# Factors that Prompted a Sample of Female Students to Choose an IT Career. A Regionalized Exploratory Study at Three National University Campuses

Sandra Cabrera Alzate [1], Irene Hernández Ruiz [2]

[1,2] *Universidad Nacional, Lagunilla, Heredia, Heredia, Costa Rica*

### Abstract
The present work is an exploratory work that reveals the perception of some of the students of the Informatics career of three campuses of the National University of Costa Rica about the motivation they have had to venture into their current study career. For this, a form was developed through Google Forms, which was applied during the first semester of 2022, obtaining a response from 87 students from the second to the fourth year of the career in three different regions where the career is taught, with the purpose to identify some factors that motivated these women to study this career and to know what were the main skills that they developed during their training and that it be an input to collaborate with future projects to motivate more women to study this area of science, technology, engineering and mathematics (STEM) .

### Keywords
Gender, Information and Communication Technologies (IT), Female participation, Factors, Motivation.

## 1. Introduction

Gender equality does not mean that men and women should be treated as identical, but rather that access to opportunities and the exercise of rights should not depend on a person's gender. Equality of opportunity must have a direct impact on the effective exercise of women's rights [1].

On the other hand, authors such as [2], The results of this study indicate that the problem of low female participation in the computer science area has two dimensions: recruitment and retention. That is, few women enroll in computer science careers and once enrolled, it is difficult to retain them.

Among some of the initiatives that stand out is that of UN Women, which since 2010 has been producing an annual report 2019-2020 entitled "The world for women and girls.", This one shows that gender inequalities and discrimination permeate all situations, whether it is a new pandemic or an old conflict, entrenched income disparities or lack of political voice, where women and girls face additional risks and obstacles just because they are women and girls. [1].

Gender equality is good business" is the slogan of WeEmpower, a partnership between UN Women, the European Union and the International Labour Organization. This initiative works with companies and entrepreneurs to open doors for women in the private sector in 20 countries, including the Win-Win initiative in Latin America and the Caribbean [1].

The report of the United Nations Educational, Scientific and Cultural Organization (UNESCO), entitled: "Cracking the Code: Girls' and Women's Education in Science, Technology, Engineering and Mathematics (STEM)." presents the global picture of the lack of female representation, the factors behind it and examples of how to improve the interest, engagement and performance of girls in these fields. Among the findings he mentions he states that 30% of those enrolled in STEM-related careers in higher education are women [3]. At the same time. The study indicates that enrollment of female students is especially low in information and communication technologies (3%), natural sciences, mathematics and

statistics (5%), and engineering, manufacturing and construction (8%), while enrollment in health and wellness is high (15%), statistics (5%) and engineering, manufacturing and construction (8%) while health and wellness is high (15%).

According to the OECD report The ABC of gender equality in education [4], one of the biggest problems in the development of careers in the disciplines of Basic Sciences, Technology, Engineering and Mathematics (associated with the acronym of those who had a STEM-based curriculum: science, technology, engineering and mathematics) for university women is the lack of interest they usually have in this type of careers due to prejudices and stereotypes that accompany these professions.. In this line, it is mentioned that the reasons are due to the fact that women have less self-confidence than men in solving mathematical or scientific problems, in addition to the fact that parents' expectations are higher for their sons than for their daughters when it comes to supporting them in pursuing careers in science, technology, engineering or mathematics, according to data from the Program for International Student Assessment (PISA).

 The "Towards 2030 Report on Science" states that in Latin America the number of university graduates and higher education institutions is growing, which is why more than 2 million bachelor's degrees, or their equivalent were awarded in 2012, where most of the graduates were women [5].

In Costa Rica, despite the legislation in force to achieve equal access for women in all fields, the numbers do not differ from those of other nations. According to data from the Dean's Office of the Faculty of Engineering of the University of Costa Rica (UCR), of the student population enrolled in the 2021 academic year, an average of 33% were women. And although some of the nine schools of that faculty show a higher percentage, exclusion is higher in the School of Computer Science and Informatics, with 17%, followed by Mechanical and Electrical Engineering, with 21% in both cases [6].

