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Identification, and the Crucial Role of Key Factors
that Affect Women's Interest in Computer Science -
A Qualitative Study of Women From Sweden,
Mexico and India

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Identification, and the Crucial Role of Key Factors that Affect Women's Interest in Computer Science – A Qualitative Study of Women From Sweden, Mexico and India

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Abstract— Women are underrepresented in the field of Computer Science (CS) in both higher education and industry. In this study we investigate which factors motivate and demotivate women to commence CS education and pursue a career in the IT industry. Furthermore,, our study aims to identify cultural factors comparing the key factors between three different countries Sweden, Mexico, and India. We applied a qualitative research approach and interviewed twelve women from these countries in total. To analyse the data, we applied a deductive thematic analysis combined with an inductive process. The findings describe female participants' experiences, and how many of the factors described have a foundation in gender culture that are encountered from an early age. This study illustrates how successful female students and professionals in CS experienced the gender culture and how they challenged the demotivating factors they encountered, and utilized the motivating factors. The main factors that motivated the participants were great interest and enthusiasm, a strong self-esteem, a stubborn attitude, and feeling passionate about science and technology. The main factors that demotivate the participants were gender prejudices and discouragement.

*Index Terms—*Women, computer science, motivation, demotivation, gender culture, India, Mexico, Sweden.

I. Introduction

There are studies over the past two decades that refer to the gender gap in CS field [1]. Statistics shows that this instability in gender affects both academic and industry careers [2] (see *Appendix A*). The fact that the female participation in CS programs has been decreasing contributes even further to the existing underrepresentation for women in the CS field. According to Galpin [3], this phenomenon is recognized worldwide. Additionally, the women's underrepresentation in CS evolves as an issue, since women are not equally employed and paid; hence, leading women to leaving the CS field [4]. Sadly, these factors affect the opportunities of future female talents and also affect the current computer science professionals.

It seems that there is a common characteristic that probably applies to most countries like in Sweden, Mexico, and India; that being a border between male and female defined by gender cultures [6]. Therefore, it would be reasonable to assume that cultural factors such as parental encouragement, self-confidence, lack of ability, gender bias of CS, lack of female role models, negative feelings of self-efficacy, lack of access to computers and negative attitudes towards computers play a vital role in encouraging or discouraging women from entering the field of CS. Besides, these cultural factors could define female's career development path in CS in these three countries.

This study aims to investigate what motivates and demotivates women to commence CS education and start working in the industry, and to compare underlying cultural factors for it between Sweden, Mexico, and India.

II. Related Work

According to Wajeman [7], CS education is perceived as masculine both by men and women in most countries, which affects women in their academic performance and also when joining the CS workforces. Beyer [8] mentions two reasons for the small number of women in CS education: negative perception of the CS field and low confidence in their abilities in the field. Studies conducted in India show a small ratio of women in CS education [9]. The main reason for this is the social cultural differences, which prevents women from studying CS. The Indian society is built upon caste system, which deprives women of their basic rights such as education. However, Indian women from influential families have access to computers, Internet as well as education. Similar pattern is also seen in Mexico, where female students have limited CS academic access and job opportunities. These actions prevent women from entering into colleges and universities; female students suffer prejudices such as lack of intellectual acceptance, and sadly, the experience of non-financial support [10]. Unfortunately, the higher-level education is still a privilege for a few in Mexico. On the other hand, Sweden has worked and continuously is working very hard for gender equality, where the policies ensure that women and men enjoy the same rights, obligations and opportunities in every area of life [11]. Meaning that according to Swedish equality policies, the access to a high-level education is available for everyone in Sweden as well as gender equality in jobs [12][13]. Despite these efforts, the problem still exists in Sweden. For instance, Schinzel [5] points out in her article that women from Scandinavian countries experience a low self-esteem referring to CS, and also, they acknowledge themselves not very capable and they "consider computing as pressing buttons".

Due to being multidisciplinary in nature, the issue of women's presence in CS has received research attention from various universities across the country [14]. The research efforts in the related area can be summarized as efforts to identify the misperception about women's abilities in CS [15][16]. Women feel less confident while studying CS because their male peer students do not take them seriously. This leads to demotivation and in time it slides downward.

Dennis, Kinney, and Yu-Ting [17] state the importance of analysing female "intrinsic interest" in CS in their article. Seymour and Hewitt [18] also mentioned in their multi-disciplinary study of female students leaving CS major. They conclude that the intrinsic interest in the subject was the main factor in helping female students to persist when facing the various obstacles such as poor teaching, lack of support and also a cold climate between the students and teacher. The importance of intrinsic interest affects female students' interest and enthusiasm in CS [18]. Meaning that the lack of computer experience contributed to the lack of interest in choosing CS [18].

Duncan & Zeng's [19] research, shows relevant motivational factors that are frequently involved in

encouraging or discouraging women: “Faculty support, class environment, department environment, attraction to another discipline, parental encouragement and self-confidence”. According to Galloway [20], the lack of diversity in CS education keeps back engineering professionals from reaching their full potential.

A. Gender Culture in India, Mexico and Sweden India Overview

India is a very rich nation full of diverse cultures and traditions. It is composed of three main racial groups Indo Aryan, Dravidian and Mongolian. Hindu, Islam, Christianity and Sikh are the four prominent religion communities in India, which create this richness and traditional complexity in the country. For the majority who live in India, religion permeates every aspect of life, from daily routine chores to education and politics. In Hindu religion the social structure is built on the caste system, which has been in practice for more than 2000 year ago. Hindu caste system is conformed by Brahmins, which consider themselves as the highest class; intellectuals of the nations such as priest and scholars. Kshatriyas class, which follows after Brahmins are mostly rulers and warriors, they manage the military service and administration. Vaishya class is found among traders, shopkeeper and moneylender. Shudra is the lowest class and integrate labourer, craft-worker, servants, and slaves [21].

The first three of these are considered “the upward caste” while the fourth one is considered as “backwards caste”. There is a degree of backwardness within the Shudra caste because traditionally the Shudras are considered as “untouchable”. Meaning that they were prevented from seeking basic education, and even though it has been banned from the government, it is still in practice in villages. A low caste woman may not draw water from the same well as the others; eat, drink or take food from the hand of the upper caste; nor can they marry into an upper caste family. In the Indian caste system, women are still the ones who suffer the lack of opportunities, which are limited even further. According to Sahni, “one can go no lower in the social order than to be a lower caste, poor, rural and female” [21]. Throughout India, girls are less likely than boys to complete basic schooling. World child report shows that the third lowest rate of secondary school enrolment for girls is recorded in India.

The Indian caste system also influences women’s decision making, as most of the gender norms are broadly enforced culturally and institutionally towards women. This is also within the household where the children first learn about the gender roles between male and female. They are learning to equate maleness with power and authority and femaleness with inferiority and subservience. Boys learn how to exercise their authority over the girls, whereas the girls learn to submit. Consequently, this leads to gender roles, which also entail to learning how to perform the behaviours that are consistent to one’s gender. Moreover, both males and females are held to account for that performance. There are social sanctions, stipulating a woman’s behaviour and the men decides and

follow-up so that women are not deviating from what is expected for their gender [22].

In India, the household is the primary site where the Indian male has the privilege and they try to take control over women’s expression. Also, the society expects girls to marry within the same caste system. The daughter’s are often proven to be financially burdensome for most of the families, as they must give a large amount of dowry (money or property brought by a woman to her husband at marriage) to the husband’s family. Additionally, it is also important to verify the women chastity, which it is called “izzat”. It is believed that a girl’s education can endangered the family reputation and her marriageability, where the schooling require going “outside the family” into the male world of public space. It is also believed that CS and Engineering exacerbates a threat, because this education will spoil a girl’s character [23], which lead to a critical step in the marriage process.

