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Artículos científicos

Análisis de percepciones en cargos STEM ocupados por mujeres

Analysis of perceptions in STEM positions held by women

Análise das percepções sobre cargos STEM ocupados por mulheres

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Resumen

El empoderamiento femenino está relacionado con el empleo de las mujeres; es un hecho que abre las posibilidades de contar con autonomía económica y de hacerle frente a diversas formas de violencia de género que se pueden gestar en la familia o en las estructuras sociales. El objetivo de este artículo es analizar las percepciones de mujeres que trabajan en sectores STEM, respecto a diversos elementos que inciden en su ingreso, permanencia y desarrollo en el campo laboral, para identificar posibles actos de discriminación y brechas de género. Es un estudio cualitativo en el que se realizaron 15 entrevistas semiestructuradas a mujeres STEM. Se encontró que las principales motivaciones de estas mujeres surgen del temprano acercamiento a los autos, computadoras, aviones, además de un fuerte sentido de logro. Por otra parte, se descubrió que las mujeres no tienen las mismas oportunidades que los hombres en los campos STEM. Otro resultado obtenido es que las mujeres, para poder colocarse en el

mercado de trabajo, han tenido que lidiar con los varones que se sienten superiores y la falta de experiencia en el campo. Por último, se encontró que en el sector público existe la cultura del mérito para poder ascender, pero en el sector privado no existen mecanismos claros de ascenso. Se concluye que, para prevenir y eliminar cualquier tipo de discriminación o violencia laboral, se tiene que trabajar con el sector que contrata a las mujeres STEM (normas ISO y certificación), además de implementar estrategias que permitan el ingreso y su permanencia en el trabajo.

Palabras clave: mujeres STEM, mercado laboral, discriminación, violencia, techo de cristal.

Abstract

Female empowerment is related to women's employment—it is a fact that opens the possibilities of having economic autonomy, and facing various forms of gender violence that can take place in the family or in social structures. The objective of this article is to analyze the perceptions of women who work in STEM sectors regarding various elements that affect their entry, permanence and development in the labor field, and to identify possible acts of discrimination and gender gaps. It is a qualitative study, in which 15 semi-structured interviews with STEM women were conducted. It was found that the main motivations of these women arise from the early approach to cars, computers, airplanes, as well as a strong sense of achievement. On the other hand, it was discovered that women do not have the same opportunities as men in STEM fields. Another result obtained is that women (in order to find a place in the labor market) have had to deal with men who feel superior, and the lack of experience in the field. Finally, it was found that in the public sector there is a culture of merit that leads to be promoted, but in the private sector there are no clear promotion mechanisms. It is concluded that, in order to prevent and eliminate any type of discrimination or workplace violence, it is necessary to work with the sector that hires STEM women, in addition to implementing strategies that allow entry and their permanence at work.

Keywords: Women STEM, labor market, discrimination, violence, glass ceiling.

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Resumo

O empoderamento feminino está relacionado com o emprego das mulheres; é um fato que abre possibilidades de autonomia econômica e de enfrentamento das diversas formas de violência de gênero que podem ocorrer na família ou nas estruturas sociais. O objetivo deste artigo é analisar as percepções de mulheres que trabalham em setores STEM, sobre vários elementos que afetam sua entrada, permanência e desenvolvimento no campo do trabalho, para identificar possíveis atos de discriminação e diferenças de gênero. Trata-se de um estudo qualitativo no qual foram realizadas 15 entrevistas semiestruturadas com mulheres STEM. Constatou-se que as principais motivações dessas mulheres decorrem da aproximação precoce a carros, computadores, aviões, além de um forte senso de realização. Por outro lado, descobriu-se que as mulheres não têm as mesmas oportunidades que os homens nas áreas STEM. Outro resultado obtido é que as mulheres, para conseguirem uma vaga no mercado de trabalho, têm que lidar com homens que se sentem superiores e sem experiência na área. Por fim, constatou-se que no setor público existe uma cultura de mérito para ser promovido, mas no setor privado não existem mecanismos claros de promoção. Conclui-se que, para prevenir e eliminar qualquer tipo de discriminação ou violência no trabalho, é necessário trabalhar com o setor que contrata mulheres STEM (normas e certificação ISO), além de implementar estratégias que permitam o ingresso e sua permanência no trabalho.

Palavras-chave: mulheres STEM, mercado de trabalho, discriminação, violência, teto de vidro.

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Introduction

The scientific literature affirms that women in Latin America participate the least in the labor markets, are employed in the informal sectors, obtain lower remuneration, and have little presence in managerial and executive positions. It is known that these types of gaps are still present despite the progress achieved in the last 50 years; unfortunately, gender biases still distort or limit human capital formation. Education is one of the most important elements to safeguard equal opportunities; however, there are two situations that limit the participation of men and women in the labor sector—the first is related to the division of labor and the second with the responsibilities assumed by men and women. Both frequently generate discriminatory environments towards women. It is essential to work on labor policies that

help create the necessary conditions to eliminate the cultural, institutional, and legal barriers that prevent women from participating more intensely in the labor markets (Marchionni, Gasparini, and Edo, 2019).

According to González (2021), despite the advances made by feminist movements, which seek to vindicate the role of women as social and political subjects, there are still pending historical debts. Unfortunately, the majority of women work more irregularly, coupled with the fact that they tend to interrupt their careers, which has important repercussions on their income (Petrongolo and Ronchi, 2020). For their part, Samtleben and Müller (2022) emphasize that women are the ones who perform most of the unpaid domestic and care activities; this creates a wide and persistent gap in relation to men. This unequal gender division of household tasks has impacts on job outcomes and career prospects, as it is reflected in labor market participation and actual working hours. The repercussions are diverse due to the low presence of women in the labor markets, such as poverty in the old age of women.