On the other hand, at the Instituto Tecnológico de Costa Rica, the selection criteria of the "Program of Attraction, Selection, Admission and Permanence with Equity" have been modified. ". This responds to the fact that the additional 5% of the careers that present over demand and are framed in the STEM areas, will be assigned with a selection alternating between women and men, starting with a woman, always respecting the criteria such as the admission score [7].

The above data, and the importance of the gender issue in careers such as engineering motivated this work, which was conducted as an exploratory study during the first semester of the year 2022 at the Liberia, Interuniversity and Benjamín Núñez Campuses. In this way this work has been structured in the following sections: ii. Initiatives in Costa Rica to promote the participation of women in IT careers, iii. Studies on the gender issue in students at the School of Informatics of the Universidad Nacional, vi. Skills in the student body, vii. Methodology, viii. Results, ix. Conclusions and future work.

## 2. Initiatives in Costa Rica to encourage women's participation in careers in IT.

There are different initiatives in Costa Rica that encourage the participation of women in IT careers, for example Intel Costa Rica developed in 2020 activities to encourage the participation of women in careers related to science and technology, Microsoft Costa Rica [1], are some of the organizations around information technology that have developed programs to promote female participation.

Also, the UNA STEM NETWORK, as an institutional project of the National University, has developed a set of initiatives with the design of videos to motivate more young people to study careers in science. The Ministry of Science, Technology and Telecommunications (MICITT) of Costa Rica [8], together with allied institutions and organizations seek to promote gender equality in training, employment, and enjoyment of the products of science, technology, telecommunications, and innovation, so that efforts are made at the country level along these lines.

## 3. Studies on the gender issue in students at the school of computer science of the National University

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[1] https://news.microsoft.com/es-xl/microsoft-anuncia-talleres-virtuales-gratuitos-para-empoderar-a-ninas-y-mujeres/

At the School of Informatics of the National University, some studies have been carried out on the incorporation of women in technology-related careers. Mata et al [9] in their work indicates that there is evidence that women tend to be underrepresented in computer science (CS) programs in many countries. Based on this fact, they analyzed the gender situation in Costa Rica and found that this situation also applies to the four public universities in the country. In addition, as in the case of the U.S., they found that the gender situation in Costa Rica also applies to the four public universities in the country, The percentage of women graduating from computer science programs at these universities is decreasing. Based on previous studies, the authors explain the gender gap in Costa Rican public universities and present recommendations to reduce it. Mora et al [10] studied the admission processes, [11] sought to identify the motivational factors and expectations involved in the choice of career by students at the School of Informatics. Hernández et al [12] consulted with students from two computer informatics careers in Costa Rica about initiatives to incorporate more students from the perspective of students who have just passed through the first stage of university entrance. Cabrera et al [5] conducted a focus group with 20 students to find some factors that would allow them to learn more about the subject [13] Projects have been carried out with the participation of students as a mechanism of motivation and as a space for them to develop their soft and hard skills. Currently, the School of Informatics of the Universidad Nacional de Costa Rica has an estimated female participation of approximately 23% [5].

## 4.  Skills in the student body

According to the Royal Spanish Academy, skill is understood as the ability of someone to perform a given task or activity correctly and with ease. A type of classification of skills into hard skills (hard skill) and soft skills (softskill).

Defines the term "soft skills" as the qualities or personal attributes or level of commitment of a person that distinguishes him or her from others, even if they have similar skills and experience [14].  It is also understood as those skills that could enhance job performance, facilitate internal mobility, catapult career development, and predict job success. These skills include social and interpersonal skills or meta competencies, i.e., the ability to work in diverse environments, and to transfer learning from one field to another [15].

While hard skills are knowledge related to education and experience level, which allow the management of data, equipment, and systems. Examples of hard skills include writing, mathematics, statistics, finance, chemistry, biology, the ability to use software programs, among others; [16] This classification and definition were used as the basis for the questionnaire, since around information technology in the labor market it is necessary for our students to strengthen these two types of skills.

When students enter the student body during their academic training, they develop a set of skills that will later help them in their professional life. In this work, it was considered important to know the skills developed by the female students at the School of Informatics during their academic process, to be able in the long term to generate academic spaces to strengthen these skills and to take them as input for the development of activities for new women students.

