

STEM women entrepreneurship and employment situation: case study UTPL

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Abstract– *This paper shows the research conducted on the employment situation and entrepreneurship projection of students and alumni of STEM careers in a private university with two modes of study (face-to-face and distance) in Ecuador. In order to carry out the research, qualitative and quantitative exploration and approximation techniques were applied to obtain comparable and differentiable data between genders.*

The results show that there are some significant differences between the tendency of the group of STEM men and women and only women in the work situation in which they find themselves, evidencing a need for work that forces them to develop in areas little or not at all related to their training, data that are complemented with the motivations, limitations and willingness to undertake of students in STEM careers.

Keywords-- *Women STEM Ecuador, WSTEM, women employment situation, women STEM entrepreneurship.*

I. INTRODUCTION

According to a report from Education 3.0, 25% of students who start higher education already choose to study STEM fields (Science, Technology, Engineering, and Mathematics) [1]. However, the lack of women in STEM careers is a problem that affects all higher education institutions, not only in Latin America but also in Europe and other regions of the world [2]. Therefore, it is necessary to maintain and offer STEM programs that are relevant to entrepreneurship, such as computer science, engineering, and mathematics [3], as they are sources of greater competitiveness in business due to their growth potential and job creation [4].

Employment is a relevant aspect in all professions, in Ecuador according to Technical Bulletin No. 05-2023-ENEMDU of the National Institute of Statistics and Census the gross employment rate in 2022 for Ecuador was 63.1% and the rate of adequate employment reaches 34.4%, by gender the rate of adequate employment for women only reaches 27% in the same year.

Entrepreneurship improves economies and people's lives, creates job opportunities, solves problems, develops technology that enhances efficiency, and fosters global idea exchange [5]. The participation of women in entrepreneurship is significantly lower than that of men in almost every country worldwide [6]. In countries in Central America, the Caribbean, South America, Southeast Asia, and Africa, the main drivers of entrepreneurial creation are the so-called push factors (necessity) [7]. Among the countries in the region, Brazil, Chile, Colombia, and Ecuador, Ecuador has a higher Early-

Stage Entrepreneurial Activity rate than the average, but also a high business exit rate (the highest in the region) [8].

The most common factors that limit people's interest in entrepreneurship, such as financial risks [7] or high responsibilities, may not be related to gender; however, there are aspects such as social acceptance, discrimination, and lack of role models that particularly affect women interested in becoming entrepreneurs in technology [9]. Studies claim that this behavior is based on the differentiated parenting style between men and women, which affects their entrepreneurial spirit [6], and that entrepreneurial intentions depend on the cultural context of their country or region [10]. Narratives about the experiences of women entrepreneurs or role models reduce barriers of race, class, and age; they diminish prevailing gender stereotypes, discriminatory work treatment, and portray entrepreneurship as a suitable alternative for working mothers [11].

Based on the report [8] the transfer of science and knowledge from universities to businesses is considered a weakness in Ecuador, which hinders scientific and technological-based companies from competing globally, given the low level of disruptive innovation [12]. Therefore, this study aims to reflect the perception of university students regarding starting STEM-based ventures with a gender focus, which will allow for adjustments in entrepreneurship education in universities and an increase in the production of services in STEM areas.

This research is limited to generating information from an Ecuadorian university located in the southern region of the country, with approximately 40,000 students, of which 7,000 are enrolled in on-campus programs and 33,000 students in distance learning programs throughout Ecuador. It is important to note that there are currently 4044 students enrolled in STEM programs.

II. METHODOLOGY

For the present research, a methodology composed of quantitative and qualitative analysis was applied in a complementary manner. To begin with, existing information was collected in the databases of students and alumni of the STEM careers at UTPL, which allowed us to characterize the study population considering the following aspects: number of female and male students by careers, study modality.