There are findings that allow us to account for the scenarios that present from childhood onwards, which highlight the realities of many countries. Hägglund and Leuze (2021) found that, across the 35 European Union and OECD countries they studied, boys are all more likely to expect to work in a STEM occupation before the age of 30, acknowledging that gender gaps are the result of various factors that emerge in each country. In addition, it is necessary to measure the results on STEM initiatives at the country level, aimed at children. Another important finding is that the challenge of gender roles in STEM fields is not related to the fact that young women observed more women develop in science and technology, since young women do not react to the gender composition in STEM fields, but rather to the gender attributes of occupations.

Another element that appears in the literature is persistence. In a study conducted at 83 educational institutions, men persist longer in STEM fields than women: 65% of them graduate, while only 48% of women do. In addition, there are findings that indicate that women perceive lower self-efficacy in mathematics, academic self-confidence, and confidence in specific abilities than men. This means that it is necessary to work on interventions that support the development of women's self-efficacy. On the other hand, it has been found that schools where there is a greater female presence increase the persistence

of women—so, schools could implement policies that favor the entry of a greater number of women (Koch, Sackett, Kuncel, Dahlke & Beatty, 2022).

In addition, shocking evidence that contributes to understanding the STEM phenomenon in the workplace, such as those found by Moss-Racusin et al. (2012): they analyzed evaluations by professors at six major universities, who rated female and male job applications for the position of laboratory manager, and found that the highest ratings were assigned to male applicants, mentioning that they are much more deserving of the position and have a higher salary. Also, Bian et al. (2018) found that men are more likely than women to be recommended for jobs that require brainpower.

A study in Mexico found that women in STEM continue to face a lack of opportunities and a lack of equality to advance their careers (Lappe, Torales-Sanchez, Fuentes, & Caratozzolo, 2021). In addition, the declaration of the global COVID-19 pandemic has led to a worsening of the crisis of violence and insecurity against women. It was found in Mexican students in a vulnerable situation that the majority drop out due to their economic condition, in addition to lack of interest, gangs, pregnancy, alcoholism, drug addiction, among others. Some of these findings are related to the lack of support from parents, who want their children to work instead of studying, having to share digital resources by not having their own to carry out academic tasks, sadness and apathy. due to the pandemic (Ruíz et al., 2021).

Another element that causes the regression for women is discrimination at work, which is a complex phenomenon. It is recognized that many women enter organizations at the lower levels of the hierarchies, but their ascent is stormy and is often hindered by both men and women due to mistaken and erroneous perceptions related to the roles and stereotypes that would supposedly be held to play in society (Daldrup-Link, 2017). Considering the previous context, the research questions were: What are the motivations for women to study a STEM career? What are the elements that influence women to enter, remain and develop in STEM fields? What are the perceptions of possible acts of discrimination received at university and at work? What have been the probable thoughts that have led them to imagine leaving their jobs? The objective of the article is to analyze the perceptions of women who work in STEM sectors related to their motivations and some elements that affect their income, permanence, development or, where appropriate, abandonment, and discrimination that generate gender gaps. The above in order to identify

and reflect on the ways in which women survive and remain in labor fields that, on various occasions, are masculinized.

The panorama faced by STEM women in the workforce

In society, it is women who bear the greatest burden of unpaid work in the family, which imposes barriers for them to be able to match the success levels of men. Furthermore, despite efforts to keep them in the labor markets, they continue to be underrepresented and still earn less than men. It is commented in the literature that this may be due to the responsibilities involved in caring for children and housework. Equality between women and men is complex, because productivity is measured by working hours, and it is evident that women dedicate fewer hours to paid work, which causes employers to decide not to promote women to higher range jobs. Despite the fact that women and men have the same job ambitions, women—due to their family occupations—are not available twenty-four hours a day, so it is thought that women are less productive by not having that time availability, coupled with the fact that employers are uncertain if a woman will lower her productivity standards when she decides to get pregnant (Iversen, Rosenbluth and Skorge, 2020).

Various efforts have been made in all countries for the incorporation and permanence of women in the world of work, and thus reduce the gender gap and labor inequality. Unfortunately, the world of work for women continues to be subject to patriarchal patterns that hinder their development (Marin and Parra, 2020). STEM women also continue to face persistent pay gaps, and the retention process has become complicated as many of them decide to leave their jobs within the first five years or after taking one or two maternity leaves (Baruah and Biskupski-Mujanovic, 2021). Certainly, a good conciliation at work and a balance in the working life of women results in a lower level of professional advancement, so conciliation is a professional barrier that contributes to thickening the glass ceiling (O'Dea, 2019). Therefore, it is essential to guarantee that women participate effectively with equal opportunities in decision-making and leadership positions in all spheres—political, public, and private—, in addition to improving access, and use of information and communication technologies to promote female empowerment (Castaño, Lubiano and García-Izquierdo, 2020).

Manzi and Heilman (2021) test the assumption that the presence of women in leadership positions allows breaking the glass ceiling for other women, nevertheless it is not

only the presence that really influences, but the evaluations towards their performance. Not only the barriers caused by the glass ceiling are considered, all the same the effects of the stone floor, which is characterized by temporary contracts, without employment benefits and with few opportunities for growth and professional advancement (Maddrell, Thomas and Wyse, 2019). Another of the elements that make up the analysis is the evidence that women prefer to work with male leaders than with women—this further thickens the glass ceiling (Salam and Javadizadeh, 2022). For their part, Chan and Wang (2018) show results indicating that female employers tend to hire more women than male employers.

The literature emphasizes that women face various barriers to ascend to leadership positions, such as the lack of a support structure within organizations, the social norms, and even the obstacles that many of them impose on themselves. The glass ceiling turns out to be costly for organizations in terms of loss of productivity among women, turnover costs, and salaries (Amaechi, 2018). There is evidence that women employed in STEM areas work in complicated and sometimes hostile environments, where sexual harassment and discrimination are present, which suggests that gender is more of an impediment than an advantage for women's career (Funk & Parker, 2018).

