrition in engineering programs.

Findings that emerged from this study focus on how female students created or discovered sources of support that helped them stay in their programs. The students described their experiences in colleges as very challenging and perceived the environment as hostile and uncertain. In addition, dimensions of Mexican culture and stereotypes were identified by the students as influencing and helping to shape the engineering environment. However, in this environment students were able to find sources of support and strategies that helped them remain in their majors such as: a strong desire to succeed; perceived academic ability and support from their families, peers, institutions, and -most importantly- their professors. Finally, the fact that the female students will finish their programs gives them a sense of pride and satisfaction that is shared by their families, peers, and faculty.

Review of the Literature

Over the last decades, scholars have been studying the scarcity of women in science and engineering, and have begun to examine reasons for this shortage. In recent years, the proportion of women entering traditionally male-dominated professions has increased
substantially. However, gender ratios in the field of engineering have remained highly unbalanced. This situation contrasts with other traditionally male-dominated professions, like medicine, in which women constitute nearly half of the entering students.2

The low representation of women in engineering is well known. Research3, 4 has documented the low numbers of women in the field and the possible barriers that have contributed to this shortage. Most studies examining female participation in engineering have focused on recruitment. The current body of research mainly addresses young women’s pre-college experiences and has identified a variety of factors that impede high school female students from pursuing careers in engineering and other technical fields, such as lack of support from family and teachers, limited guidance for taking advanced prerequisite courses, and limited hands-on experiences with science and technology.4, 5

A recurring problem in engineering education is the high rate of attrition, or the rate at which students withdraw from higher education institutions without finishing a program.6 Statistics show that the total attrition from engineering has always been very high.7, 8 Research on women in science and engineering has also helped determine the factors that contribute to female student attrition, such as the lack of female faculty and role models especially in engineering colleges, the chilly climate of engineering colleges, and poor teaching especially by science, math and engineering faculty.9, 10, 11

Studies in college student retention, or students who remain at the same institution where they start until they complete a program,6 have found retention is influenced by individual and institutional factors, such as student background, ethnicity, high schools grades and SAT scores, socio-economic status, participation in social activities, faculty, size of the institution, and attachment to the institution.12, 13, 14

In summary, literature examining female participation in engineering has been helpful to determine the factors that contribute to female student recruitment into science and engineering, and to identify causes of female attrition. However, research on student experiences that contribute to the retention of females in engineering programs is scarce. Furthermore, the studies cited above do not consider the uniqueness of Mexican schools of engineering. That is they do not take into account the cultural context of Mexican higher education and Mexican schools of engineering. Education cannot be understood outside its own particular contexts. Theories on social learning argue that learning is shaped by the skills and abilities valued in a particular culture.15, 16, 17

There is currently little research on the experiences of female students in engineering programs in Mexican universities. Studies that do focus on women in engineering do so from the perspective of documenting demographic changes or outlining economic growth. For instance, Noriega’s18 study about educational polices in Mexico focuses on how globalization and the job market influence higher education institutions to improve their access to technology majors. Another study by García Guevara19 describes how women’s roles in Mexican society influence whether they will choose a particular engineering major. In addition, most studies exploring women in engineering rely on quantitative statistics about women’s participation and attrition.7, 20 While such studies are informative and important, what is missing are in-depth qualitative
explorations of retention. Given the limitations of the existing literature, there remains a need for research on female student experiences in engineering programs in Mexico. This research will focus on the experiences, competencies, and strengths of women in engineering colleges in Mexico that help them remain in their programs.

Methodology

The methodology used in this study was exploratory and descriptive with the intent to identify and describe the experiences of women engineering students in Mexico and the sources of support and strategies that helped them persist in their programs.

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”. Data were collected mainly from interviewing students individually, and secondarily by collecting observational data at selected universities. In addition, institutional documents describing the background of the students, enrollment, and attrition rates were reviewed.

The data collected in this study were analyzed using the constant comparative method. According to Strauss and Corbin, this method involves three processes or steps in data analysis. The first step involved in the process of analyzing data is called open coding and consists in the identification of units of data, defined by Merriam as “any meaningful or (potential meaningful) segment of data”. Creswell states that the process of coding data occurs during data collection, and ends up by the assignment of units of data or codes into categories. The second step in the constant comparative method is called axial coding and consists in 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. The final process of coding is called selective coding, and consists in interrelating categories, or the process of integrating and refining categories at a higher level of abstraction can include inferences, developing models, or even generating theory.