The parents of the girls are very strict and they try to control over their daughter’s well being such as where she goes and what she wants to do. Due to this reasons the girl’s parents arrange an early marriage for their daughters and in many cases girls are often stopped from continuing with their studies.

According to Ghose [24], gender-based discrimination and exploitation including “dowry death, high level of female illiteracy and morbidity” are widespread in different states of India. As a consequence of Indian women’s low status, the education for daughters within a family is not always given the same emphasis as a son’s education. In the Indian family, sons are valued for the status and wealth. They will eventually contribute to the family’s economy and likely will take care of their parents in their old age whereas the daughters are temporary members of their own family, since their roles are to be wives and daughter-in-laws. Ghose [24] indicates that the relationship between the low literacy rates, high fertility level and women’s low status give a contradictory emphasis to the women’s empowerment. From a very young age the Indian girls are indoctrinated by telling them that their proper place is at home, fulfilling the domestic chore and taking care of their father and brother needs, whereas the boys learn that they are superior over the women and they exercise this kind of authority [25]. Furthermore, the Indian women also face hindrance by patriarchy system where the men embrace the male dominance within the family; this type of system is not particularly of Hinduism but also seen in different religions in India. Men enforce a superior right, privileges, authority, power and their influence is very strong in India. According to Basu [26], the Indian tradition dictates that a woman is a subject to her father while she is unmarried and later becomes a subject to her husband after marriage, and later a subject to her sons if she is a widow. The family lineage is passed through the sons who have specific ceremonial roles including funeral rites for the parents where women cannot participate. All the properties are vested in, exercised and transferred through the patrilineal descent [27]. According to Gupta and

Das [25], the parents have strong preference for male children due to their dominant value over daughters in India. Because of this fact, the sex-selective abortion of female fetuses or female foeticide (practice in which an unborn baby is aborted or killed before birth simply because it is not a boy) has become increasingly common and excess female mortality among children under 5 years old and is seen in all parts of the country [25]. Despite being banned by the Indian government they turn blind eyes and continue practicing sex-selective abortion. Unfortunately, the official numbers do not reflect the reality of the situation that India is living [28]. In a recent study conducted by Huyer & Halfkin [29] shows that the number of women in India enrolled in engineering, physics and CS are on the decline because of the low rate of females in higher education. The representation of females in software and electronics workforce is 12.5% and corresponds to the number of female researchers in all disciplines (physics, chemistry, software and electronics).

Mexico Overview

Mexicans extol the value that the family represents and its hierarchy and structure within the family matters. It is very common to find the traditional extended family structure in Mexico where the family units are usually large. As for gender culture in Mexico, it is important to refer the phenomena of *machismo*, which is defined as everything that is not feminine [30], and also the phenomena of *marianismo*, which is described by Lara-Cantu [31] as the syndrome of “self-sacrificed-women”. *Machismo* is a cultural attitude that is commonly adopted by men in Mexican society where being born male is a high prestige rather than being born a female [32]. According to Pigeon [32], *machismo* is a series of attitudes that allows a man to overly assert his presence on women but also among other men. *Machismo* means also to take care of the family and working hard for money to support the family. On the other hand, the woman is raised to think that one day she will marry a man who will be the head of the family and she and her family will obey him [32][31]. Lara-Cantu [31] characterizes *marianismo* by keeping women’s attitudes as dependent, submissive and passive. Within the family member’s settings, both the father and the mother possess equal importance, however, it is given more authority to the husband, while the woman is expected to make ultimate sacrifices for the family and not being recognized by her functions and abilities. Moreover, her role is minimized [33]. Schmitz and Diefenthaler [33] point out that among those sacrifices; women encompass education, career and social life outside the family while they take care of their own family.

Mexico has been affected by the economical and social changes in the past decades such as industrial, educational, technological, scientific, etc. Those changes have been reflected in the family’s central roles, its structure and the women’s role [34]. Herrera and DelCampo [35] mention how the women’s pattern has been influenced by those changes such as education, work and within the family. Some of those changes include the participation of both married and non-

married women in the work forces, their presence in higher educations creating post-educational professional opportunities as a result financial gains for the family. Merritt [36] says that most women who seek to be involved in technology and science need to overcome not only professional hurdles, but also personal and social obstacles.

Etzkowitz and Kemelgor [37] explain the importance of the traditional extended Mexican family for providing support to women involved in science and technology. Even though, higher paying positions in industry and high-paying fields such as CS are still designed for men [38]. Nowadays, the gender differences in Mexico are evident when women attain senior or managerial positions within CS industry, but men are still usually in charge. Moreover, women face another type of discrimination, which according to Etzkowitz and Kemelgor [37], is the discrimination produced by the particular nature that a woman in CS education and / or career shows. To be taken seriously as a potential professional in the CS field, women are forced to demonstrate a higher level of knowledge and abilities than the male analogues. Additionally, in many cases, women in Mexico are excluded from educations such as CS because of poverty, political and cultural environments [36]. In the same way, Garcia and Gonzalez [10] state in their paper how the role that the higher education has played throughout history in Mexico where it has impeding women from achieving equal status in society. Despite this, women have gained access to universities and to educations such as CS, although these areas are men dominated. However, women still have to go through the latent prejudices such as lack of intellectual acceptance and the experience of the lack of financial support [10]. This is because most of the times, the father is the breadwinner of the family and the breadwinner must evaluate if it is possible or not to pay the university’s fees. Since female students are economically dependent on the breadwinner, the financial support plays an important role for the girls’ academic educational future.

Sweden Overview

According to Daun [39] in his book *Swedish Mentality*, Sweden is a country conformed by several different cultures, and he emphasizes that anyone who is looking for Swedish culture will find a multicultural Sweden. Due to these characteristics, Daun points out different kinds of cultures such as professional cultures, youth cultures, minorities’ cultures and social cultures. Swedish society has been transforming and changing and Nordstrom [40] states in his book how Sweden is a country which leads the ongoing process of freeing individuals to live their lives as they choose. Despite the progress that women have made in many aspects of Swedish life, the fight for true gender equality continues [40]. Similarly, Juntti-Henriksson perceptively states that the concept of ‘gender equality’ has a long story in Sweden, as well as equity between men and women at work. Meaning that while women have been encouraged to take place in the workforces, men have been encouraged to take equal responsibility for childcare and homemaking [41].

Swedish society has been working on acknowledging that both men and women should participate in both economy and care. Sweden counts on gender equality policies, which fundamentally encourage each individual to achieve economic independence through a lucrative job. An individual, no matter the gender, should be able to combine work with parenthood. These advances in gender equality give the opportunities to both women and men to have a balance in equal responsibilities; specifically those that refer to economical family support, housework and child care [41].

While Sweden has earned the reputation as a pioneer in pursuing in the gender equality area, there is still a long way to go before Sweden achieves gender equality in CS education and industry [42]. In fact, in Sweden, the field of CS is still dominated by men and the number of women admitted in CS programs in universities is quite low [42]. In accordance to this, Nordstrom says that about one fifth of all system designers and computer programmers are women and only a fourth of it are employed in the CS industry [40].

Brandell et al. [43], state that it is mainly the masculine culture surrounding computers that causes a 180-degree turn away from studying CS topics for many girls. On the one hand, their study indicates that women are suited to careers as mathematicians or computer scientists. On the other hand, women must fight back towards the traditional mentality regarding CS where women are seen as having less skill than men such as determination, dedication, competitiveness, perseverance, independence, domination, objectivity, assertiveness, ambition, charisma and authority [44]. Moreover, women are perceived as “soft leadership”, a “maternal management” and “women-friendly practices” [44].