## 5.  Methodology

To learn about the motivation of female students, the following questionnaire was used as a basis. "Relevance of Science Education questionnaire" ("ROSE-Q" for its acronym in English) [17], this instrument is made up of closed-ended questions [18]. For this paper, 5 questions were selected from this questionnaire that probe learning experiences in school, inspiration for the choice of education, as well as future work expectations. It was also completed with 3 additional questions that allowed to delve deeper into the motivations for entering technology careers and to learn about their developed skills.

## 6. Results

The questionnaire was developed in an exploratory way and was implemented through Google Forms. The questionnaire was distributed among female students of the Computer Science program of the Universidad Nacional at three different campuses: Central Campus (Benjamín Núñez Campus, Interuniversity Campus of Alajuela, and Liberia Campus). For the collection of information was sent by e-mail and 87 responses were obtained, thus corresponding to a convenience sample.

Description of the group that answered the questionnaire is confirmed as follows: the ages of the female students range from 17 to 31 years old, and they are distributed in different career levels.

**Figure #1 Career level of female students surveyed**
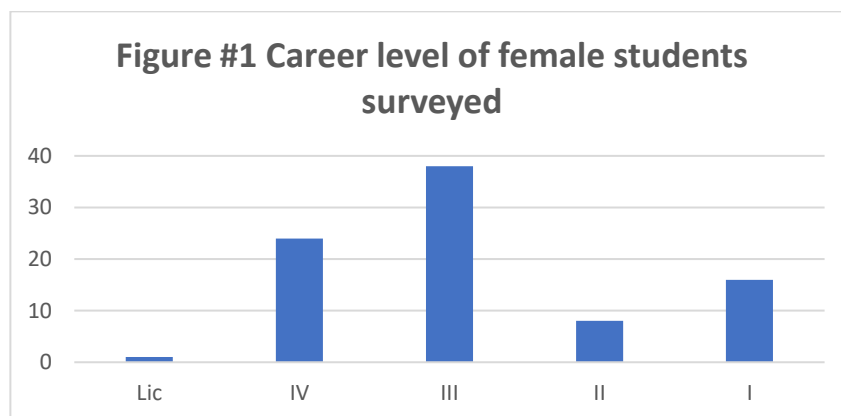


**Source: Own elaboration**

Figure 1 shows that the largest number of female students who completed the questionnaire were third-year students, followed by fourth-year students as the second group to complete the instrument. This means that the majority group already has advanced knowledge in the career as well as in their knowledge in the career areas.

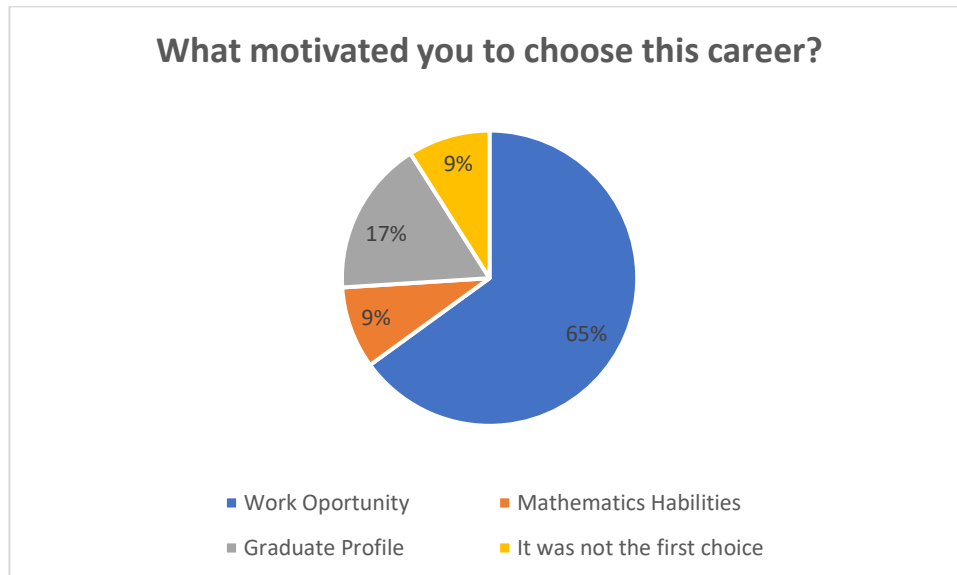**Figure #2**
**Are you working?**
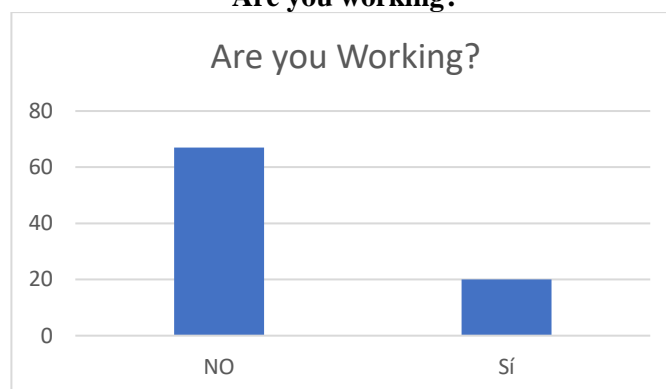