Merriam states that “research is concerned with producing valid and reliable knowledge in an ethical manner” and validity and reliability can be approached through careful attention to conceptualization, data procedures, and findings presentation. Triangulation leads to credibility by using different sources. To assess credibility, different methods to collect data for this study were used: interviews, observations, and documents. In addition, peer debriefing was used to provide an external check of the inquiry process, to discover biases, to clarify interpretations, and to discuss possible future directions. Finally, the respondents have an opportunity to review the data gathered and provide or modify the information. This member checking technique is described by Lincoln and Guba as the most important in establishing credibility.

Findings

In this section, we describe the dimensions of the Mexican culture participants identified as influencing the engineering environment. Then we describe the characteristics of the engineering
Mexican Culture

The engineering environment is situated in the patriarchal Mexican culture which has a strong influence on the student experiences of the female participants in this study. The masculine culture has been manifested in the inequalities in the education of males and females throughout history. Today in Mexico, this division is often masked as cultural expectations; stereotypes concerning the roles of women still abound.

Gender roles

The masculine culture that dominates Mexican society is visible to participants in different ways and has contributed to the culture of gender discrimination present in colleges of engineering. Participants identified gender roles as a direct manifestation of this culture, and they also discussed how their own perceptions of gender roles differ substantially from society’s. Students in this study all expect more equity and view themselves as professional engineers.

Participants described their perception of how Mexican society has conceptualized the role of women in society. They were aware of the stereotypes of gender roles and described how it is common for Mexican society to expect women to take care of the house and for men to work outside of the home; 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. [It is like] the man is for work and the woman for the house. We are used to women doing everything, the one that takes care of us, understands us, it is like a Mexican society tendency (Gaby).

Although participants in this study stated that they felt greatly supported by their families, they also reveal that their families upheld traditional, stereotypical ideas about gender roles. Participants 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 brothers’. She also stated that her family transmitted to her the perception that she could not participate in activities that were “just for men.”

Nevertheless, what is common among the students interviewed is the support they all have from their immediate families. Families played a big role in the Mexican culture as they are seen as a motivating force and a source of support. 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 themselves for a variety of reasons, including getting married and having to play the traditional role of homemaker, not having the opportunity for higher education, or not having the support of their 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
own choices, these mothers advised their daughters about life and the importance of being self-sufficient. Gaby’s quote is representative of these beliefs,

[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 (Gaby).

In contrast to their parents, the students in this study did not embrace gender stereotypes. Instead, they believed that job needed to be divided according to ability, not according to gender. Claudia and Amalia stated, for instance,

It needs to be balanced, men and women should cooperate, yes we have different capabilities and abilities, and we can make a team, like a couple or a family. I do not believe in stereotypes (Clau).

I think that it is like an organization, first the couple, you must have a balance and also teach the children the same, that balance should include everybody (Amalia).

Challenging traditional gender roles was more important for the participants when they mentioned life choices. When they refer to their future life, they talk about balancing work and family responsibility and finding the time for having and raising children. They recognized the pressure that Mexican society posed on professional women engineers. They talk about how working women are perceived and judged by Mexican society, holding 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 aspects. I think it is cultural. Whatever you do it will be wrong (according to society). If you work, they’ll say “What about her children?” and if you don’t work they will say “What a waste!” Engineering is very demanding; we will need to balance work and family (Ana).

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

Some participants discussed how the traditional, stereotypical attitudes about gender roles and expectations have affected them in the workplace. They stated for instance that they have seen jobs where only men were accepted, and they also argued that stereotypes against women help structure the job market and the job opportunities available to women. For example, some women decide to stop working to take care of their families, and this situation can hurt the job opportunities for women. Paty explained:

It is like if the companies don’t see a woman as a long term investment. It’s harder for women; men do not have other responsibilities. I want to have a family of course! But I want to work too; I will not stop working, that’s why I’m studying so hard (Paty).
Paty in this quote nicely illustrate the strength of gender stereotypes, and how women are constantly negotiating and struggling trying to go break the stereotypes.

Gender roles were seen by the participants as part of the masculine culture and they recognized that society’s perspectives are present in their families and have impacted the job market. Challenging these gender role stereotypes seems to be more difficult when the participants talked about life choices. Some participants shared their desire to raise a family and also work outside the house. Even if they see in higher education as a way to challenge these roles, they recognized engineering as very demanding and the need to balance work and family. In addition to the gender roles, the participants were aware of other cultural stereotypes that affect women students in engineering, as we describe below.