B. Motivational and / or Demotivational Factors

Recent researches have identified several key social and structural factors that influence girls’ participation in CS. Often deterring them from choosing future education or career in CS field and CS education [45]. The following model (*Diagram 1*) portrays key factors, which could create at least one motivational or demotivational factor on women's perceptions. These factors influence women’s interests, confidence and career decisions.

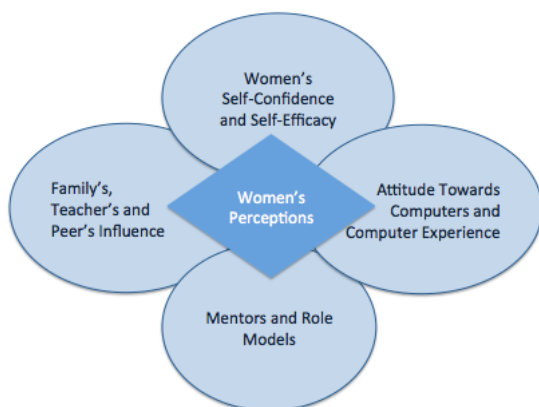


Diagram 1. Motivational and Demotivational Factors

A growing body of educational research papers has documented factors that influence female attitudes, perceptions, and behaviour toward computers. Also, when females reach adolescence, they often begin to attach their career interest to role models and many of those adolescents choose to pursue occupation other than technology, because they are unable to relate their everyday interest in computers into IT career [46]. Another factor is the lack of interest in pursuing a CS degree, which could be related to the typical perception towards female computer scientist [47]. Even though some of the female adolescents spend more than 16 hours in front of the computer each week, many of them express negative views about programming and have a general version about CS [48]. Also, computing career is often perceived as involving little human contact where the keyboard work creates a boundary in creativity. According to Gilbert [49], these kinds of jobs are often unattractive to the girls. In addition, some of the factors that create a positive influence for a woman could dampen other women’s enthusiasm and self-efficacy regarding math and science. For instance, if someone says to a woman “women are not logical, that’s why you cannot code”, this sentence could be considered as a motivation for continue studying CS. On the other hand, the same phrase could be taken as a huge demotivation for someone else; making her not even gives it a try.

Family, teachers and peer support

There is a phase that says that education starts at home, meaning that parents teach their children how to act as a girl or boy [50]. It is here where most of the girls are exposed to face gender bias; finding obstacles that most of the times if not always are coming from the parents. Moreover, this bias is to provide more support for their male kids [51]. On the other hand, it is very likely that talented girls in technology and science lose interest in pursuing a CS education. Güner & Camp [52] explain the importance of the mother’s role in the daughter’s perception towards technology. For example, “if a technically challenged mother presents herself with a fearless attitude when manipulating computers and other technical devices, her daughter will mimic that same attitude”.

Moreover, female student encounter another hardship in the classroom where the teacher who do not make an effort to provide a gender neutral atmosphere actually end up promoting a male-oriented domain [53], and in addition to the problem the instructor from both sex tends to devote more time to their male students [54]. This automatically leads to the process of creating a male-dominated environment that female students have to overcome [52]. In general, young girls lack self-esteem and without self-confidence so it is almost impossible to break new ground and experience new things [52]. Therefore, it is crucial for teachers and parents to take every chance available to recognize girls for their accomplishment encouraging them to take risks and accept new challenges.

Computer experience and attitude towards computers

Mounfield & Tyler [55] states that those women entering into CS programs at the university with lower levels of experience compared to their male counterparts. The lack of computing experience and skills is one of the reasons that lead women not to choose CS major. While a person who gains more experience with a computer raises her confidence level [52]. A positive attitude towards CS may increase the possibilities to succeed.

Mentoring and Role Models

The research shows that mentoring programs help in recruiting and keeping the retention rate of women in CS and increase the number of women joining the CS majors [56]. Papastergiou [57] also states that female role models give a great contribution to the CS education and the IT industry. For example, bringing women professionals in IT as a guest speaker to the CS classroom would help girls to challenge the misconception view towards CS such as being “nerdy” or “geeky” [57]. Female role models are important influence for girls when taking decisions to pursue a CS education.

Self-confidence and self-efficacy

Self-confidence and self-efficacy are important in CS education and industry. These feelings can influence dramatically whether women attempt and keep going with the CS education and start a career within the IT industry [52]. The effects of a low or a high self-confidence level is reflected on the performance and the accomplishment of assignments and projects, also, affects the capacity for observing and learning from others; finally, a balance self-confidence let freedom from anxiety, which increase the self-efficacy [19][52].

III. Research Strategy

The main objective of this study is to identify the factors that motivate and demotivate a woman to commence a CS education and pursue a career within the IT industry. In order to investigate the women’s interest in CS, the following research questions were defined:

- **RQ1:** Which factors motivate women to enter a CS education and industry career?
- **RQ2:** Which factors prevent women from selecting a CS education and their future industry career?
- **RQ3:** What are the main similarities and differences of the gender culture comparing Sweden, India and Mexico?

A. Planning and Design

The method applied for gathering data was by conducting semi-structured interviews, which is one of the most common methods used in qualitative research [58]. According to Creswell, when information is gathered by talking directly to people, observing their behaviours and reactions, a rich and detailed data gets generated [59]. Hence, we also applied more techniques when conducting interviews, such as “Probing” [60]. These techniques, according to Russell, stimulate the

interviewer to produce more information, for example, by applying the “Uh-huh” probe, the “Long Question” probe or “Tell-Me-More” probe [60]. The techniques could not only lead to obtaining longer and more informative answers but can be also used to generate follow-up questions.

The design of the interview questions was done to cover the following areas (*see Appendix B for details*):

- a) Motivational and demotivational factors for studying CS.
- b) Motivational and demotivational factors for pursuing a career within IT industry.
- c) The influence of gender culture role when taking decision for an education or career.

B. Data Collection

This study intends to capture different experiences and perceptions of women from Sweden, Mexico and India. In order to gather detailed data, we used semi-structured interviews with open questions. This method gives interviewees the opportunities to answer the questions freely and at the same time gathering the information efficiently that goes into the depth of our research [58][59].

For the data collection, we interviewed two women from each country who study a CS bachelor program in their own homeland and another two IT professionals who work in IT industry. The six female students selected for this study were at least in their third year of CS education, which gave us the evidence that they have decided to stay in the education. The criteria applied for the participants in the IT industry was first that the female professionals were finished with the CS education and should have been in the IT industry for at least two years. In total, we interviewed twelve women in this study; detailed information is provided in Table 1 (*see Appendix C*). We recorded each of the interviews with permission from the interviewees. The data was collected during a period of three weeks. Each one of the interviews took approximately between 35 to 45 minutes and they all were conducted in English. Afterwards, the interviews were transcribed and analysed.

C. Data Analysis

To answer our research questions we decided to use a combined technique of deductive and inductive approaches for analysing the data. Both approaches are systematic processes for analysing qualitative data.

First and based on our research questions we developed framework [61], which helped us to organize the main key themes namely motivation and demotivation. The framework was used as a data management tool where we organized and placed the raw data according to the key themes. This kind of first approach is called deductive [61].

After designed the framework and considering the key themes, we use the inductive approach where its main purpose is to allow the research findings to arise from a frequency, dominant or significant themes in the raw data. Strauss & Corbin [62] point out that the inductive approach is evident in

several types of qualitative data analysis; especially the grounded theory. Creswell [63] defines grounded theory design as a systematic and qualitative procedure, which is used to generate a theory to explain at a broad conceptual level, whether it is an action, a process or an interaction about an essential topic.

In addition, inductive approaches are designed to aid an understanding of the meaning in complex data through the development of themes from the raw data [62]. After transcribing the interviews, the transcripts were read several times. During this process we were able to identify segments of text from the raw data and located them according to the key themes. Also, there were identified subthemes, which helped us to sort in a more intelligent way the data. We also gave a particular code to each of the key themes to be used in more detail during the qualitative data analysis [64].