When studying the barriers related to the achievement of women in STEM, Amon (2017) found that they were not recognized as authority figures, so, in order to mediate the situation, they work to maintain positive relationships, which caused them to wear out their energy and time, since they were all the time concerned about pleasing others. An interesting finding is that women seek social support and sometimes find it in mentors, who help them cope with negative experiences. Also, the most important challenges were aimed at finding a balance between work and life, in addition to working with few limited degrees of freedom, coupled with the fact that subordinates do not take seriously when women are the ones in charge.

The glass ceilings, which are supported by various barriers—such as social, governmental, and internal business barriers—, block the advancement of women in the labor field under equal conditions. Social barriers have their origin in gender stereotypes and prejudices; those limitations for the formation of skills for the labor market that have their origin in the scarce guarantee of equal access to quality education are also considered. For their part, the obstacles that generate glass ceilings in government institutions are due to the lack of labor policies that help to make the load of highly demanding positions compatible

with family life, in addition to the lack of a care system that allows women to extend their working hours (Marchionni, Gasparini and Edo, 2019).

The glass ceiling is an invisible barrier that prevents women with well-qualified skills from moving up the organizational ladder, despite the fact that they have significant achievements and merits (Marin and Parra, 2020). Continuing with the theme of barriers, we talk about the individual factors that are self-imposed obstacles by women for the development and advancement of their career: lack of self-confidence. Women's goals differ from men's, as they tend to choose jobs that balance family and personal life—when women have to make decisions about full-time jobs that take them away from their family priorities, they choose to leave employment temporarily. However, attention should be paid to the education that women receive from childhood, where the social roles that cause great differences between women and men are prescribed. In addition, they generate a lack of self-confidence and a lack of management in aspirations. It is important to work on the confidence of girls and women, because its absence prevents them from participating in the promotion processes, which in turn causes their professional development to slow down in the workplace. It should not be forgotten, however, that frequently they decide to delay their organizational promotion processes because they are in charge of caring for their children and parents. Other elements that influence the perceptions of the glass ceiling of women are the level of education, marital status, maternity situation, age, social class (Maheshwari y Lenka, 2022; Saifuddin, Dyke y Hossain, 2019).

Lubinski et al. (2001) found that gender gaps in STEM, and more markedly at higher levels, are related to the life priorities that men or women show: they mention that young and intellectually gifted men prioritize professional success and income more than women; in the case of the latter, they want a job that allows them to have a balance with family and friends. In addition, it is recognized that men invest more hours in paid work than women, coupled with the fact that they are more willing to make sacrifices to reach the top. The average woman thinks that career advancement is just as achievable as men think, but less desirable. Interesting data showed that it seems that the choice of professions, specific career interests and priorities in people's lives are related to prenatal hormones: women with CAH have been found to be more exposed to abnormal levels of androgens, so these women tend to be more oriented to things than to people; in the same way, they do not show interest in being mothers,

prioritizing their professional development, and they are also more likely to work in masculinized environments.

Riffle et al. (2013) found in their research that STEM men and women identified elements of their work environment that contributed to success: they mentioned that mentoring, social support, and work-life balance had been important. However, they noticed differences between them in relation to the perception of the departmental climate: women reported greater discrimination and sexism during the interviews, less departmental camaraderie, and having less influence in their department. Another interesting fact is that women, despite having the same productivity as men, noted that their departments considered their productivity to be lower than that of their colleagues. This makes it possible to identify the various faces of gender inequality and helps to make visible the obstacles that women face in STEM areas.

Education and paid work are elements that allow the social mobility of women. When they achieve important academic results, they obtain social prestige, coupled with the fact that they show greater social and psychological motivation in the academic field, which may have the consequence of responding to patriarchal models (Dalouh and Soriano, 2017). In a survey carried out with students in 75 countries, it was found the perception that stereotypes related to talent are associated with men, and that these stereotypes are stronger in high-achieving students and in more developed countries; gender gaps were also found in competitiveness, self-confidence and willingness to work in occupations that are related to Information and Communication Technologies (ICT). Assigning empowering stereotypes to men with special qualities explains the glass ceiling that women are facing (Napp & Breda, 2022). According to Leslie, Cimpian, Meyer and Freeland (2015), they were able to demonstrate the existence of a stereotype of gender brilliance that makes men see themselves as more brilliant than women. These beliefs carry over to the family—in fact, parents think their sons are smarter than their daughters (Furnham, Reeves y Budhanl, 2002).

For Swafford and Anderson (2020) the main barriers to pursuing STEM careers were found to be: masculinization of STEM careers, little knowledge about the educational and professional opportunities available in these fields, lack of female mentors, lack of visibility of the obstacles in this type of career, the hours of dedication needed to master some area of knowledge, personal expectations, and the dying glass ceiling perceived by women. For Yu and Hsieh (2022), it is not enough to improve leadership in higher education, but work must

be done from the departmental level of schools, in such a way that each department manages to develop a positive climate, allocate resources and structure policies to increase the integration of students and encourage young people to persist in careers, especially those who come from families with few resources.

Reviews have been carried out on the programs that have been implemented and that are oriented towards motivating women and girls towards STEM areas, and strategies were identified such as: 1) talks, 2) support guides, 3) workshops, 4) mentoring, and 5) visits to technology industries. Likewise, UN Women identified limitations in the programs in Latin America and the Caribbean, which are aimed at the integration of women and girls in STEM areas. Some of them are: a) these programs are initiatives that are presented occasionally, but lack continuity to offer follow-up to the actions implemented; b) the programs are worked on separately and with little support between the institutions, coupled with little linkage; c) the programs are carried out with little budget, which makes it difficult to continue and strengthen them in the long term; d) scarce holistic approach related to gender equality, which tends to maintain a reduced vision of what science is; e) the activities do not contemplate mothers and fathers, who reinforce education at home and scientific vocations, and f) the barriers faced by women in populations in marginal areas are not made visible (González, 2021).