Subsequently, to collect qualitative information, a semi-structured survey was designed based on instruments applied

in similar studies. The survey is grouped into 3 sections: (i) personal and family information composed of 5 questions related to gender, age, career, marital status, number of family members, (ii) work situation composed of 1 main question regarding current work situation with four response options: studying, students and working, working only and unemployed, if the answer includes the option working 8 questions related to their work are deployed, (iii) entrepreneurial conditions and environment, with 8 questions, 6 of them based on the methodology mentioned by [13] and an open question about the training in entrepreneurship received in their training within the curriculum of the UTPL.

The analysis sample is composed of 159 students of the STEM careers in face-to-face and distance mode of the UTPL <https://www.utpl.edu.ec/>. The survey was applied to men and women based on the proportion of participation of women in STEM careers in order to establish differentiated indicators that allow us to understand the behavior of students in relation to entrepreneurship and job performance, with different curricular training. The survey was applied from January 27 to March 2, 2023.

The survey was developed in the ArcGIS Survey123 tool in order to facilitate the collection of the survey data and to be completed online. In order to apply the survey, it was sent to the students through the Whatsapp groups that the research teachers maintain with their students,

In the case of alumni, we worked with information provided by the Alumni Unit of the UTPL, referring to the follow-up studies of graduates that are conducted annually; specifically with the information of STEM careers both in the face-to-face modality 596 data and in the distance modality 138 in the interval of years 2018 to 2021. For the analysis of the information, the descriptive and comparative statistical methods were used.

III. STUDENTS RESULTS

A total of 159 responses were obtained from students of the following careers and representation of civil engineering (30%), architecture (21%), computer science (10%), telecommunications (9%), geology and mining (7%), information systems (5%) and computer science in face-to-face mode of study and information technology (17%) and computer science (1%) in distance mode of study.

Regarding the gender of the sample of students, 28% are women and 72% men in the on-site modality and 21% are women and 79% men in the distance learning modality, as shown in Fig. 1.

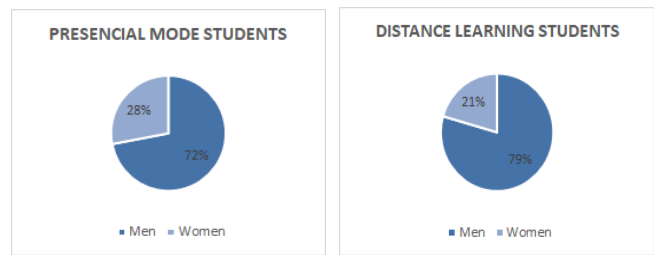


Fig. 1. Gender of students by mode of study

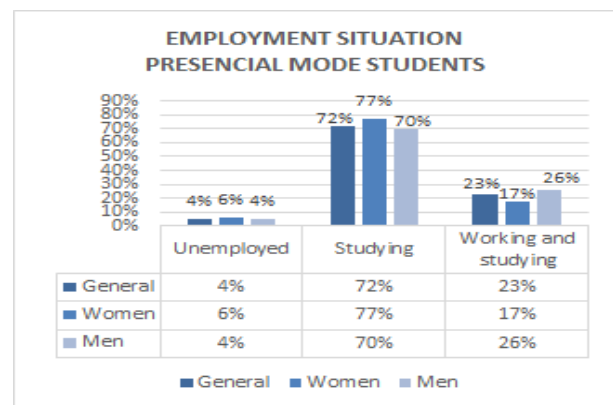
A. Personal and family information

This is a young 22, almost 67% are under 24 years of age. In the case of women, the average age is lower than the general trend, with 79% in the under 24 range and 17% in the 25-34 range, together representing 96%. On the other hand, in terms of family status, men and women are mostly single with almost 85%, while 12% are married and 3% have a marital status of free union. In the case of women, their marital status is higher than average and represents 93%, while 5% are married and 2% are in a free union.

The average number of students with family responsibilities is 30.81%. In the case of women, 26% say they have one family burden, 4.76% have three family burdens and another 4.76% have other family burdens, total 35.42%, which is higher than the general average for men and women.

B. Employment situation

Fig. 2 shows the employment situation of STEM students, where significant differences are highlighted between on-site and distance students, since in distance mode nearly 70% study and work, while in on-site mode slightly less than 25%, in the case of women in distance mode less than 45% and in on-site mode less than 20% study and work.