Overview of the inductive process

Emerging subthemes were developed from studying the transcripts several times. The multiple readings and interpretations let us to identify the data that belonged under the key themes, leading us to identify subthemes for each of the key themes. The raw data was marked with a series of codes, which was extracted from the text. The relevant data was associated with the key themes; labelled applying the same colour. This process helped us to develop the subthemes for each of the key themes. The subthemes were conceptualized as relevant data after further discussions. The organization of the themes and subthemes is:

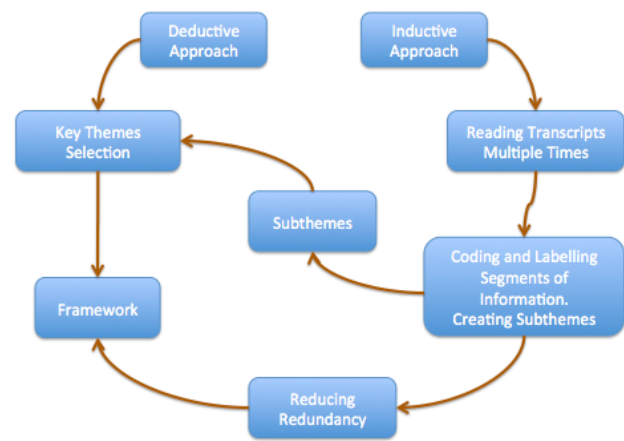


Diagram 2. The process of analysis and coding in the deductive and inductive approaches.

IV. Validity Threats

Although, we tried to conduct a bias free study, there are several types of threats that could affect the quality of our study. Depending on the design of a qualitative research study, the validity threat can be misinterpretation, observation or experiment description, and manipulated data [59]. For example in our case, we could misinterpret vocabulary or meaning of the sentence in transcriptions of our data from the interview, which could lead to our findings, would be bias. Maxwell [65] identifies five threats, which are Descriptive validity, Interpretation validity, Research Bias, Theory validity and Reactivity validity.

Lewin's in his action research method [66], points out that it should be a relationship between the interviewer and interviewee in order to be able to reinforce the validity of a qualitative study. For instance, when we conducted the interviews, we focused on being consistent while asking the questions. Thus, it reinforced the quality of our study. At the same time, we were aware of the validity threats that could affect the quality of our research. To avoid any possible threats, we considered possessing a bias free objective, which means that we interfered as less as possible during the interview session. In addition, we avoided bias question that would give us bias free results, in the end. Also, we considered that the interviewer could affect the interviewees' answers and they may not feel comfortable in sharing and describing their own experiences about education and workplaces. So, it was important that we conducted the interviews in a natural setting; avoid collecting data in a designated matter because this could affect our findings and lead to biased results [59].

It is very important that the researcher is fully aware of all these possible factors while analysing the result, so that these factors have to be taken under consideration while drawing into the conclusions. Besides the topic of our qualitative study could be sensitive to the companies of interest since six professionals work in those companies and they do not desire any negative exposure that could tarnish the company's

Motivation	Demotivation
A. Interest	D. Discouragement
B. Encouragement	E. Gender Prejudice
C. Role Model	

For example, the word "encouragement" was labelled under the key theme "Motivation" as a "Encouragement" subtheme, and coded with the yellow colour. Furthermore, we made a selection of the relevant data where we reduce the overlapping and redundancy among the themes and subthemes.

We found links or relationships within the subthemes. These common meanings in the data let us to document the relationships between the themes within the different countries. Links are likely to be based on commonalities in meanings between subthemes. Finally, we used the framework to create an embedded network where all the themes and subthemes were located and organized. This facilitated the identification of any connection in between the themes.

Process of analysis and coding are illustrated in Diagram 2.

reputation. To prevent this kind of bias we tried to formulate bias free questions and kept the companies and the interviewees confidential and unidentifiable.

Descriptive validity - We had twelve interviewees, six students study CS and six others work as professionals in CS industry. In agreement with our interviewees, we recorded all the interviews and we ensured them that the collected data would be treated confidential. By doing so we made them feel more comfortable so we could receive more answers free from bias. The recording helped us to ensure that our findings were documented correctly and it helped us to avoid missing out relevant data and to remember the interview process clearly, which would help us when analysing our data.

Interpretation threat - During this process we have tried to effectively interpret the real context that was given from the interviews, we have interviewed the interviewee in separate occasion. The primary threat in a quality study is misunderstanding and misinterpreting. To avoid these kinds of threats, we tried to formulate our interview question open-ended. This would allow the interviewee to elaborate on the responds and we had to keep a neutral position. However, there is also a risk that the interviewee misunderstands or misinterprets the interviewer. Our strategy was to be as neutral as possible and we tried not to pose leading the questions, which could affect our data from the interview.

Researcher bias - Possible bias could be during the process of asking different questions to different individuals, mixing our own point of view by asking leading questions and rephrasing the interviewee response, which could influence our findings and our results. Hence, both researchers took part during the interview session to ensure that the interview process was on the right track and also each researcher double-checked the record with the transcript to confirm the data.

Theory Validity - As a researcher, we strictly restrained our personal perception, expectation and judgment from our study and were impartial and observant to the data, regardless of the data being contradictory to our personal expectations, and therefore we avoided the possible bias by rephrasing the questions.

Reactivity validity - The reactivity validity gives the impact of the researcher presence that can influence the interviewee response. We tried to avoid too much communication with the interviewees because we wanted to avoid influencing the environment or unintentionally misleading the interviewees, which could give a biased research outcome. In order to minimize this threat, we implemented the interview questions as a guideline helping us to keep the interview session in focus and in control trying to keep the interview on the right track. English was not native language for any of the interviewees but they could understand and converse fluently. We tried to avoid as much bias and threat as possible in order to improve

the quality of our study and tried to provide exact and fair result.

V. Results

Under this section, we present our findings based on the key themes that guided the data analysis process so called motivation and demotivation together with gender culture. Under each key theme, we present the subthemes identified from the data. We also present the similarities and differences found between the gender cultures comparing India, Mexico, and Sweden to each other.

Motivation

A. Interest

Motivation is one of the driving forces helping most of the women to study CS and to build a career within the industry. The outcomes showed the positive effect that creates reinforcement towards CS with the help of family, teachers and peers, which is a positive influence to young women and also the importance of having role models.

When the question was asked whether they could talk about the factors that motivate them entering to a CS education, most of the interviewees had the same answer. According to them, it was the interest and curiosity that pulled their attention into CS. For example, the participant I4 had the intrinsic interest to study CS, since her childhood and said that “*I was interested in logical thinking and I always liked CS education. That is why I choose CS major.*” Also participant I3 has been interested in coding (programming) and stated that “*I work in the CS field which I really enjoy and it keeps me happy and I do not think that I will leave the industry*”

M1 and M2 commented their great interest towards computers from the beginning. Both of them did a previous research about educations that they could pursue; M1 got interested in CS and Management while M2 got into Engineering of CS saying “*from the beginning CS was something very interesting for me. Something that I thought it was super creative*”. S1 stated “*I’ve been very interested in computers my whole life*”, her curiosity started when she used to help her father in fixing his computer and learning how to use it when he was working with it but this interest grew further more because of her own enthusiasm and passion for computer games. At a very early age, her motivation and skills drove her for experimenting and installing her own software. Moreover, her interest that was grown from pure curiosity took her as a result into the computer’s game industry. On the other hand, the reason behind S2 motivation for getting into the CS program was the broad information area found about the education and she continued, “*You could be anything you want to be*”.