Successful professional women are female role models and help mitigate gender stereotypes that stem from traditional gender norms. Women in competitive fields allow those who admire them to recognize their self-confidence and to accept that competition between women is positive. There is evidence that the most admired women in roles that go against stereotypes are politicians, scientists and astronauts—these models challenge traditional gender norms, which are those that people assume and reflect what society expects of them (Chhaochharia, Du, & Niessen-Ruenzi, 2022). Therefore, it is essential to develop training programs that address the issue of women's leadership and that emphasize the importance of preparing more women leaders. It is recognized that women in leadership are important in decision-making and in the legislation of the countries, since they give women a voice, and they make the problems of women and girls visible, in addition to positively influencing health issues, welfare, poverty, and work (Amaechi, 2018).

Economic models that explain discrimination

According to Chiplin and Sloane (1976), economic discrimination models are oriented towards racial discrimination, but they also explain sexual discrimination; that is, they analyze the reasons why men and women do the same job but women receive different salaries. For his part, Becker (1971) works with the idea that there are some employers and workers who do not want to work or be close to members of other groups, including women. The group that is discriminated against is just as productive—however, the company may decide to hire them, but at lower wages, or it may not offer them work, and decide to stick with the people they like but cost more, meaning the company absorbs the cost of discrimination.

On the other hand, there is the theory of human capital that analyzes the occupational segregation of women as the result of the decisions that they are making during their lives, derived from their absences from the labor force due to the fact that, on some occasions, they have children and have decided to raise them. What is a fact is that women's domestic work is one of the most important elements of occupational segregation, coupled with the number of hours they invest. As a result, they lose hours of training and acquisition of skills that could be applied in the labor markets (Pratt and Hanson, 1991; Mincer and Polachek, 1974). Likewise, there is talk of a segmentation of the labor market in which women are disadvantaged, on the other hand, men benefit, since they are the ones who are mostly chosen for jobs. The foregoing attracts consequences in wages; in this way, women are segregated from the best jobs because they are less socially accepted and not because they lack skill (Boston, 1990).

Method

In this research work the qualitative method was used. A semi-structured interview was designed using the literature review. Fifteen women who were working in the STEM sector were interviewed (see Table 1). The questions focused on inquiring about: a) their motivations for studying their STEM fields, b) perceptions about whether women working in STEM fields have the same opportunities as men, c) discrimination in university studies, d) discrimination in work, e) effects of the COVID-19 pandemic, f) challenges to find a place in the labor market, g) mechanisms that allow to move forward (or, where appropriate, go backwards) within organizations, and h) perceptions about whether they have thought about

leaving their job because they find themselves in a masculinized environment. The way to contact each interviewee was through an invitation that young researchers in training made in October 2021. The profile of the women that was sought was aimed at having completed their career in STEM and that they had found working The interviews were developed using information and communication technologies, and audios were recorded with the permission of the interviewees. Each of the interviews was transcribed and analyzed using Atlas Ti version 9 software.

Table 1. Women participating in the study

Case number	General data	STEM Career	Institution of graduation	Active time in the labor market	Current position	Organization
1	Sweet 25 years Single No children Graduated	Automotive Systems Engineering	National Polytechnic Institute, Mexico	2 years	Supplier Management Analyst	GNP Insurance
2	Adriana 28 years old Single No children Graduated	Industrial Engineering	National University of Colombia	2 and a half years	Research Professor	University of Colombia
3	Alejandra 30 years Married	Military Aviator Pilot	College of the Air, Ministry of National	7 years	Military aviator pilot	Secretariat of National Defense

Case number	General data	STEM Career	Institution of graduation	Active time in the labor market	Current position	Organization
	2 children Graduated		Defense, Mexico			
4	Diana Guadalupe 26 years old Single No children Graduated	Computer Systems Engineering	National Polytechnic Institute, Mexico	3 years	Software Analyst	Company dedicated to software development
5	Diana 43 years old Married No children Graduated	Chemical Engineering	Tecnológico Nacional de México, Orizaba campus	20 years	Professor	Higher Education Institution
6	Karen 28 years old Single No children Graduated	Civil Engineering	Instituto Politécnico Nacional, ESIA, México	1 year and a half	Site Supervisor	Rotoplas

Case number	General data	STEM Career	Institution of graduation	Active time in the labor market	Current position	Organization
7	Mireya 33 years old Single No children Graduated	Bionic Engineering and Master's Degree in Automatic Control	Instituto Politécnico Nacional, UPIITA, Mexico	7 years	Data scientist	Company dedicated to IT platforms
8	Vianey 30 years Single One daughter Graduated	Bacteriological Chemist and Parasitologist	National Polytechnic Institute	5 years	Clinical chemistry	Mexican Social Security Institute
9	Liliana 36 years old Married No children Graduated	Food Engineering	Universidad del Valle	10 years	National leader of the master's degree in food biotechnology	Universidad Nacional Abierta y Distancia at UNAM.
10	Sandra 27 years old Married No children	Renewable Energy Engineering	Benemérita Universidad Autónoma de Puebla (Autonomous University of Puebla)	3 years	Energy Analyst	Environment Secretariat

Case number	General data	STEM Career	Institution of graduation	Active time in the labor market	Current position	Organization
	Graduated					
11	Evelyn 26 years old Single No children Graduated	Automotive Systems Engineering	National Polytechnic Institute	2 years 10 months	Product engineer	Chrysler
12	Jacqueline 48 years old Divorced Two children Graduated	Civil Engineer	University of Nariño, Colombia	23 years old	Director in auditing	Service to individuals
13	Maricruz 39 years old Single A son Graduated	Computer Science	Centro Universitario Grupo Sol	18 years old	Digital lab leader	Pharmaceutical company
14	Paulina	Computer Engineering	National Polytechnic Institute	2 and a half years	Data Engineering	Google

Case number	General data	STEM Career	Institution of graduation	Active time in the labor market	Current position	Organization
	26 years old Single No children Graduated					
15	Rocio 29 years old Single No children Graduated	Civil Engineering	National Polytechnic Institute	1 year	Entrepreneur in construction, design of structures and hydraulic works.	Own business

Source: Prepared by the authors based on the results of the interviews.