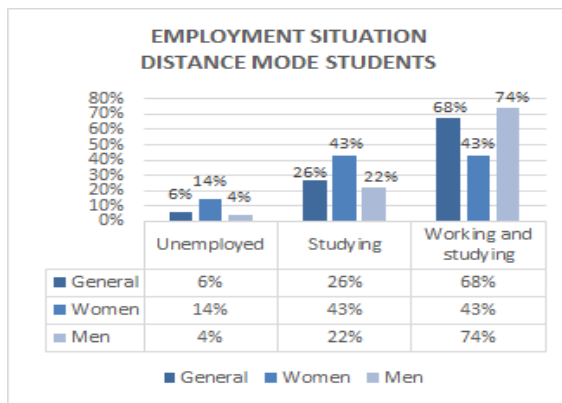


Fig.2. Employment status of UTPL STEM students by gender.

It is important to mention that the questions shown below were only answered by 52 students, which represent 23% of the overall sample and correspond to those who are working.

Regarding the relationship they have with the company where they work, 68% work for a third-party company, while only 32% work for their own company. In the case of women in this modality, 80% work for third parties and 20% work for their own company (see Fig. 3).

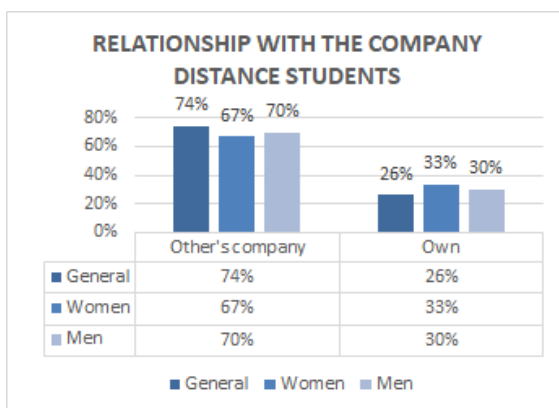
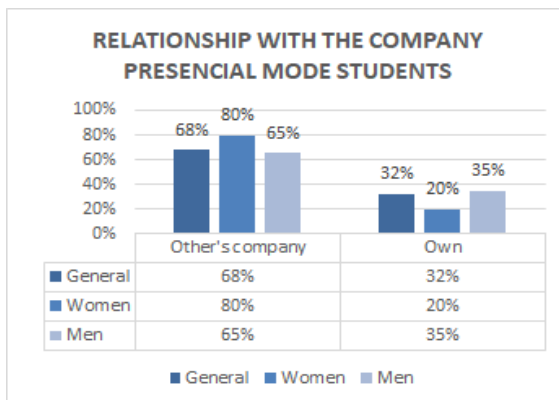


Fig. 3. Relationship with the company UTPL students.

Regarding the relationship of their current job with the career they are studying, in both on-site and distance mode, about 40% say that it is not at all related, about 30% that it is related and the other 30% that it is not very related. In the case of women, there is a greater difference between study modalities: 80% in the face-to-face modality and 67% in the distance modality state that their work is not at all related to their career, and 20% in the face-to-face modality and 33% in the distance modality state that their work is not at all related to their career.

C. Entrepreneurial conditions and environmental

Regarding entrepreneurial conditions and environment, the answers obtained show a partially favorable environment, some of the results obtained are shown below. When asked if they have thought about creating their own company, the majority (77%) stated that they have thought about it. In the case of women, 86% mentioned that they have thought about creating their own company.

Regarding the motivations for entrepreneurship, it can be determined that the main ones are to improve income, which can provide financial independence, professional growth, since they must manage all areas of the business, flexibility in the workday, and being their own boss. 57% of the men and women surveyed have financial independence as their main motivation, for 32% their motivation is personal and professional growth, and 11% do it to generate employment, mainly for their family; if we analyze only the responses of the women, we find that 63% have financial independence as their main motivation, 25% are motivated by the generation of employment with their entrepreneurship and 13% do it for their personal growth.