**Source: Own elaboration**

Figure 2 shows that most of the women who responded to the survey are not only working, but also have a job.

- **Analysis of the ROSE-Q questionnaire:**

As explained above, 5 questions were selected from this questionnaire focused on student motivation. The results of these questions are presented below:
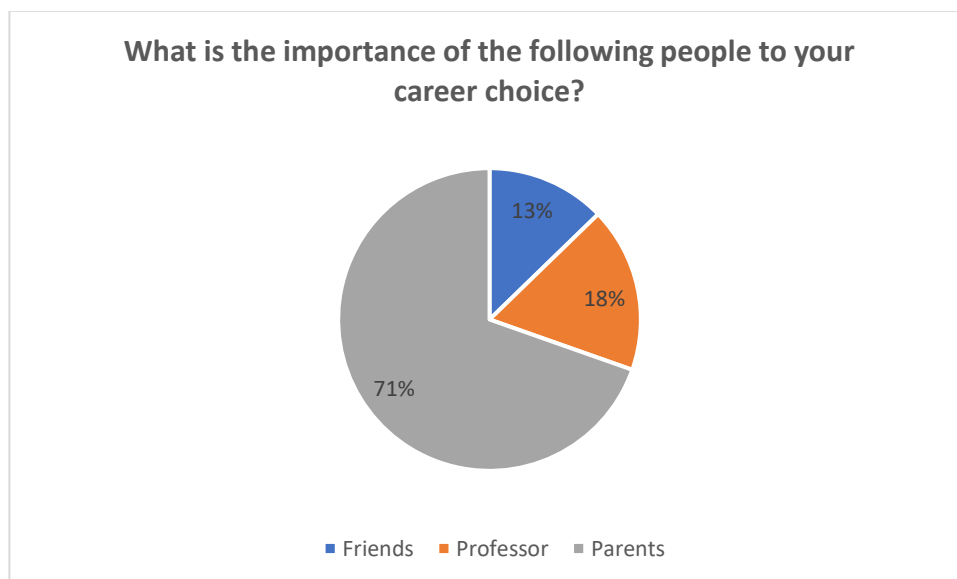
**Figure #3**
**What motivated you to choose this career?**



**Source: Own elaboration**

Figure 3 shows that 65% of female student's main motivation for entering the Engineering program was the job opportunities that exist in Costa Rica in the area of information technology and, in second place, the graduation profile and subjects.
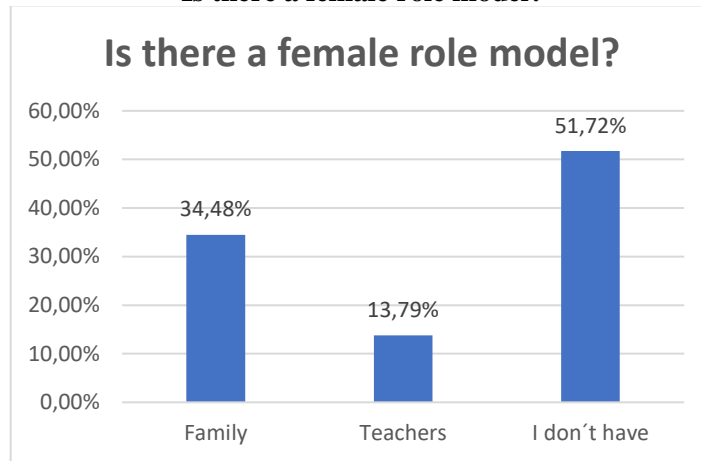
**Figure#4**
**What is the importance of the following people to your career choice?**



**Source: Own elaboration**

Figure 4 shows that the majority of female students indicated that their parents were very important to them in their career choice.