Results

Motivations for studying STEM fields

The participants were asked what had been the motivations that led them to study STEM careers. It was found that a source of inspiration for one of the women was her brother and wanting to become like him—that is, a brilliant engineer, despite the fact that she confessed that she did not like mathematics and did not understand it either, but she always kept in mind the desire to be an engineer. Another testimony was obtained in which she wanted to enter the university to continue advancing in her personal life. In another case, her father was an important inspiration: he was a pilot, so she grew up among airplanes. Similarly, another of the engineers expressed that several women in her family are engineers and that is where her main motivation arose. In addition, in several cases a taste for mathematics was detected,

together with contact with cars, a love for computers and the desire to know how certain devices work (see Table 2).

Table 2. Motivations for STEM studies

Category	Content analysis
Motivations for studying STEM	Older brothers and sisters who opted for those careers. Studying a university degree with the goal of getting ahead. The father who has contact with airplanes, cars, in that way it is naturally assimilated that it is a suitable environment for them. The family. Taste for mathematics. Taste for difficult challenges. Concern about how things work.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Perceptions about whether women studying STEM fields have the same opportunities as men

The findings in this area offer certainty about the fact that women perceive that they do not have the same opportunities as men in STEM fields. It was found that one of the participants mentioned that she feels satisfied for having managed to complete the university degree, but she does not recommend that other young people take it, since the emotional exhaustion is a heavy toll. Another of the women said that she perceives inequality in the labor field between women and men, since society has been in charge of giving men greater visibility in the areas of mathematics and technology, coupled with the fact that companies prefer to hire men. One of the engineers expressed that, in several cases, she has seen how it is more difficult for female colleagues to rise to high-level positions and, if they succeed, it is because they have had to demonstrate too much extra work, while it is more difficult than for men to be taken into account. In the same way, it is recognized that in several job offers they prefer the profiles of men. It was also found that there is a belief that they are more rational and that,

therefore, they have greater ability to be programmers and manage to obtain employment faster (see Table 3).

Table 3. Perceptions of whether women studying and working in STEM fields have the same opportunities as men.

Category	Content analysis
Women studying STEM fields have equal opportunities to men	Women seeking the opportunities receive a heavy emotional toll.
	Gender inequality in the labor field and in universities.
	Jobs that do not allow women to work.
	Age discrimination.
	Disadvantage because they are women.
	Preference in hiring males because they do not get pregnant.
	Women have to prove themselves more in order to move up in companies.
	Companies are more willing to hire men because of the long working hours.
	Women encounter various difficulties that prevent them from practicing.
	Men are better programmers than women, they are more rational.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Discrimination in University studies

It was found that one of the interviewees had to face sexist comments from the professors: they questioned what a woman was doing studying a men's degree, and, with contempt, they made comments that women were later complaining because they couldn't find work; they even told her to change her career. In addition, they belittled her and did not take her work into account in the evaluations, in the same way as they did with the boys. Also, she commented that she came to feel that the teachers ignored her, and did not take her presence into account, which brought with it the desperation of moving to another academic unit where the environment was not so hostile.

In another case, the female pilot acknowledges that the road was never easy in the army; she had comments such as "go sweep your house, go do your chores", coupled with the fact that more was expected of women, since at all times they were stressed that they had to obtain

better grades. She also commented that during the history of the military school there are only twenty-five women graduated as aviator pilots.

One of the engineers pointed out that many of her classmates felt superior in relation to her intellectual abilities. Another of the interviewees commented that she felt like one of the teachers ignored her; despite the fact that she participated in class, he made her feel less and she expressed: "Many of the teachers are machos." On the other hand, one of the women mentioned that in postgraduate school she had perceived acts of machismo, such as the fact that some of the projects were given more to men than to women, coupled with the fact that she was questioned why a married woman would not better stay at home tending to her husband. In another case, one of the women recounted that one of the teachers sent her for her breakfast, but she also highlighted that some of the teachers treated the women with greater tenderness. Similarly, one of the interviewees pointed out that she was excluded from the teams that were formed within the classroom, in addition to not taking into account her technical contributions to the projects; she expressed that some teachers came to invite her to have a drink with them. One more of the young women expressed that many of the comments, jokes, and pranks where women are involved are normalized at school and their ability is questioned, in addition to expressions by teachers where they expressed to the young women that they did not go to exercise and paid more attention to men (see Table 4).

Table 4. Interpretations of possible acts of discrimination in university studies

Category	Content analysis
Discrimination in university studies	Sexist comments. Ignoring and disregarding the participation of female students. Expectations for more effort from women in masculinized sectors. Belief that men have greater capacity. Women are excluded from work teams. There are doubts about their performance because it is thought that, since they are women, they do not have the capacity to achieve certain results.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Acts of discrimination in the labor world

The interviewees were asked if they had received acts of discrimination in their jobs; important findings were obtained. One of the women emphasized that she had experienced various obstacles in applying for a promotion. The foregoing was caused because she refused to have a sentimental relationship with her boss, and when she complained, he expressed that this type of behavior would affect her work. When one of her friends got promoted, she was able to apply and win the position. Another of the interviewees expressed that she, because she is a mother, has been the victim of acts of discrimination. Many of the expressions that she has received are aimed at casting doubt on possible promotions due to lack of time. It was also found that one of the engineers has felt how they minimize her work proposals, making her believe that they are not significant (see Table 5).

Table 5. Perceptions of acts of discrimination in the workplace

Category	Content analysis
Acts of discrimination in the workplace	Sexual harassment. Discrimination for being a mother. Minimization of ideas and proposals. Men do not like to be bossed or instructed by a woman. Agreements with women are not respected.

Source: Own elaboration based on the analysis in *Atlas ti* software.