The main limitations for entrepreneurship would be the lack of seed capital, lack of training to have a clear vision of the business in terms of entrepreneurship and marketing, including how much to invest, which markets to attack and which are your competitors, as well as the lack of knowledge of issues such as legislation, taxation, trademarks; another of the main limitations is the motivation for lack of self-confidence and security in their proposals. When analyzing the responses of men and women we have: 47% consider financing as their main limitation, 25% training and 27% motivation; however, when analyzing the responses of women we have that: 40% consider financing as their main limitation, and 35% consider their own motivation, as well as 25% consider that they require more training to start their business.

On the other hand, when asked specifically if they have perceived opportunities for entrepreneurship, 59% responded that they have perceived opportunities for entrepreneurship and 41% have not. In the case of women, 57% stated that they have perceived opportunities for entrepreneurship, while 43% have not perceived opportunities for entrepreneurship.

Regarding entrepreneurial skills, 85% of the students in general say that they have the skills to become entrepreneurs.

In the case of women, 83% responded affirmatively to this question.

Regarding whether they know another entrepreneur in their environment, 75% say that they do know another entrepreneur. While 81% of the women responded affirmatively to this question.

Regarding the question whether they consider that their environment has favorable conditions for entrepreneurship, 55.35% of the students say Yes. In the case of women, 52.38% say that their environment has favorable conditions for entrepreneurship.

IV. ALUMNI RESULTS

A. Personal and family information

From the study applied, 137 Alumni in distance mode and 91 Alumni in on-site mode participated, therefore a total of 228 responses. Once the information has been analyzed, it can be seen that women represent 26% with respect to men, who represent 74% of graduates in the School of Engineering and Architecture in the face-to-face mode. As for the open and distance modality, the representation of women corresponds to 15%. These data continue to show the low rate of representation and involvement of women in engineering.

Regarding the gender of the Alumni of the School of Engineering and Architecture in the area of Computer Science, it has been determined that there is a population of 25% female and 75% male in the face-to-face modality; while in the open and distance modality, 15% corresponds to the female gender and 85% to the male gender. Based on this population, the data corresponding to student employment will be analyzed (see Fig. 4).

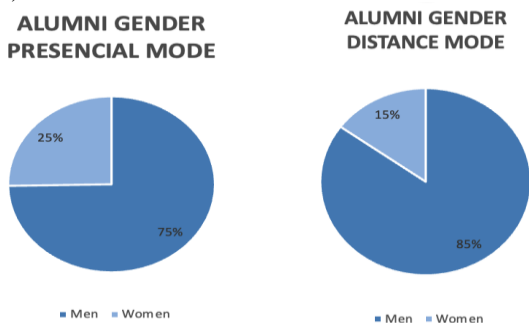


Fig. 4. Alumni gender by mode of study.

B. Employment situation

Regarding the economic situation of the Alumni in the on-site modality, 0% of women are unemployed, compared to 13% of men; as for the population of alumni who are studying a second career, 0% of women and 4% of men; on the other hand, 71% of women and 78% of men are only working, and 10% of women and 10% of men are working and studying at the same time.

It is worth mentioning that with respect to the average, women exceed the percentage of those who only work by 6%,

while they exceed the average of students who work and study by 2%.

Regarding the distance mode, 20% of female alumni are unemployed compared to 8% of men; while 60% of women are only studying and men correspond to a population of 84% and 20% of alumni who are working and studying at the same time correspond to women and 8% to men; however, the percentage of unemployed women is 10% higher than the general average of unemployment among alumni; as for the population that is only working, women are 21% below the general average and 10% higher than the average population that is working and studying (see Fig. 5)