B. Encouragement

Different types of encouragement were encountered which means that when encouragement is positive it works also as positive reinforcement for example coming from family

members, teachers or peers. This kind of aspect creates a great influence on women's decision to pursue CS. In other words, it is very likely that parents and relatives' attitudes and beliefs on computers and technology influence a young woman's perception towards computers. The results showed that in those particular Mexican families or in most of them, mothers play a key role. M2 stated she was worried about her parents and their expectations of getting married young to be able to start a family of her own and in order to follow the social traditions and norms. The fact was that she wanted to pursue CS education and then make a career in the field. The most important positive influence was when her mother encouraged her saying "I don't want you to get married now. I want you to pursue your dreams, I want you to study an education and make a career, I want you to do something for yourself and not depend on a husband". Encouragement came also from her relatives where most of them were involved in the engineering world. They encouraged her by giving her information about the education and in this way she could make a career within the IT industry.

Similar data was raised from the Indian participants I2 and I3 where their mothers played a key role. Participant I2 stated that "she encouraged me, it is like mother play a major role in giving you more support spending their time but father works outside the home", it was very similar to I3, she stated that "it was my mothers dream that I become a software engineer". The participant I3 also mentioned that her parent wanted her to be a workingwoman, independent and standing on her own feet. Even after her marriage her husband encouraged her to work.

Before starting the CS education, S1 got the main support from her life partner that encouraged her by handling information and orientation about programming. By that time, her partner was interested in programming and actually, he was taking the CS education. When S1 expressed that she has always been interested in how to create a video game but she did not know how to program, then her couple replied, "Why don't you try? Here's a starting book. Try it!" According to S1, she got more confident and after trying it she realized that programming was really fun. Thus, she stated, "This is what I really wanna do with my life. So, I applied to the Gothenburg University and here I am!". Also, S1 put some more goals to reach in her life such as "I wanna be a developer". It is important to mention that S1 has always been motivated by her mom who encouraged her through any path S1 decided to.

Moreover, M3 related her experience to the encouragement not only from her parents and sibling but also from her teacher. While she was studying Applied Mathematics towards Computers program at the public university in Mexico City, her calculus teacher who was worried for the educational system in Mexico by that time and its effects on young Mexican population and more specifically the negative effect that could cause women. "He was a very strict, super disciplined teacher and too meticulous with the program and activities in the course but after the classes he opened himself a little bit to us. We were just a few girls in the class and he

started teasing us by asking us: why do you want to study if you are gonna end up getting married or you gonna end up just cooking and doing laundry. Why do you want to study CS, or mathematics? Why do you want it? What he was doing was to try to challenge us and tease us in order to not go in that way, to say no! I am a woman and I can do much more than that! My teacher said: I am telling you this because I want you to do something good for your lives. I want you girls to realize it! This studies you are doing are just for you. These studies are just the beginning and you will make them grow and get lots of satisfactions from them. Do not get married after you finish, take advantage of your knowledge. Work, travel, learn more!"

Even the outcomes from the Mexican participants showed that their parents supported them in their decision on studying CS. M1 stated, "Well, I had a scholarship because it is not a cheap university. Actually, it is one of the most expensive ones. My family is not rich and we are a middle class family. It was not easy for my parents to afford the monthly payments and that's why for example failing was something very bad because it was about a lots of money". Equally, M3 stated, "I had to change to a private university. I got a scholarship and I made a deal with my dad that he was gonna pay 25% and I promised to keep the scholarship the rest of the major. It was very tough, but I had the skills. However, it was a lot of pressure!" Both cases showed that getting a scholarship pushed them not only to keep the certain level of grades but also to finish the education in the end. Both pointed out that the private universities are very expensive and basically not everyone has the financial means to attend the university.

C. Role model

To have a role model(s) is another important factor that has a positive influence on women to visualize themselves as determined CS students who can make a career in the field later on. Role models with their stories about how they were able to reach their goals within the CS career is a triggering reason behind success of young women who are about to make their life decisions after graduating from high school.

For example one of the interviewees from India stated that "It was my cousin sister who was a software engineer, she was my role model, I always look up for her". The other interviewee stated that "It was my dad, he was my role model even he study computer science and if I had any problem I could go and consult him". Both scenarios indicate that both of the young women got influenced at an early age by seeing their family members working in the CS field.

A Swedish interviewee stated that "while studying at the junior high, I had a very good teacher in science and math and she saw my potential and encouraged me to study". These are few positive factors for young women while opting for CS education. This scenario showed the teacher's supports while the participant was studying in junior high and helped her in taking her bachelor's as well as the master's degree in CS.

Additionally, S4 stated the importance of finding a role model. She got inspired by women who were coding in different programming languages, after attending to one of “The girls in GitHub” community meetings. After that meeting she added, “*I can do this! I will study CS*”. Thus, it was very important for her to find a female role model to reinforce such inspiration. She thought to herself that “*I can be very stubborn, maybe I can become a role model for somebody else also*”, and she started her journey through CS field.

On the other hand, M4 explained that her brother was the one who guided her much before her education and she added, “*My brother has been my inspiration and I would say that he has been my role model as well!*”. M3 shared the background of her inspiration by explaining about a film where the main character is a female expert in computers and coding systems, saying, “*So, I got inspired by the film and I decided to become one of the experts in computers knowing how to use it and all about what you can do with a system*”. Thus, the results showed that participants were inspired from various sources to seek for CS.

Demotivation

D. Gender Prejudice

“*People didn’t have any faith on me just because I am a woman!*” These were the very first words that M2 said when she related her experience to demotivation factors involved. Further, she also mentioned that some of her closest relatives tried to demotivate her and guided her to take another path saying “*oh, no! That education is just for guys! You should study something that is more for you*”.

In our interviews we found arguments that showed how gender culture works as a limitation, making women doubtful of their lives decisions and actions. It would definitely have a decreased effect on women’s self-esteem not letting them get empowered. There were statements such as “*This is something just for boys and you are just a girl. Don’t you want to get married...*” that commonly were found in their families but also society contributed saying demotivating statements such as “*CS is just for boys, lesbian and ugly women*”.

S1 pointed out a couple of situations during her first year in the education where she and her male peer were working in some programming assignments. Some other classmates approached and asked the question directly to her male peer “*Do you know how to solve this assignment?*” and he replayed that it was easier if they asked S1 because she was the one who knew how to program. S1 stated, “*I don’t think they expected that I would know!* Additionally, she did not experience receiving any recognition from other classmates when she had completed her programming tasks. She told us that some of her classmates would comment such as “*oh! That is because someone else did it for you*” This kind of experiences had a double effect on S1. She explained that it was demotivating not being recognized because of her knowledge and being underestimated by them because she is a

woman. However, those factors worked simultaneously as a motivation for her.

All the participants commented during the interviews that they were treated differently than their male colleges. They felt not only they had to be good enough all the time but also they had to prove that they were better than their male colleges in order to be acknowledged and respected.

E. Discouragement

Negative peer interaction among the female students play an important role, for example, S2 stated “*My male classmate at my class said If you are not good at programming then you should not study CS*”. In addition, she stated that when “*she applied for a supervisor position, and when I got the job my male classmates criticized me by saying that I got this job because the faculty wants equal number of male and female applicant*” In the contrary, participant I1 did not face such experience while doing her bachelor in India. There were more girls in the class explained I1 “*I’m not the minority in the classroom. The guys in India know that everyone is equally good at programming. When exams are conducted both genders scored equally good but the scenario was completely different when I came here to Sweden. We were so few girls. I do not know the outlook here in Sweden but it seems that men at the class have a different perspective of women. They usually take women lightly ... thinking that we women are incapable of doing assignment or programming*”.