The COVID-19 pandemic

These women were questioned whether the pandemic slowed down or boosted their professional careers. One of the engineers expressed that the pandemic was a difficult process due to adapting to confinement; she only dedicated herself to work, sometimes more than twelve hours, which resulted in depression—however, the physical activation and discipline brought about by her hard work allowed her to move up in her job and begin the admissions process for a graduate program. One of the participants emphasized that the pandemic affected her in the development of her research—which she carried out in the laboratory—: due to her confinement, she lost material and microorganisms, which generated a significant delay. In addition, the pandemic caused the closure of child care centers, coupled with the

second of her pregnancies, which prevented the pilot from continuing to fly; all this set her back in her professional career, in addition to the burden of domestic chores that she admits are heavy. Similarly, for one of the civil engineers, the pandemic stopped the labor, so she had to resort to her savings. Another of the interviewees mentioned that, because she was working in a pharmaceutical company, the workload increased.

On the other hand, it was found that the pandemic served as a boost for some of the women participating in the study. The clinical laboratory worker mentioned that the pandemic brought her benefits, such as the collection of extra bonuses for caring for COVID patients. Another of the women stated that home office is something that allows people to get even more training, and that she found herself much calmer at home. Likewise, one of the participants pointed out that she was able to participate more in international conferences and expand her network of contacts related to her research topics. In another case, the savings in transfers served to dedicate that time to priority things at work. However, one of the women pointed out that she has been lucky to have a job during the pandemic—she said she got a job just two months before the government communicated that the population had to go into confinement (see Table 6).

Table 6. The COVID 19 pandemic, interpretations of participants' career momentum or delay.

Category	Code analysis
The pandemic by COVID	Stress and anxiety due to confinement. Loss of biotechnological material, which delayed laboratory research. Closure of day care centers, which increased work at home. Work from home, which allowed access to training courses, congresses and seminars. Extra bonuses for attending COVID patients. New objectives achieved from confinement. The women feel fortunate to have jobs before the confinement was declared. The pandemic delayed such work as construction development. Increased workload.

	More time dedicated to study.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Challenges to enter the job market

It was found that in job interviews, one of the participants was questioned about why she had studied that type of career. In addition, she explained that it has been difficult for other of her fellow graduates from her generation to find a job, for which she feels lucky. On her part, elements were found that complicate entry into the labor market, such as work experience and knowledge, which sometimes do not match the requirements of the sector.

In another case, it was found that it was not difficult for the interviewee to enter, but rather that she has encountered obstacles in order to grow, in such a way that she has only managed to have eighteen hours. She expresses that she doesn't understand why she can't get more hours, and even perceives that it might be due to a lack of honesty and ethics in allocating the hours. In the same way, it was found that one of the barriers is having to deal with men who believe they are superior, in addition to the incessant discrimination due to the fact that they are women who seek opportunities in the engineering area. Also, in most of the vacancies for plant managers, the profile requires applicants to be men.

Likewise, it was found that as a strategy to find employment given the competition that exists in the sector, are the relationships between friends that have worked in STEM. However, verifying that they have the knowledge of technology has also been a challenge (see Table 7).

Table 7. Perceptions of the challenges to entering the labor market

Category	Code analysis
Challenges to entering the labor market	Questions about why they study certain careers, given that they are women. Little professional experience. It is difficult to get in, but the hardest part is getting promoted in some jobs. Lack of knowledge and its application in the industry. Discrimination because they are women, which prevents them from continuing with the recruitment stages. Vacancies for men only. Demonstrate mastery of technical knowledge. Perseverance to be able to face the exams to qualify competencies. Men are given greater opportunities than women in some jobs.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Mechanisms that allow women to advance (or, where appropriate, go backwards) within organizations, and perception towards promoting or stopping promotions

The women were questioned if there were mechanisms in the organizations that would allow them to move up in the organizational structures. The findings obtained were divided into two sectors: a) the industry sector, and b) the public sector.

In the case of the industry sector, it was discovered that, despite the issuance of vacancies, the interpersonal relationships that women come to have forward promotions more quickly. Similarly, in the case of technology project leaders, it was observed that organizations take their skills into account to place them in those positions. On the other hand, one of the women pointed out that being able to access strategic positions in small companies is something that would allow women to obtain more experience, but that the requirements that must be covered are unclear. In addition, it was found that in one of the companies there is an association that carries out talks aimed at the female sector that allows them to empower themselves.

In the case of the public sector, it was found that merit is an important element in higher education institutions, since they allow the analysis of profiles where abilities, skills, and knowledge are displayed. In the same way, it was identified that in the case of the Army and the State Secretaries of the Mexican government, there are established requirements to move up.

The interviewees were also asked if the organization where they work promotes or stops their promotions—important findings were found. In one of the cases, one of the participants mentioned that the company has a platform where vacancies are published; in addition, the organization encourages staff to apply, however, she recognizes that, within the process, there is no clarity in the negotiations and agreements reached to assign the places. In the same way, another of the women expressed that she feels that her promotions are stopped due to the fact that it is a small company: since it does not have so many staff, there are no other levels that she can access. It was also found that there are companies interested in women raising a level, but sometimes they feel insecure to make that decision. In another case, one of the engineers stated that she entered as an intern but that, in order to reach level three as a product engineer, she needs to have eight years of experience in the industry, and expressed that it is important, in order to be promoted, whether the boss likes or not the employee. Therefore, interpersonal relationships become a key element in their professional development (see Table 8).

Table 8. Mechanisms in the organizations that contribute to their progress or setbacks in their trajectories

Category	Content analysis
Mechanisms in organizations that allow them to move forward or backward in their trajectories	Interpersonal relationships carry more weight. Advancement within the organization through a culture of meritocracy. In small companies, there are few opportunities for advancement, and senior positions are reserved for family members. Career development plans. Existence of associations within the companies that offer talks to women. Years of seniority. Lack of knowledge of the mechanisms that promote women.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Perceptions about whether they have thought about leaving their job because of being in masculinized environments

Interviewed women were asked if they had considered leaving their employment. One of the participants in the study declared that she has had the need to leave her job, since she has felt gender discrimination and rejection. Another of the women expressed that she has also wanted to leave her job since she sometimes perceives that the work groups are closed and do not allow her to contribute with ideas to the research projects. In the same way, it was detected that one of the engineers had already left her previous job due to situations related to workplace violence, where she was told rude words, mistreatment, and constant scolding from the owner's son. In other cases, the work environment makes them question their abilities and end up self-sabotaging. One of the interviewees stated that the times she has left her job was because of the salaries: she has noticed that men earn more income in the places where she has worked, which is considered unfair, since she performs the same activities than them (see Table 9).