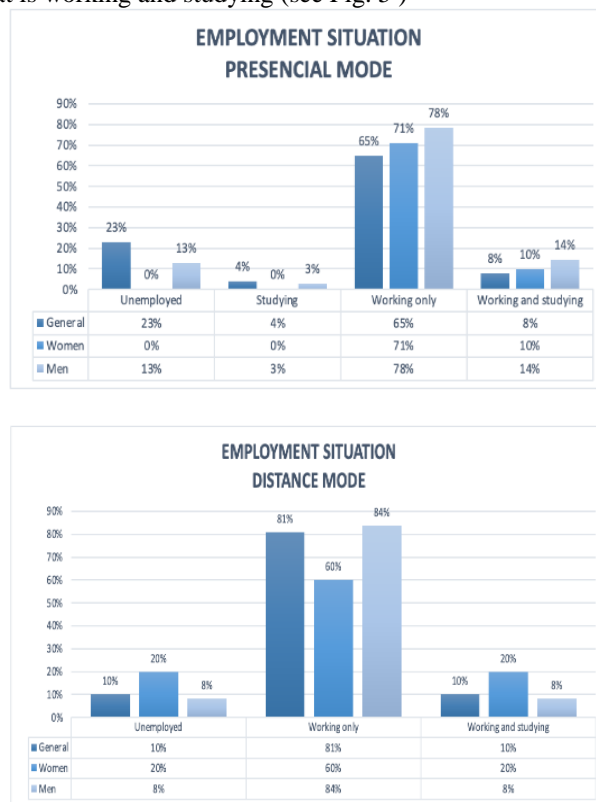


Fig. 5. Alumni employment status by mode of study.

We have also analyzed data on the relationship of dependence that our alumni maintain, that is, whether they are working in their own companies or in other companies. Thus, the overall average of on-site students working in other companies is 88% and 12% in their own companies, of which 86% of female students have a relationship of dependence with other companies and only 14% in their own companies, from which we can highlight that women exceed the overall average of those who work in their own companies by 2%. As for distance learning students, the general average of those who work in other companies is 87% and 13% in their own companies; thus, 75% of women work as employees of other companies and 25% in their own companies; that is to say, 12% more than the general average of those who work in their

own companies. In this way, it can be seen that female distance learning students are better entrepreneurs.

Finally, the relationship of the current job with the career has been analyzed, so that the general average of the on-site mode students who perform activities not related to the career is 1%, of which women represent 3%; on the other hand, the general average of those who perform activities related to the computer career is 80%, with women representing 69%, and the general average of those who perform activities that are not very related is 19%, of which women represent 28%. In contrast to the distance learning students, where 6% work in unrelated activities and the same percentage of women; as for those who work in the field of computing, the overall average is 73% of which 69% are women; while those who are not very related, 21% is the overall average of this population, women represent 25%; therefore, it can be concluded that 69% of the female students are working in their own careers.

III. DISCUSSION

The results show that women's participation in work and entrepreneurship is significantly lower than that of men. This highlights the importance of addressing the barriers and challenges that limit women's interest and participation in STEM entrepreneurship.

Among the barriers identified are social acceptance, discrimination, and lack of role models. These barriers can discourage women from engaging in STEM fields and limit their access to job opportunities in these sectors. Therefore, it is necessary to implement programs and policies that promote gender equality in STEM entrepreneurship, provide support and resources to women entrepreneurs, and encourage the creation of female role models in these fields.

In addition, there is evidence of the need to include entrepreneurship education in universities to address the specific needs of women in STEM. This involves offering entrepreneurship education and training programs that are relevant to STEM fields, as well as strengthening the confidence and self-confidence of women entrepreneurs. The production of services in STEM areas should also be increased to promote economic growth and job creation in this field.

VI. CONCLUSIONS

After the analysis carried out, regarding work, as expected, students in face-to-face mode are mostly dedicated to study only 72% in general and 77% of women, while in open and distance mode 81% of the students are dedicated to work only; there is a significant difference between the general average results (both sexes) and women specifically, about 20% less of female students study and work; and a similar percentage of 20% less of female students work only.