Stereotypes of women in engineering

Another manifestation of the masculine culture is the cultural stereotypes that created extra stress for women students in engineering. 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. Mexican female students in engineering also must deal with cultural stereotypes about superior ability to take care of the house and children. In addition, female students deal with the stereotype of being perceived as unfeminine and the “least attractive” students of the university.

According to participants, these cultural views of inferiority lead men to feel they have to “look after” the women who are close friends or family members. These attitudes and behaviors were present in the university setting and in the classroom, and the students in this study perceived that their male classmates tended to “protect them.” Yola’s quote represents this belief:

… also because of machismo, even if [the environment] is competitive, they [male students] tend to protect you, yes even if it is competitive, they think we are their property in this sense they support you a lot. I think this situation is everywhere [in Mexico] (Yola).

In addition, if not directly part of the Mexican culture, universities in Mexico 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 the participants of this study 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 is like if someone goes to the library, they think she is a like bookworm, and that’s when they start thinking that if you are at the library and you have a scholarship, well you are boring and also if you are boring you are not pretty. Generally pretty persons are seen as more cheerful (Paola).
To negate this stereotype the participants stressed the value of intelligence over beauty and tended to associate beauty with superficiality. A mechanical engineering student shared that for her “intelligence is more important than a pretty face” (Amalia).

Similarly, the participants talked about paying less attention to their personal look, supporting this attitude by saying that their focus is on their educational goals. For example, Ana explained

…”another joke is “if you don’t have a moustache you are not in Engineering.” Maybe we are more in our place, if you are going to school you don’t need to pay that much attention in your personal look, or maybe five more minutes of good sleep… (Ana).

The participants in this study were aware of the masculine culture present in the Mexican society and the different ways it is manifested. This masculine culture influences the engineering college environment which the participants encounter as challenging and hostile, as we describe below. Despite this, women decide to enter and engage in engineering colleges, and go against the norms. Students had a strong desire to finish college and had learned to develop confidence in their abilities. In addition, they have found in their engineering colleges, families, and society different sources of support that helped them stay in their programs.

College of Engineering Environment

Enrollment in engineering colleges in Mexico is dominated by male students. A 2004 report from ANUIES states that only 30% of the students in engineering and technology are female. It is important to mention, however, that this percentage also includes architecture and design, majors in which women participation is higher than in engineering. Different engineering programs in Mexico have different percentage of women participation. García Guevara states that the difference between enrollments in different engineering programs has a relationship with the traditional role women have in the patriarchal Mexican society. According to García Guevara’s study, some engineering programs offered options for professional development that are more accepted in the society—for example, the introduction of computers in daily life, and the wide options that industrial engineering offer for professional development, such as marketing and business of industrial products. In contrast, some other engineering programs like civil or mechanical have less female participation. According to García Guevara these programs offer a work environment which is “dirty” and is seen by the Mexican society as less suitable for women. Some of the students interviewed for this study, especially the mechanical engineering students, were the only females 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. In addition, the participants described the dual role faculty and peers play in their retention. On one hand women still faced discrimination in the college coming from faculty and peers, while in the other hand they found in faculty and peers one of the most important sources of support, as we illustrate bellow.

Academic environment
The first dimension of the challenging environment identified by the participants is academic. Students are faced with subjects that are difficult to learn and they stated that they realized early on in the program 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.\textsuperscript{9,10} It played a big role in the doubts participants experienced about their academic abilities and their sense of “belonging” to the program in their first years of college.

The rigor of the curricula in the first two years of the engineering program contributed to the uncertainty some participants experienced in this study. The high rates of attrition that are part of engineering colleges in Mexico, and the “weed out” courses, along with faculty comments, contributed to the fear and intimidation experienced by participants. In the first years, as Paola explained, the difficulty of learning the material contributed to the uncertainty the students experienced.

\ldots first at the personal level, because the major is very demanding, it takes more from you every day\ldots and each day or each step is more difficult than the last one, and there is a moment when you feel cornered or tired, and you really ask yourself if you are going to make it (Paola).

The participants in this study embrace challenge, when discussing their decision to study engineering, most participants referred to the challenge: the challenge of mastering such difficult and complex subjects, of solving practical problems, and of creating things that work. The selection of engineering major was accomplished by their self-perceived strength in difficult classes such as math and science taken in high school. Lucy explained,

\ldots In high school I enjoyed math and physics, also chemistry. I decided that what I really wanted was engineering, I wanted a major that required intellectual challenge, and I found mechanical engineering had the challenge. It does not limit you, I like to develop and create new things (Lucy).