Table 9. Thoughts about leaving employment, incentivized by being in masculinized environments.

Category	Content analysis
Thoughts about quitting jobs, encouraged by being in masculinized environments	He has felt rejection and discrimination. Closed groups that do not allow them to enter. Hostile work environments where there is constant scolding and mistreatment. Low sense of relevance. Environments that cast doubt on the ability of women. Self-sabotage. Complications in joining male groups. Lower salaries.

Source: Own elaboration based on the analysis in *Atlas ti* software.

Discussion

Regarding the motivations for studying STEM fields, the work carried out by Prieto-Rodríguez et al. (2022) discoveries are similar to those observed in our research, since they found that the interest of women in STEM begins at an early age, in addition to the fact that it is essential that they have the determination and resilience that allow them to get ahead in hostile environments. which they often face. For their part, similar results were expressed by Nugent, Barker, Welch, Grandgenett, Wu, and Nelson (2015), who emphasize that educators, peers, and family positively influence STEM interests; this has important effects on self-efficacy and expectations of the results that can be achieved in STEM. In relation to this, Yang and Gao (2021) add that the low career expectations that parents have, together with the gender stereotypes rooted in culture, have a negative impact on the achievement motivation of women—this continues to strengthen the preference of parents for having sons instead of daughters.

Similarly, other results that are aligned with those found in this research are the ones presented by Talley and Martinez Ortiz (2017), who noted that the intrinsic sources of motivation of young people who are in STEM are related to creativity and resolution of problems, along with the satisfaction they feel from carrying out tasks and work related to

their areas of interest, as well as feeling proud of being resilient and seeking to conquer the subjects and challenges of STEM careers. It was also found that students constantly feel that they need external recognition, mainly from the family, so they develop a strong desire to meet the high expectations they place on them. Finally, other findings by Leaper and Starr (2019) state that the family allows predicting the aspirations that one has in STEM.

However, in relation to the perceptions about whether women who study STEM fields have the same opportunities as men, it was found in previous studies carried out by Sassler, Glass, Levitte and Michelmore (2017) that those women who want to enter STEM occupations have difficulties adapting to the climate that is mostly set by men. The foregoing leads to women having to work twice as hard as men, as stated in the results found in this research. Also, Dancy, Rainey, Stearns, Mickelson and Moller (2020) found in their research that women work more than men, as they are perceived as less hard-working as a result of the sexism they face. In addition, the results found in this research unfortunately recognize that the presence and permanence of STEM women in the labor sectors is short and with limited success, and they are more likely to leave their jobs. More highly educated women have been known to leave the workplace and attempt to move into non-STEM sectors. Another element that must be considered is that women face complex situations in the workplace, such as job insecurity, hostile work cultures and tokenism, which are practices carried out by organizations to avoid criticism, and make people think that they are treated fairly. In addition, employers prefer to hire people who can dedicate themselves full-time and, for the most part, they favor men, giving preference to male domination in the world of work (Williams, 2019; Glass, Sassler, Levitte, & Michelmore, 2013).

On the other hand, regarding the perception of acts of discrimination during university studies, as already mentioned in the scientific literature presented in the introduction, it is pointed out that it is likely that women perceive threatening educational environments. In addition, when they experience threats to their identity in academic settings, this leads to decreased feelings of belonging, decreased academic performance, negative impacts on self-control, and low self-esteem. Threatening environments are generated by a chain of psychological events that unfold over time. It is recognized that when women are more aware of gender stigma, they are more vulnerable to the threat of social identity—furthermore, it is associated with poor academic results and deterioration in mental and physical health (Casad, Petzel, & Ingalls, 2019; Ahlqvist, London, & Rosenthal, 2013). In the same way, it is

mentioned that, since there are few women in this type of scenario, they have to acclimatize to the masculine culture and even pay a fine for femininity. This demoralizes women and leads them to make radical decisions such as abandoning their career or seeking changes in other areas (Simon, Wagner y Killion, 2017; Parson, 2016; Blackburn, 2017).

According to Kuchynka, Salomon, Bosson, El-Hout, Kiebel, Cooperman, and Toomey (2018), teachers are advised to avoid supposedly well-intentioned paternalistic messages that convey and reinforce negative stereotypes about STEM skills in women. The foregoing, because unfortunately there is evidence that teachers tend to favor children in mathematical performance (Lavy and Sand, 2018).

Regarding perceptions of acts of discrimination in the world of work, our results are in line with Kacmar, Bachrach, Harris, and Zivnuska (2011), who emphasize that gender biases derived from cultural beliefs continue to be one of the barriers that impede the advancement of women in their academic and professional development, since it is believed that men are the ones with the skills to be leaders, and leave a clear message that women are not suitable for leadership roles. This, coupled with the fact that men have a preference for dealing with other men over women, and even, when there are opportunities for promotion, defend and sponsor men. Women are also thought to be less likely to succeed, less likely to be promoted, and less likely to become leaders. Unfortunately, STEM women put more effort into maintaining favorable relationships, which is caused by the negative evaluations they receive from their environment (Amon, 2017).

Finally, it is a reality that there are gender gaps in employment and income. Unfortunately, having children increases inequalities. Therefore, it is recognized that women value those jobs that are compatible with domestic responsibilities—however, this considerably affects income opportunities (Petrongolo and Ronchi, 2020).