As it has been mentioned, there is already an underrepresentation of female students in CS major. Therefore, it is very important the pedagogical method that teachers implement to approach the student in class. The participant I1 explained that she already felt stressed because of the low number of girls in the room and she felt quite demotivated when her programming teacher divided the class into two groups, A and B. She stated, “*The group A were the smart and clever students whereas the group B were not as clever as the first group but a hard working group. We women were placed in group B*”. She explained that this kind of approach created a setback among the girls in the class not only because of being in minority but also they felt the pressure of being underestimated in coding and programming compared to their male classmates.

Participants who work in the CS industry pointed out job recognition as a motivational or demotivational factor. M3 experienced a negative feedback from the company she was working for. At first, she was offered a leading position that she applied for along with a male colleague but the company told her that if they did not give the position to her colleague then he could be demotivated. The company recognized her job and talent at the time, but the situation gave a negative feedback to her. On top of that, the person who was promoted became her boss and stated, “*This is not for women*”. M3 mentioned that the *macho thinking* affected her career in that moment. Also, the majority of the interviewees explained that

the possible explanation could be because the people who take the decisions are men. *“I think that they think we women cannot still deliver, sadly, we are forced to prove ourselves. They still look down at us”*.

Situations were women experienced being ignored and not being respected by male colleges during job meetings were common, according to different experiences of the interviewees.

Overview across the countries

The most common factors that motivate or demotivate women in each of the countries are listed in above Table 2. It also highlights a couple of factors of differences between the countries. Furthermore, the comparison drew the similarities and not similarities of those factors according to the different cases. Thus, in Table 2 the “Financial support” factor is included, since it was considered as a crucial point of comparison within the countries, which draws a very interesting panorama among the participants whether a constraint or an opportunity was created for them.

Table 2. Overview of the factors that motivate and demotivate women across the countries

Factors to compare	India	Mexico	Sweden
+Interest	- Intrinsic interest towards computers and technology.	- Intrinsic interest towards computers and technology.	- Intrinsic interest towards computers and technology.
+Encouragement	-Family members, specially mother. -Strong and stubborn personality.	-Family members, specially mother. -Strong and stubborn personality.	-Family members, specially mother. -Strong and stubborn personality.
+Financial support	-Father breadwinner.	-Father breadwinner. -Scholarships.	- Centralastudiestödsnämnden, CSN ¹
+Role model	- Family and close relatives.	- Family and close relatives. Specially mother.	- Consciously looked after female role models.
-Discouragement	- Male colleges did not appreciate efforts. - Being underestimated in their skills. -The pedagogic methods used by some teachers went far from achieving objectives and being goal oriented instead the methods were used like a discouragement tool.	- Male colleges did not appreciate efforts. - Being underestimated in their skills. - Not taken seriously by their male classmates when coding.	- Male colleges did not appreciate efforts. - Being underestimated in their skills. - Not taken seriously by their male classmates when coding.
-Gender Prejudice	- Being married is another hindrance that most of the women faced. They cannot take any job, they are forced to prioritize their family. - A curfew restricted woman on accepting good job offer.	-Negative comments such as “you are just a woman”, “CS is not for girls”, etc.	-Negative comments such as “you are just a woman”, “CS is not for girls” or “they hired you just to cover the quota”

¹ Swedish students have a studied aid benefit from Centralastudiestödsnämnden (CSN), which is a government agency. <http://www.csn.se/>

VI. Discussion

Here the focus will be on discussing the presented results and relating them to the findings from the literature review papers. As presented extensively in the results section, this study has identified two overall themes among the responses of the interviewees regarding their experiences when making the decision for studying CS and pursuing a career within the IT industry. These themes are ‘*Motivation*’ and ‘*Demotivation*’. Also from the data analysis raised subthemes: ‘*A. Interest, B. Encouragement, C. Role Model, D. Gender prejudice and E. Discouragement*’. These themes and subthemes are presented to discuss the potential motivational and demotivational factors that possibly may influence women’s decision when choosing a CS path in education and as a working career.

Motivation

A. Interest

According to Cheryan, Master, and Meltzoff [4], girls systematically underestimate how good they could do in CS fields, driving them to a lower interest of choosing CS education [6]. When looking at the CS students and professional participants from India, Mexico, and Sweden there was clearly a great interest towards computers and technology. They showed a strong self-confidence, a stubborn attitude, a great passion towards CS and something that they quite emphasized: “*I was like a ‘tomboy’, doing not ‘girly’ stuff*”. Hence, Schinzel’s theory [33] would not be applicable since she states that women from Scandinavia experience low self-esteem towards CS. These students were out of the regular boundaries that each of their gender cultures dictates such as in Mexico for being passive, submissive and dependent. Moreover, the results also showed how females from three different cultures have overcome personal, family, and social obstacle [36], and yet still fighting for a more balanced equality between genders. According to Juntti-Henriksson [41], Sweden is the country that has gone further regarding acknowledging both women and men and their responsibilities in both care and economy. However, Peterson [42] pointed out in his paper that there is still a long way to go to be able to reach a gender equality regarding CS education and industry, since CS field is still male-dominated.

Seymour and Hewitt [18] conclude that the “*best foundation for survival and success is that women have to choose one’s major because of intrinsic interest in CS discipline or in one career which is leading*”, which was also seen among our Indian, Mexican, and Swedish participants. Their experiences revealed that women’s interest are intrinsic and it is continuously shaped and encouraged by external factors or internal response. However, this interest is concocted with gender culture where the male-dominated history, culture, education practices and peer interaction contributed to shaping the female participants’ paths in CS. In our result we have seen that most of our participant are enthusiastic about CS, they love the logical thinking behind CS and they will not change their career in CS. This evidence contradicts MacDonald’s theory [47]. Besides, the desire for a

secure employment and better paid jobs contributed as a motivational factors.

We conclude that the main factors that motivated the participants were a great interest and enthusiasm, a strong self-esteem, a stubborn attitude and the feeling of being passionate by technology.

B. Encouragement

It is something natural that boys and girls get attracted to science. Girls at a young age want to be astronauts, engineers, scientist, and innovator. The curiosity drives them to find science behind and under the rocks in order to find answers for their wonders. While all this development is taking place something happens and stops the development. Then it is noticed that the development is interrupted by the social and cultural gender roles. Here is when many dreams are lost, when the gender roles start shaping girls’ minds. The Mexican gender culture roles teach boys that they will be the head of the family; therefore, it is set in their minds to consider how to earn a living in order to be the breadwinner of the family one-day [33][35]. Herrera and DelCampo [35] point out that nowadays, girls consider both how to earn a living and be at home. The women’s great desire for expanding their achievements take them to increase their duties and reinforce their attitudes such as “*I think we women can do whatever we want!*” Miller and Swanson [30] emphasize the importance of early education at home and the serious role that parents play when motivating or demotivating girls towards technology and science. Therefore, the pressure that some of the participants experienced from family and society concerning marriage, drove them into adopting and accepting the marianismo concept and embrace the “self-sacrificed woman” role in order to follow social traditions [31]. In many cultures, the family is considered as sacred, meaning that family goes first, before anything else. This statement has been abused and used as a limitation against women to be controlled. Güner and Camp [52] claim that parents must assure their daughter can still be ‘girly’ and succeed in technology fields such as CS.

However, in India, the educational decision is considered to be a family affair rather than individual student’s decision, since the long terms goals are a collective family concern simply because the decision involves the investment of the family’s resources. Since gendered family obligation produce gender educational expectation and educational goals, the educational investment gives the advantage to sons over daughters. Thus, family concerns about girl’s marriageability, social reputation, and family honour. These factors make the education for daughters socially problematic [23].

We believe that it is critical, decisive and highly important to create a fearless attitude towards computers and empower girls to increase their self-confidence by recognizing girl’s accomplishments and encouraging them to accept challenges and risks. We consider that having a girl empowerment at home would create more confident and goal oriented women.