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**Figure#5**
**Is there a female role model?**



**Is there a female role model?**

**Source: Own elaboration**

Figure 5 shows that half of the female students consider that they do not have a female role model. In this result, it is very interesting as it can be seen as an opportunity to carry out activities at the high school level to motivate more women to study computer science.

**Figure #6**
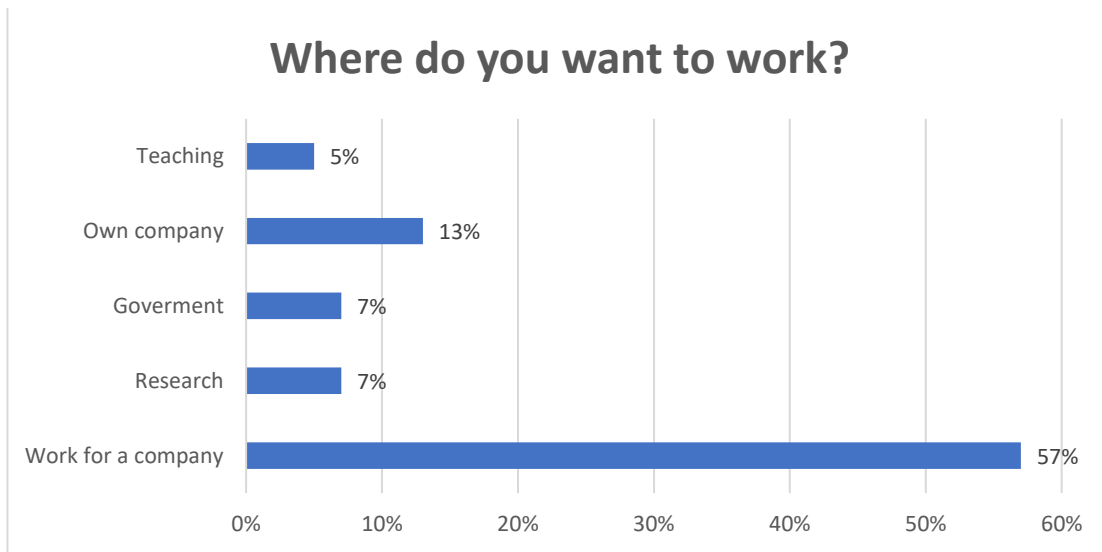**What is your goal?**



**What is your goal?**
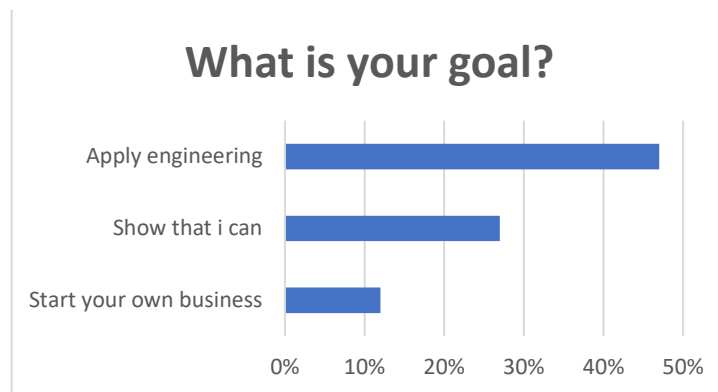
**Source: Own elaboration**

Figure 6 shows that the highest percentage of female students (48%) expect to apply for engineering as one of their personal goals.

## Where do you want to work?

| Category | Percentage |
|----------|-----------|
| Teaching | 5% |
| Own company | 13% |
| Goverment | 7% |
| Research | 7% |
| Work for a company | 57% |

**Source: Own elaboration**

Figure 7 shows that the majority of female students expect to work in a company at the end of their studies. This topic allows the School of Informatics to bring opportunities closer to our students so that they have a greater opportunity to develop their professional practice or to be incorporated into the working world.

In addition to the questions above, additional questions were also asked which are detailed below.