In contrast with previous studies\textsuperscript{27} that suggest that beliefs about abilities tend to be associated with unwillingness to persist in the face of obstacles, the participants in this study believed that when encountering difficult subjects what was important was the effort they put in studying and the interest they had in the subjects. In addition, the participants agreed that abilities can be developed and learned, as they state below:

\ldots in any subject while you keep trying and if you try hard, do your homework and study for the exams [you will do fine] (Yola).

It is like with any ability, for me maybe you have not had the appropriate situation to develop it; it is not that one [person] can do it, and the other no. I think that we all can but it depends on the effort each one puts on it (Lulu).

The students in general were self-confident about their intellectual capabilities. The challenging of mastering difficult subjects gave the students a sense of pride, and most students shared that
among their best experiences were how they were able to succeed in difficult subjects. The
students stated:

All my positive experiences are about how I feel good when I passed all the tests with
good grades, especially if the classes are difficult (Liz).

Sometimes I needed to take time away from family and friends to study, but yes it was
worth it (Gaby).

It required hard work and personal effort, but at the end it’s good to know that I finish
because of my ability and my effort (Carmen).

Social environment

The second dimension of the challenging environment identified by the students is social.
Female students in engineering face an environment that is competitive, individualistic, and not
very social. The participants experienced isolation in this environment. Additionally, the
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.

Engineering faculty and people in the society 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 the
participants can be a challenge for students entering the engineering college, especially for
women who can feel isolated in this environment. The participants observed a competitive
environment and discussed how male students felt threatened by good female students. They
reflected on their experiences and expressed that male students wanted to prove themselves and
show that they were better than the female students. Lulu stated, for instance,

They [the male students] were … like always wanting to impose, like my [computer]
program is better or I’m the only one who can do this [the job] (Lulu).

Similarly, the students shared feelings of distrust coming from their male peers:

They [male students] wanted to do the “thinking part”, it was like we [female students]
won’t be able to do it right (Cristy).

They [male students] thought that we [females] don’t know how to do things, or that we are
not good for computers, even if normally our grades were better (Paola).

In this environment, the participants described how they focus on proving that they can do the
work and to show an “image of a good student” and obtain good grades in order to be trusted and
recognized by their peers. One student 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 they [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… (Paola).

In addition to competition, the participants perceived an individualistic environment where they experienced feelings of isolation. The participants stated that within the university, engineering students are perceived as isolated persons. The students discussed the low participation of engineering students in social events—even those organized by the college—and argued that engineering students are seen in the university environment as not very social. When participants compared their students’ social experiences with those of students in different majors, they perceived that social life is easier in other majors because even in school (academics), it is considered important to learn to socialize. Paola explained:

… but in other majors, it is easier simply because they manage social relations and because it is part of their job to know each other and how to interact. In contrast, we even say engineers are the ones who use the library, the “ñoños” (Paola).

This image of “ñoños” or nerds and engineering students not very social is supported by the participants’ comments about how students in engineering tend to get together more for academic reasons like for doing homework or a team project than for social interaction.

Furthermore, participants stated how the lack of time to participate in social events due to the students’ challenging course schedule contributes to the isolation students experienced in college. Paola’s comment was typical among the participants:

…well I was a little bit alone and also I was very interested in studying, and I didn’t pay attention to others (Paola).

In addition to the intense coursework, and the image of engineering students as “nerds,” the low participation of women in engineering programs contribute to the lack of social life experimented by female students in the college. Some students, as stated before, were the only females in their class, and they felt very isolated,

…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 … your [female] friend, your [female] best friend…(Georgina).

However, their experiences of isolation tended to disappear when participants found a good working team, which gave them much needed social support. The students stated, for instance,

If I had had the [academic] work team that I have now from the beginning maybe my life would have been different (Evelin).
At the beginning [of the program] I was scared, but after a while I realized that all my friends were “boys”; yes I have very good friends (Caro).

The students shared how they were able to establish good academic working teams, where they can trust each other and how even if these relationships started as academic experiences they were able to establish 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 interact not only for the work aspect, but also for personal aspects (Gaby).

Faculty

Participants’ relationships with professors varied; some professors were very supportive and encouraging and helped participants broaden their engineering views, while many participants reported bad experiences with professors, especially during their first years.