On the other hand, the relationship with the company for which they work in the case of on-site students 32% say they are working for their own company, in the case of women 20%; in open and distance mode 26% of students work for

their own company and in the case of female students 33%. For on-site alumni, 12% work for their own company, compared to 14% of women, and for open and distance learning alumni, 13% work for their own company, compared to 25% of women alumni. From which it can be highlighted that female students and alumni, both face-to-face and distance mode, have a work relationship for their own companies of about 10% more than the average.

Regarding entrepreneurship, we can be concluded that we have a high percentage of female students in STEM careers at UTPL who are interested in entrepreneurship, who have thought about starting a business, and know people in their environment who have started a business and it seems that the conditions for entrepreneurship would be favorable, They also mostly express the need for entrepreneurship to improve their economic situation, be independent and generate employment, however, among their main limitations, unlike men, are their motivation, self-confidence and self-confidence, followed by the need for financing and training.

Likewise, when performing a detailed analysis, we see that female students in civil engineering consider lack of motivation as the main limitation; female students in the field of computer science consider financing to be their main limitation; and female students in architecture consider lack of financing and training to be their main barriers to starting their entrepreneurship, so we can conclude that although it is necessary to implement actions that allow female students to realize their entrepreneurial ideas, these must be adjusted to the needs of each university career.

One of the main conclusions is to determine that the enterprises that have been started and those that are planned to be started respond to a need, but not to a market opportunity, which reflects the lack of employment, and it is confirmed in the information of the students who have graduated, that most of their work is not related to their university education.

It is important to consider that it is a strength that universities provide training in entrepreneurship, however, the training is not focused on STEM topics, so students do not expect to have the necessary tools for entrepreneurship, unlike the food sector, wholesale trade [8], retail trade of basic necessities, clothing [7] among others.

ACKNOWLEDGMENT

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REFERENCES

- [1] Materias STEM: el 25% de los estudiantes que inician estudios superiores ya lo hacen en este campo. <https://www.educacionrespuntocero.com/noticias/estudiantes-stem/>
- [2] García-Holgado A, Segarra-Morales S, González-Rogado AB, García-Peñalvo FJ (2022) Definition and Implementation of W-STEM Mentoring Network. CEUR Workshop Proc 3321:32–41

- [3] Entonces, ¿quieres una carrera en STEM? <https://www.studyusa.com/es/a/4063/entonces-quieres-una-carrera-en-stem>.
- [4] Debeljuh P, Foutel M, Carbonell ST (2022) Barreras y desafíos de las Emprendedoras STEM. 360: Revista de Ciencias de la Gestión.
- [5] Idrovo Carlier S (2020) Realidades y desafíos de los emprendimientos de mujeres en áreas STEM. INALDE Nro 54 17–21
- [6] Shahriar AZM (2018) Gender differences in entrepreneurial propensity: Evidence from matrilineal and patriarchal societies. *J Bus Ventur* 33:762–779.
- [7] Silvana M, Guerrero C, Giomara B, et al (2022) Tendencias del emprendimiento joven: caso Emprende Joven Ecuador 2021. *Universidad y Sociedad* 14:215–221
- [8] Entrepreneurship in Ecuador - GEM Global Entrepreneurship Monitor. <https://www.gemconsortium.org/economy-profiles/ecuador-2>.
- [9] Kovaleva Y, Hyrynsalmi S, Saltan A, et al (2023) Becoming an entrepreneur: A study of factors with women from the tech sector. *Inf Softw Technol* 155:107110.
- [10] Shinnar RS, Giacomini O, Janssen F (2012) Entrepreneurial Perceptions and Intentions: The Role of Gender and Culture. 36:465–493.
- [11] Byrne J, Fattoum S, Diaz Garcia MC (2019) Role Models and Women Entrepreneurs: Entrepreneurial Superwoman Has Her Say. *Journal of Small Business Management* 57:154–184.
- [12] Hugo V, Tomalá V (2020) Los factores que afectan a los emprendimientos en el Ecuador. *INNOVA Research Journal* 5:122–133.
- [13] Abbasianchavari A, Block J (2022) Perceptual factors explaining the gender gap in entrepreneurial propensity: A replication and extension. *Journal of Business Venturing Insights* 17