- Initiatives to motivate more female students:



**Figure 8**: Initiatives to motivate more female students

Figure 8 shows a conceptual map which was elaborated with all the brainstorming ideas that the students presented in the questionnaire. This conceptual map will serve as a guide for future activities to be carried out at the School of Computer Science.

**Figure #9**

**Skills that women have developed the most during study**
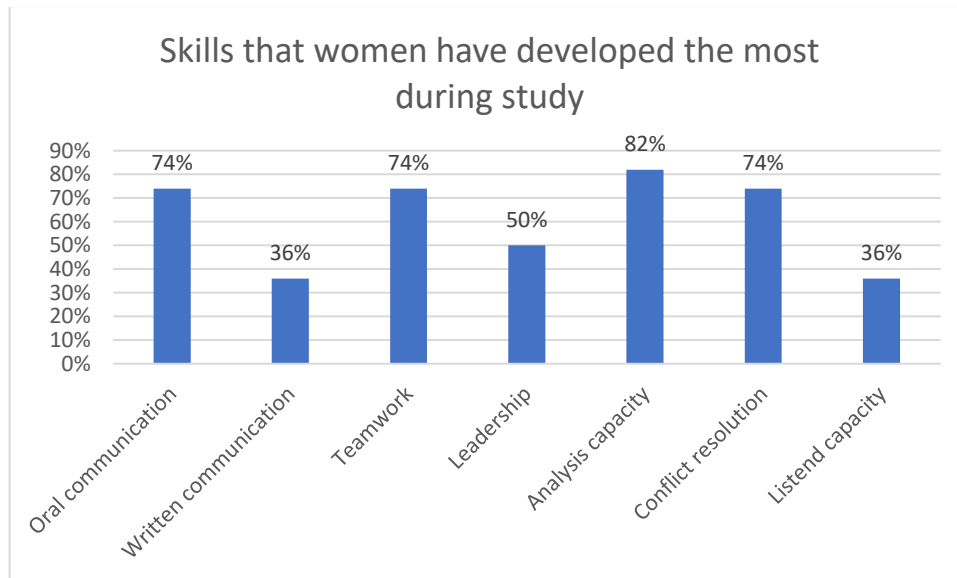


**Source: Own elaboration**

Figure 9 shows the skills that women have developed the most during study, and it shows in first place the theme of analytical skills with 82 of the options selected by the women students. In this topic, it is also important to propose activities that can further promote these skills, especially the topic of written communication.

**Figure #10**

**Choice of female students with respect to their choice of work area**
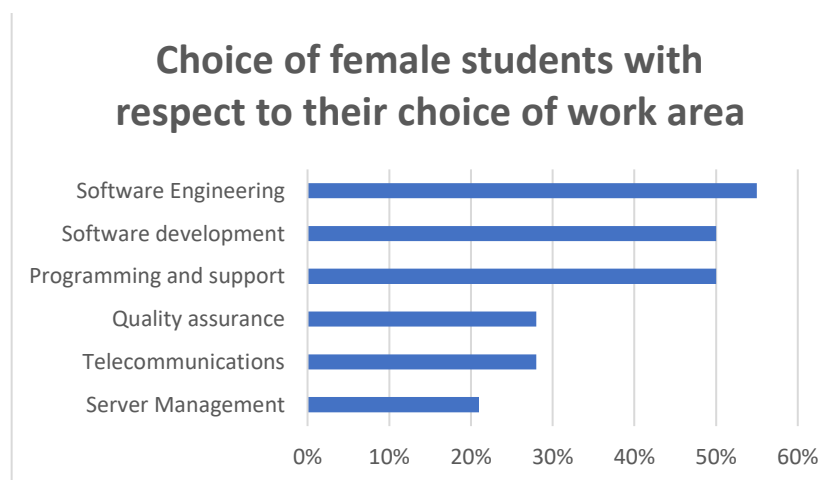


**Source: Own elaboration**

Figure 10 shows the frequencies of choice of female students with respect to their choice of work area, in this case most students are inclined to the software development part, in that sense software development is the most frequent option in the selection of the work area, as well as Software Engineering.

**Table 1**
Women Students and their choice of where to work

| Yes | Working in a Company | Own Company | Teaching | Investigation | Government |
|---|---|---|---|---|---|
| 20 | 12 | 4 | 3 | 1 | 0 |
| No | | | | | |
| 67 | 64 | 9 | 2 | 5 | 6 |

Table 1 shows that although both working and non-working female students have as their first choice that they would like to work in the IT business sector, they would like to work in the IT sector.