Participants recognized the derogatory way some professors interacted with them, which took on specific characteristics when directed at female students. Some students reported that some faculty members insulted and humiliated students who asked questions during class. Some of the insults were directed towards the whole class (male and female students), like a professor who told the students that “they were the worst he had ever seen” (Evelin), or a professor who stated that students were “garbage” (Paola). However, in some cases the insults were directed specifically toward female students. Participants perceived that faculty had biased attitudes against women. For example a participant shared that when she went to see a professor after class for tutoring with her female friends, the professor expression was “oh! Here they come, the do not understand anything” ![Ay! Ya vinieron, las no entienden nada](Ilian). This expression, as stated in Spanish, “las no entienden nada” associates the lack understanding of the subject with only female students.

Another dimension of hostility experienced by participants is how they felt ignored or discounted by professors in their engineering classes. This form of discrimination was clearly identified by the female students interviewed. For instance, Georgina explained how in a class where participation was part of the final grade, when women try to participate in the class the professor tended to ignore them:

…There was a rejection, an excuse, the excuse was “I don’t ask you because of respect”, “you do not pass to the blackboard because of respect”, and you said I want to participate; I am like them [male students]. I know, I have studied, but there was always an excuse. I saw that as a form of discrimination (Georgina).

This professor’s attitude toward women is based on cultural values where woman should not be exposed or should be treated differently than men. This exclusion is seen by the participants as a form of covert discrimination.
One of the ways that women worked against various forms of discrimination was to see them as obstacles to overcome. Once again, as with the challenges, participants shared how they were able to prove to themselves and to faculty that they could succeed in engineering. For example, Evelin revealed that she stayed in the program because she wanted to demonstrate that “Ah! Girls can do many things”.

In the other hand, professors, congruent with the literature, are identified by the students as the most influential group in the university that affects retention. More specifically, faculty attitudes and behaviors affect retention, as faculty can contribute to student retention by being supportive of student’s needs, being approachable and responding to students in a timely manner.

As students advanced in their programs, they were socialized in the elitism of engineering. Participants experienced a shift in their student experiences and their relationships with professors because of their perseverance. Upper class students felt recognized by their professors, and the participants agreed that the professors perceived them as capable, good students, and responsible. This change in perception gave confidence to students, as they explained:

…as I entered directly to the major [upper class], that is to move from the Annex to the Principal [building], it was different, the professors recognized that we [women] were good students --it was a change in mentality (Georgina).

It was great, great! Also now with my project with Dr. G, Dr. S., and Dr. O. is among the best experiences I have had. They are persons that motivate students a lot (Paola).

Good experiences with professors include good teaching and caring for students, participation in research and projects, and friendship. Although in some cases they had students as teaching assistants, they all recognized that most of their professors liked to teach and showed interest in the students’ learning. One participant shared that she enjoyed the way professors had taught her, and how they were able to explain the difficult subjects; this student wants to be a professor.

Peers

Similar to faculty relationships, participants cited peer relationship as a factor that was strongly related to their retention. On one hand, participants described situations where hostility came from male students and on the other hand they cited the importance of their classmates’ support in their decision to stay.

The participants relayed comments their male peers made about women in engineering and about their perception that women have less ability in math than men. These comments were seen by male students as jokes, but for female students were taken as derogatory. For instance, Paty explained

Once a female friend asked a question and a (male) student joked “of course, how will you be able to understand?”, then he said “it was a joke”. No, it wasn’t a joke (Paty).
In this environment female students felt intimidated and did not feel confident asking questions in class.

Similarly, the image of lack of ability and distrust was covered up with a sense of protection. The participants perceived that male students’ attitudes shown as caring and protective sometimes covered attitudes of distrust or beliefs that female students are not capable or will not do the activities properly.

Well, because sometimes I think that yes, we needed to lift things or handle toxic substances in the chemistry lab, [it was] like they [male peers] didn’t want it “we will do it”, maybe because, well I don’t think so, well some of them because they thought we will do something wrong (Yola).

Participants commented that since they spent a lot of time with their male peers, they needed to adapt and make changes in their life styles. In order to fit in, female students even learned to play card games and soccer, activities popular among the male students in engineering. Caro’s experience was typical among the participants,

In engineering, well it is more common to have male friends, a lot of male friends, then your activities change, even the way you speak, and the things you get used to are different, it is all about, not to do what men do, but there is not much for girls (Caro).

I don’t know with my friends… well many times they like to go I don’t know to a bar or to the movies, but very few times, they like [more] to go to see wrestling… If we were more female friends I don’t think we were going [to those places] (Yola).

The female students’ perceptions of their peers changed over time, and the environment began to feel less hostile. The interviewees cited the importance of peer support in their decision to stay, and how they have been able to establish good friendships, and they commented how the best experiences of their student lives included their relationship with their classmates.