Another of the elements analyzed was the COVID-19 pandemic, which was one of the most important challenges in the lives of women, since it brought a substantial increase in care and upbringing activities, which increased stress and lack of time for the development of paid activities. This considered, according to the International Labor Organization (ILO), women in the world, on average, carry out 4 hours and 25 minutes of unpaid work, and men 1 hour and 23 minutes (which implies a higher salary compensation for men in relation to women), the existing gaps with respect to the use of time are very evident. There is also evidence that 75% of girls and women are responsible for unpaid care work. Feminists have come to talk

about the third shift: the unpaid work carried out by women, which has led more than 606 million women (41%) to be inactive in the labor market, derived from unpaid care activities (Pozzan y Cattaneo, 2020; Moreira da Silva, 2019; Addati, Cattaneo, Esquivel y Valarino, 2018).

It is undeniable that capitalism and patriarchy cause conditions of gender inequality, since they have strengthened the value given to the traditionally masculine forms that permeate organizations and knowledge (there is no favorable evidence regarding women in countries with governments based on an active role of the state). This means that situations such as double shifts, care and domestic work are made invisible. The central problem is the division of labor between men and women, which places men in a position of superiority and women in a subordinate position (García, 2020).

Regarding the challenges to find a place in the labor market, it is interesting to observe that, in all the cases of the women interviewed, there were difficulties in entering the labor market. This is considered by Burone and Luciana (2022), who found that women face worse working conditions than men. In addition, gender gaps benefit men, in axis such as autonomy at work, promotion opportunities, and job security. Unfortunately, women have lower job expectations than men, but the way to equalize the conditions of men and women is through the evolution of society towards greater gender equality. In this way, women begin to have expectations similar to those of men.

On the other hand, in this work we inquired about those mechanisms that allow women to advance or, as the case may be, to regress in the organization, making it clear that in small companies there are no promotion mechanisms, and that in the most solid companies and institutions, meritocracy is a means to grow. In this regard, it has been emphasized in the literature that women continue to be the minority in strategic positions, despite various laws that seek the existence of mechanisms that promote equal opportunities between women and men. This is generated by the glass ceiling, which is the vertical discrimination of women in companies, which has implications for organizational attitudes and well-being at work. In addition, it is important to work with women so that they do not develop "Queen Bee Syndrome," which makes them think that they have gotten where they are solely because of their hard work, thus demanding extra effort from other women, who will have to work much harder than them—this means that they will think that their successes are only due to their merits, but not because they have overcome structural barriers. It must also be considered

that the organizational culture is oriented towards men, which is why it is incompatible with women due to their roles as mothers, wives and administrators. (Cohen, Dalton, Holder-Webb y McMillan, 2020; Babic y Hansez, 2021).

Lastly, with respect to perceptions about whether they have thought about leaving their job because of being in masculinized environments, the results indicate that women who have thought about leaving their jobs are related to workplace violence, low wages, rejection, and discrimination. Our findings are consistent with Flores, Settles, McGillen and Davis (2021): women earn less than men, and this type of difference is more marked in those professions where there is a greater male presence. In addition, the consequences at the individual level of the glass ceiling are negative—it generates dissatisfaction, sadness, stress, and exhaustion among employees, as well as a lack of commitment and high turnover, low self-esteem, devaluation, depression, and loneliness. (Maheshwari y Lenka, 2022).

Conclusions

STEM women continue to face a harsh reality, not only during their academic careers, where they find themselves in complex environments plagued by sexism, machismo, patriarchal and androcentric education that questions and normalizes a diversity of manifestations of discrimination and gender violence. This provokes in women a feeling of resistance and frustration in the face of these hostile scenarios, because in the patriarchal culture women are submissive and subordinate to the authority of men, who are the leaders, the intelligent, the brilliant, the talented, those who know math, while women are bystanders waiting to be accepted into the world of men.

Unfortunately, in school and in the world of work, men are preferred in many ways: vacancies benefit men, keep women away, or, where appropriate, offer them part-time, higher-level operational positions. Therefore, it is necessary to work with small and medium-sized companies so that they bet on hiring women, in order for them to develop their talent, but that this recruitment of female talent eliminates the barriers related to the stigmas of gender roles and stereotypes. This in addition to being offered the same salaries as men and ways to advance in their professional career.

The outlook for women in the world of work is uncertain, especially for those who are in charge of caring for children or the elderly: the lack of support, infrastructure, and support networks ends up relegating them to part-time jobs, precarious working conditions, low

wages, and little time for training. The low participation of women in paid work has discouraging effects on the economy of nations, coupled with the fact that it leads them to suffer poverty, violence, and an uncertain future. It is essential to encourage their presence and permanence in the different sectors, in addition to strengthening leadership and trust in them so that they motivate other women to be present in the economy of the countries. In the same way, there is need for work with the mentality of women so that they continue to open the way for the girls who come after them: they have to capture their attention and raise awareness about the situation that women are experiencing. Also, there is necessity of support with elements that allow women to take care of girls and guide them in an uncertain world for them.

An encouraging piece of information is the future ISO 53800 draft standard, which will support the sustainable development goals, specifically number five, which seeks to achieve gender equality, and to empower women and girls. This standard aims to work on equality between women and men, regardless of the field and size. The foregoing, making use of an integrative model that presents the possibility for the empowerment of women in the participation and integration of women in decision-making processes, in order to reduce inequality gaps. However, it is clear that the efforts of the standards cease to have an effect when organizations do not take seriously or are not interested in creating management systems that facilitate the inclusion and non-discrimination of women and other vulnerable groups.

The limitations of this investigation are found in the fact that the salaries of the women, and the working conditions in which they are hired were not investigated, to find out if they receive the benefits by law, in addition to the time they dedicate to their jobs. In the same way, it is necessary to know the time that is assigned to the activities of domestic work and self-care.

Finally, future lines of research lie in investigating organizations that employ women in STEM fields and conducting semi-structured interviews to identify possible good and bad hiring practices, as well as working conditions and possibilities for growth and support. for those workers who are mothers and heads of family.

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