Hence, applying this strategy would help to raise the number of women in CS field. Güner and Camp [52] as well as Miller and Swanson [50] agree that it becomes too late, or it is more difficult, to turn around a woman once the gender roles have taken place at an early age among girls. The evidence showed the importance of encouragement from parents, but also the encouragement coming from partners and teachers when a girl or a woman have interest in CS.

As it is mentioned before, teachers contribute to encouraging girls at school or women at universities when the pedagogical method in the classroom is gender neutral [53]. Culley [53] states that having a gender-neutral atmosphere within a classroom contributes to minimizing as much bias as possible regarding the promotion of a male-dominated domain. In most cases, teachers are key to reinforce CS interest by implementing effectively the use of computers in the educational system. Teachers have a huge responsibility and obligation with society, they have an immense potential to transmit beliefs and values to students. Teachers may contribute to diminishing gender culture role and low-level experience and increase a positive attitude towards computers and develop earlier computer skills [55]. Mounfield and Tyler [55] observe that women tend to develop confidence and self-efficacy when they have had positive experiences with computers. Furthermore, they claim that the real problem to be solved is the lack of participation by females, because they do not have the ability and skills.

The access to a higher education is completely different across the different countries. In Sweden, the higher education is financed by tax revenue. Likewise, the Swedish students may apply for financial aid at CSN. The student's aid has two categories, grants, and loan. A Swedish student is free to decide whether to apply just for grant aid or both of them. On the contrary, the higher education in Mexico is public and private. There are two main public universities, which are the most important in the country and at an international level as well. The high level of population in Mexico creates a higher demand for these two universities and makes it impossible for everyone to get a place in any of them. The private education is very expensive and possible only for very few people. Some private universities offer scholarships and some people are able to afford it but most of them cannot. Mexico is one of those developing countries that face the problem regarding women in developing nations where women are excluded from participation in technology and science. Some of the main reasons are poverty, lack of education and lack of financial aid programs for students [36]. The situation is quite different in India, for instance, the participant in this study were financially supported by their parents; they pay the tuition fee and the donation to the university. The I2 stated that her father asked her which education she wanted to enrol in and emphasizing if "*my money will be wisely spent?*". Overall the Indian participants said that their parents paid around 150,000 SEK for four years of bachelor's program in India. Those that are studying the master's program in Sweden, their parents are

paying around 250,000 SEK for the two-year education; plus the cost that infers for living in Sweden.

C. Role model

It is evident that for most of the participants from India and Mexico, the parents and mostly mothers took the place of a role model in their lives, the one who inspired, encouraged and empowered them to pursue their education in CS and career in IT industry. There were some other cases where close relatives played a part as a role model. In this case, the role model was people close to them and in many cases; they were not part of the IT world. On the other hand, most of the Swedish participants had a very conscious understanding of the benefit of finding female role models within the CS field. As has been noted, all the participants concur with the opinion of the relevance and importance of finding role models.

Some of the studies recommend the faculties to organize lectures where successful female guests representatives of the CS and IT industry present and share their experiences with the female student. This kind of activities is directed to motivate and encourage the female student. It is easier to see yourself as a computer scientist when you have a model to follow [52]. "*The perfect life is the one that you want to give to yourself, if you wanna travel, study, get a scholarship. I mean you can do it and there is nothing that can stop you or prevent you not to pursue your dreams. If there's someone that could keep you away from reaching your dreams, that person is only yourself. The one that it is in front of the mirror!*" This participant mentioned that even though, she actively searches for female role models she believes that she is her own best role model. Every time that she achieves and accomplishes a goal that she believed to be hard to achieve, she becomes stronger and as she states herself "*I am my best role model*"

Demotivation

D. Gender Prejudice and E. Discouragement

We decided to add both of the subthemes in this section. It was considered that the discussion about gender prejudice leads to an imminent discouragement and when discussing discouragement, the influence of gender culture is involved.

Gender prejudice is broadly enforced in all three countries whether it shows prominently or is hidden within the society. Thus, the importance of Miller and Swanson's [50] statement, where it is noticed that the gender prejudice initiates at home. Meaning that the parents teach their children how to act as girl or boy. It is from here that girls face gender-bias. In the household where parents unknowingly discriminate girls while choosing toys for their children. For example, Barbie Dolls are for girls and Lego bricks are for boys. Pink colour is for girls and the blue colour is for boys, it is already imprinted in our brains. In our study, we encountered that some of the female participants' experience they were encouraged by their parents and closer relatives. Swedish and Mexican participants did not experience a gender prejudice while they were kids at

home, however, they experienced gender prejudice coming from society.

In contrast, in India, the patrifocal family model has a more negative educational impact on daughters than on sons. Parents consider putting an especial focus on boy's education because of the large investment. If the parents evaluate that it is worthy to invest the family resources in their daughter's education, this woman faces another restriction that involves social danger. The financial consideration affects all children within a family but it is more limited to girls than boys. For instance, when a man has a bachelor's degree in CS it facilitates a good marriage for him while the women's situation is quite different. A highly educated woman faces more difficulties to find a good match, since the potential groom should be more educated than her [23]. Among the female participants from India, the evidence showed that this cultural behaviour was not experienced in their cases since firstly, their parents paid the education in India and as well as their education abroad. On the other hand, Mukhopadhyay's theory [23] is evident among the married participants who got married to a man higher educated than them.

Bias treatment against women is a type of discouragement at the campus and workplace, which all of our participants had an experience "*we women must still to prove that we have the skills!*". This is a typical case where is founded gender prejudice leading to a discouragement. The participants have experienced different kind of discouragement, where it is implicated gender issues such as not taking them serious, not being appreciated for their contribution among their male classmates and lack of job recognition, which Etzkowitz and Kemelgor point out in their study [37][10].

VII. Conclusion

This study showed multiple reasons that influence a woman in choosing CS field. These reasons vary from culture to culture and from country to country, therefore, the results are just a contribution for further research. However, based on our findings, we can conclude that the main factors that motivated the participants were a great interest and enthusiasm, a strong self-esteem, a stubborn attitude and the feeling of being passionate about science and technology. The parallel participation between home and schools is dramatically important for the reinforcement of self-confidence, which reflects on the women's self-efficacy. On the other hand, the encouragement that the participants experienced regarding economical support from parents and in some other cases from both parents and scholarships was essential. Firstly, for having the chance to continue studying in a higher education such as CS, and secondly, the compromise for keeping high grades increased the female participants' encouragement for accomplishment. Additionally, the participants were conscious of the positive influence that role models create in women's inspiration.

However, the results of this study also highlight the role that gender culture plays among the participants' experiences. Also, they describe the challenges and difficulties they went

through during their studies and the obstacles that they experienced at their jobs because of the fact that they were women. The females from the three different countries must deal with gender prejudices of being perceived as unfeminine, ugly, nerdy and unattractive. This kind of gender prejudice is rooted in the gender culture; merged in a society, which stresses CS as masculine and consequently the female position in CS field as unfeminine. But this is just the peak of the iceberg for discouragement, where gender prejudice are implicated both at university and at the workplace such as not taking them serious, not being appreciated for their contribution among their male analogous and lack of job recognition.

As it has been mentioned previously, there is still a long way to go to be able to reach a gender equality regarding CS education and industry. Many socio-cultural obstacles are still there to hinder women from pursuing a CS path, and furthermore, prevent women from making a truly free choice.