The students learned to integrate more with their classmates and establish good friendships.

[Relationships with male students] turn out to be more casual, you are with them all the time, it is like you only are with them [male students] (Olivia).

With my classmates and other engineering students, yes I have good friendship; yes there is friendship and respect (Liz).

Gender roles tend to change over time, the experiences of distrust tend to end, and the roles of female students undergo change. As the students advance in the programs, female students tend to take position of leadership. A student shared how in her work team she is called “the boss” because of the role she plays:

I don’t know if it is my ability but I know how to tell them what to do, “you are going to do this, you that”, and they joke “the boss, the boss” [“la jefa, la jefa”], but finally they
did what I told them, and they let me organize, that’s what had happened and I like it (Claudia).

Pride of success

The participants in this study gained a sense of pride and satisfaction for being able to persist in their majors. These feelings encourage young women to keep going, keep focus and have confidence in doing what they want to. Engineering is not easy, but they recognize the need to take time away from family, friends and social life in order to be successful in their programs, and that is part of the pride they have in finishing college. In addition, they have proved to themselves and to others that they can succeed in engineering. The students commented:

…at the end, you are going to have the satisfaction to say “I made it” (Ilian).

Yes, … I feel good, not only because you are capable, you aren’t a genius or anything but you know you are capable and other girls … it’s not that they can’t but it is like they don’t dare to do it (Amalia).

The participants’ perceptions of being a student in engineering changed during the time they spent in college. At the beginning the students perceived two major challenges: the academic environment, and the fact that they need to live with mostly male students.

With time I learned to live with them [male students], it turned to be like studying any other thing, except it is lonelier” (Olivia).

The participants were self-confident in their abilities and they shared that they believed that “they can do anything” (Clau). Furthermore, the college experience broadened the students’ initial perceptions of engineering. The students are now aware of the many possibilities engineering has to offer.

I didn’t know that many magic things could be done… (Amalia).

…when I saw a highway I thought of all the work behind it, you learn to see things from many different perspectives (Evelin).

All interviewees agreed how self-esteem had played a big role in their success. They found strength in themselves, even within a hostile environment. The students felt that the struggles of being a woman in an engineering college environment had served to make them stronger. The interviewees enjoy their major, and all of them would decide, if they had the chance, for engineering again.

Absolutely, I’ll choose engineering again. No other option seems more appropriate right now (María).

Yes, I’ll choose engineering again, any engineering. I like my major very much; yes I’ll pick the same (Ana).
I have learned a lot, the idea of yourself takes force, you have self-esteem, and you are proud of yourself (Lucy).

**Discussion/Conclusion**

In Mexico, women continue to be underrepresented in engineering programs. This paper describes the experiences of female engineering students that decided to stay in their programs, and the sources of support and strategies they perceive as helpful for their retention. Mexican engineering women students face significant cultural stereotypes and the participants in this study developed strategies to overcome them. The results of this study show the complexity of gender relations in engineering colleges. Mexican society holds stereotypical views of females, seeing their role as mothers and caregivers, and as having low ability for math and science. The women in this study confronted these broader cultural stereotypes but also more specific stereotypes of women engineering students, where they are viewed as less capable and less attractive. It is noteworthy that the participants in this study came to value hard work over natural ability, intelligence over beauty, and as they progressed in their programs they gained confidence in their abilities to succeed in their programs.

In addition, the participants described the academic and social challenges they experienced in the college. The participants of this study enjoy challenge and they see obstacles as challenges to overcome. Relationships with faculty and peers have two sides, in one hand the participants experimented gender discrimination coming form some peers and some faculty, in the other hand professors and peers are identified by the participants as very important for their retention.

Finally, I described the fact that the female student’s persistence in their programs gives them a sense of pride that is shared by their families, peers, and professors. Success in engineering as perceived by the participants is dependent of a variety of factors, the participants of this study described a journey where character, interest, and engagement is required. The pride experienced by these students for persisting in the college reinforces the elitist culture of engineering.

The experiences of these students offer engineering colleges challenges and opportunities. Retention of female engineering students is important for all engineering colleges, but cultural factors must be taken into consideration. The dominance of machismo attitudes and values in Mexican culture present specific challenges to achieve an environment more supportive of women in Mexican engineering colleges. This study gives us important insights into how this might be achieved. The women in this study were ready to take the challenge and they show a passion for engineering. 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.

**Bibliography**