## 6.1.  General analysis of motivations

The students who completed the survey mentioned current job opportunities as a factor that prompted their career choice. They also mentioned the influence of their parents or relatives in motivating them to choose the career, as well as the equal treatment in their family. On the other hand, the female students, as they advance in their careers, have enthusiastically taken on the different challenges in the different areas of the career. Most of the students who completed the survey mentioned facility around mathematics during their development in high school.  Other respondents mentioned the influence of their parents, relatives and friends, who have urged them to enter the computer field professionally. Likewise, a large majority of the responses obtained, are struck by the wide range of jobs in the field of information technology.

## 7.  Conclusions work and future

In this work an exploratory analysis was carried out, which reflects some important aspects among which the following stand out: the main motivational factors, as well as the skills developed in them, which are an input so that later on a study can be carried out that covers all the female students at the School of Computer Science. Most of the female students who completed the questionnaire are juniors and seniors, which implies an advanced knowledge in the career as well as in their knowledge in the career areas.

Most of the women surveyed chose this career because of the current employment opportunities in Costa Rica, as there are many transnational and national companies in the country.

A high percentage of more than two thirds of the women surveyed stated that their parents were very important in the process of choosing a career.

There is an interesting percentage of female respondents who stated that they were motivated by their professors and teachers, which can be interpreted as an opportunity to carry out activities at the secondary level to motivate more women to study computer science. For which it is expected to be able to develop spaces in activities such as open doors that the National University carries out annually, which makes this career known to students who are in the fifth year of all public and private schools in the country.

The vast majority of respondents stated that they are interested in working for a company; in a smaller proportion, they mentioned an interest in starting a business, working in research and/or teaching, which shows that it is necessary to motivate the latter possibilities, to achieve this, the School of Informatics has an elective course to motivate students in this part of entrepreneurship and is expected to encourage students to participate in research projects of the institution

Among the skills developed, the following were identified in order of highest to lowest: analytical skills, oral communication, teamwork, conflict resolution and leadership, followed by written communication, listening skills, and the ability to listen to others. These soft skills are currently in high demand by IT companies, so it is evident that throughout the career of Information Systems Engineering, students manage to develop them.

Female students leaned their choice of work in software engineering and development, followed by programming and support, quality assurance, telecommunications, servers, and server administration. These are the emphasis of the course for the first two years of the course as students leave with a Diploma in Computer Applications.

This exploratory work allows us to reflect on the incorporation of women in the IT area, which allows us to look for alliances and initiatives to promote the participation of women in IT careers, with projects at a national and even international level.

All students of the School of Informatics should be motivated to participate in activities and courses that foster personal and psychosocial skills. Especially to female students, as an additional mechanism to further encourage more female students to complete their studies in the area.

It is important as a stimulus, to let high school students know studies of women who have excelled especially in the world of engineering, as well as workshops on women in STEM, testimonials of successful women in the area. Figure 1 shows a summary of the strategies to be designed within the School of Informatics.

Hold workshops to showcase the outstanding work and progress of women in this area and related fields. To achieve this, we hope to organize events on very specific dates such as Women's Day, the Day of the Girl Child, and Women in Science, among others. Since they are important spaces in which they can be used to generate enriching spaces for the exchange of knowledge.

Currently, the School of Informatics, in conjunction with the activities promoted by the National University to make the careers known to the national population [20], however, it is necessary to carry out more activities during the year where models of women who have worked in this area are presented.

It is recommended that, "Disseminate success stories and female references with women and researchers who share their testimonies Propose telecommuting possibilities and/or flexible schedules to attract women with children or family commitments." [5].

Some students recommended holding meetings of advanced and beginner women to discuss how they are progressing along the career path, share tips and how they have achieved their goals. They also suggest holding conferences to provide information about the career, the profile of the graduates and opportunities in the labor market.

It is important to create sites with information on scholarships, training, tips on how to get a job, contacts with potential mentors or women coaches in the area of IT and computing [5].

It is also recommended to create support groups for women students, formed by professors of the area, graduates and advanced students, for which purpose the School of Informatics will be looking for the creation of such spaces.

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