On the other hand, we faced two main limitations during the process of the study. The first one was the time constraint where we had a framework of 10 weeks in which the whole design of the thesis took place. Second, considering the time constraint, we were forced to limit the research into a small sample. This study conducted 12 interviews, 4 female participants from each country who contributed with very valuable data. We consider that if we had an extended time framework we could include a larger sample of participants in the study and have a wider picture of the different motivational and demotivational factors that influence women for choosing CS path, and at the same time, the study may help women to challenge the different cultural beliefs and cultural prejudice. The findings in this study showed that the environment and culture around women influence their decisions and performances. Therefore, we would suggest future research within an environment for only women to compare and contrast women's experiences. We also suggest larger studies, including more women, both in mixed environment as well as environments for only women to get a broader view of women's perception

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Lee Yung Liu & Erika De Lara

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Erika De Lara

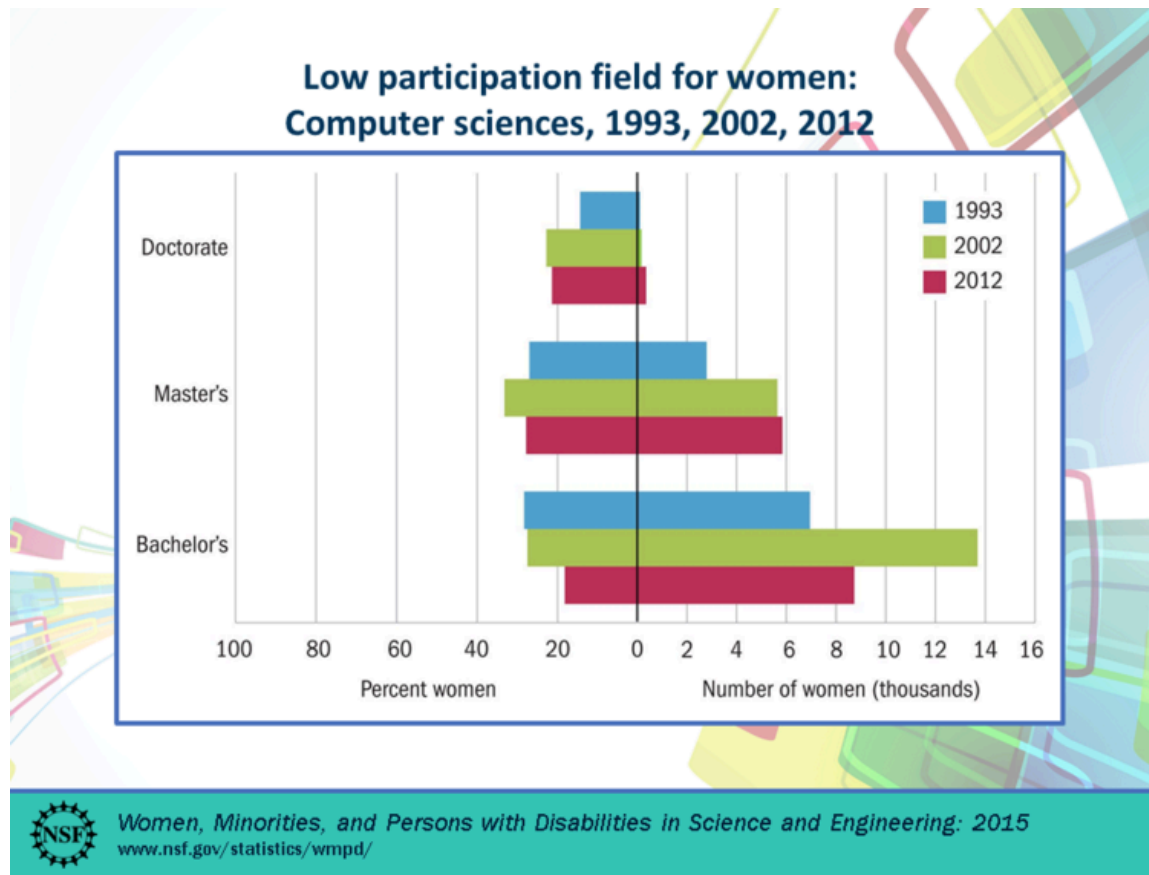
I would like to thank my late mother and my father. My father taught me and my sister to be strong and independent women. I owed it to him. Lastly, I want to thank my two daughters who motivated me to reach my goal. My struggle was hard but in the end, I am very proud of my achievement. Since it is not easy to be a single mom trying to juggle with school, work and taking care of my daughters. I Salute to all the single moms out there, who fight, struggle in order to achieve their goals and dreams.

Lee Yung Liu

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Graph 1. Computer Science— low participation field for women, 2015.

<http://www.nsf.gov/statistics/2015/nsf15311/digest/theme2.cfm>

Appendix B

Interview Questions

1. Family & Society

- 1.1.1. Could you talk about the factors that motivate you entering to a CS education?
 - 1.1.1.1.1. Is there any aspect that could demotivate you studying the career?
- 1.1.2. Could you tell us your opinion about the factors motivate or demotivate women in your country to enter into CS education?
- 1.1.3. Do you think there are differences between genders when getting support from family or society for studying CS?
- 1.1.4. Do you think that gender culture plays a role while choosing this education?
- 1.1.5. Is there someone who inspired or encouraged you to pursue a CS degree? If yes, please describe your experience with him/her.
 - 1.1.5.1.1. Could you describe any experience of someone who tried to demotivate you if there is any?

2. University environment

- 2.1.1. Could you describe your academic experience?
- 2.1.2. What kind of support did you get from the university?
- 2.1.3. How was your experience being part of the minority in class?
- 2.1.4. How was your experience within the class environment?
 - 2.1.4.1.1. Could you please elaborate it more?

3. IT industry

- 3.1.1. How was your experience while finding a job within the IT industry?
 - 3.1.1.1.1. What are your expectations while seeking for a job?
- 3.1.2. In your personal experience When a man and a woman are applying for the same job position in (Sweden, Mexico or India) and having both the same qualification. Who do you think that would get the job?
- 3.1.3. In your personal experience could you describe What is the gender culture role in (Sweden, Mexico and India)?
- 3.1.4. Which factor do you think that could be a reason for leaving the CS field?
 - 3.1.4.1.1. Is there any aspect that could lead a woman to abandon her career?

Appendix C

Table 1. Description of the participants

Country	ID	Status	Characteristic
India	I1	Student	- Computer Science – BSC - Chennai University, India - Wireless Plutonic in Space Engineering - Master 1st year Chalmers, Sweden
India	I2	Student	- Computer Science - BSC - Embedded System - Master 1st year (now maternal leave) Chalmers, Sweden
India	I3	Professional	- Computer Science – BSC - Poona University, India PRO: Consultant Java and IOS Developer Working for a consultant company in Gothenburg
India	I4	Professional	- Computer Science – BSC - Hyderabad University, India - Computer Science - Master's degree - Blekinge Technical High School, in Blekinge PRO: System analyst Working for a Large automobile company in Gothenburg
Mexico	M1	Student	- Computer Science for Management – BSC - Tecnológico de Monterrey, Mexico - IT Project Management - Master's 1st year Stockholm University, Sweden
Mexico	M2	Student	- Engineering of Computer Science - 3rd year Universidad Tecnológica de la Riviera Maya, Mexico
Mexico	M3	Professional	PRO: Business and Portfolio Manager working for a large automobile company in Mexico- Sweden - Computer Science Engineering - BSC Universidad Tecnológica (UNITEC), Mexico
Mexico	M4	Professional	PRO: Back Office Engineer working in a software company in Stockholm - Systems Engineering in Computer Science - BSC Universidad Autónoma de Nuevo Leon, Mexico - Engineering and Management on Information Systems - Master's degree
Sweden	S1	Student	- Software Engineer & Management - 3rd year - Gothenburg University, Sweden
Sweden	S2	Student	- Computer Science - 3rd year - Chalmers, Sweden
Sweden	S3	Professional	PRO: Test leader and line manager. Working in a large company with mobile telecommunication at Lund
Sweden	S4	Professional	PRO: System developer Working in a large consultant company in Stockholm