Identifying factors influencing women academics in STEM careers: evidence from a Latin American country

Beatrice Avolio
CENTRUM Católica Graduate Business School, Lima, Perú and
Pontificia Universidad Católica del Perú, Lima, Perú, and
Jessica Marleny Chávez Cajo
Escuela de Posgrado Newman, Tacna, Perú

Abstract

Purpose – This phenomenological study, conducted within the discourse on the underrepresentation of women in academia, examined the factors influencing the advancement of women academics in science, technology, engineering, and mathematics (STEM).

Design/methodology/approach – The sample comprised twenty-one women academics from both public and private universities in Peru. Data were collected through in-depth interviews based on the women’s experiences and subsequently processed using Moustakas’ (1994) stages for encoding, categorization, and analysis.

Findings – The study introduces a conceptual framework of nine factors – personal tastes and preferences, attitudes towards science as a vocation, care work, work–life balance, congruent gender roles, occupational segregation, lack of opportunities, low salaries, and lack of gender equality policies – that impact the career progression of women in STEM fields.

Originality/value – The results offer valuable insights for policymakers and academic authorities to address the barriers affecting women academics in STEM. The uniqueness of this paper lies in its investigation in Peru, a country with the highest female labor force participation in Latin America, where women constitute the majority of undergraduate program graduates.

Keywords Science and technology, Women in science, Women in academia, Phenomenological, STEM

Paper type Research paper

Introduction

The underrepresentation of women professors in STEM exacerbates the gender gap in science. Despite the crucial role of STEM in national development and the need for both qualified women and men (UNESCO, 2021b; Vázquez and Manassero, 2017; Tuen et al., 2019), women continue to be underrepresented in this field. For instance, in 2019, in the US, women represented only 27% of STEM employees (Women’s Bureau, 2023); in Canada, less than 25% (Government of Canada, 2023); and, in the European Union, 41% (Eurostat, 2023). Similarly, in the US in 2019, women represented 47% of mathematicians, 45% of life and physical scientists, 26% of computer scientists, and 15% of engineering employees (Women’s Bureau, 2023). Several authors have noted a decline in the number of women transitioning from undergraduate STEM education to graduate and research levels (Goulden et al., 2011; Diekman et al., 2015; Sax et al., 2016; López-Aguirre, 2019; Morales and Morales, 2020). Only 33.3% of all researchers globally are women (UN, 2022).

The authors are grateful to the anonymous referees of the journal for their extremely useful suggestions to improve the quality of the paper. Usual disclaimers apply.

Funding: This work was supported by CONCYTEC/FONDECYT - Fondo Nacional de Desarrollo Científico, Tecnológico y de Innovación Tecnológica.
The underrepresentation of women in STEM is a widely studied topic (Avolio et al., 2020), although the results are still contradictory (Ceci et al., 2014). Various factors can contribute to gender gaps in STEM, including personality traits, the influence of university organizational structures that restrict women’s opportunities, cultural factors shaping gender norms, and non-epistemic aspects related to the gender bias present in science (UNESCO, 2021a; Vázquez-Cupeiro, 2015; Sagebiel and Vázquez, 2010). Other theories suggest factors such as less experience, the social and gender division of labor, and even patriarchal reasons (Goren, 2017). Several factors lead to the gender gap in academia in STEM disciplines, such as the influence of male role models, and restricting women’s engagement in academic and research leadership roles, since they tend to be directed towards feminized teaching and administrative positions. While the literature has primarily focused on understanding gender barriers and implicit biases in academia, some studies suggest that these barriers are perceived differently by women academics (Bird and Rhoton, 2021). Undoubtedly, biases are associated with women academics in STEM disciplines; therefore, their underrepresentation could be linked to pre-university factors and the inclination to specialize in these disciplines (Ceci et al., 2014).

This phenomenological study aims to explore the factors impacting the career advancement of women academics in STEM disciplines in Latin America, recognizing the unique contextual nuances present in non-developed countries. The selection of Peru as the study context is significant for several reasons. First, Peru experienced the second-highest growth rate in female labor force participation globally (after Malta) from 2000 to 2019 and, since 2000, Peru has consistently maintained the highest female labor force participation in Latin America (World Bank, 2023). Second, women in Peru are increasingly entering academic and professional fields (female labor participation rate increased from 43.1% in 1990 to 66.1% in 2023) (World Bank, 2023). Third, women represent the majority of university students in Peru (53.7%) (SUNEDU, 2020) but, in STEM, women are a minority: only 32.9% of all students enrolled in STEM programs and 29.2% of them were women (SUNEDU, 2016a); and 33.40 and 31.98% (SUNEDU, 2021) are women university professors and researchers, respectively (RENACYT, 2023).

While studies on women in STEM exist, few examine the situation of women academics in STEM in Latin American countries, notably Peru, where there is a dominant patriarchal system (Espinosa, 2022). Research on the underrepresentation of women academics in STEM in Latin America is crucial for identifying the barriers encountered by this demographic, and generating academic insights to inform policies promoting women’s development in this field.

The present study aimed to identify the factors influencing the career advancement of women academics in STEM in Peru. Specifically, the study analyzed individual factors, factors related to the family environment and context of women academics, social aspects, and factors related to the work and economic circumstances influencing the career advancement of women academics in STEM disciplines. The manuscript is divided into six sections. The introduction is followed by section two and the theoretical framework. Section three presents the research methodology. Section four includes the results. Section five presents the discussion and section six includes the conclusions, implications and recommendations.

**Theoretical framework**

*Gender division of labor*

The sexual division of labor, as conceptualized by Goren (2017), provides insight into the underrepresentation of women in STEM fields. This framework, linked to the gender division of labor, as highlighted by Anker (1997), elucidates how social norms and gender roles can constrain occupational choices and contribute to occupational gender segregation. Horizontal
Segregation refers to the gender-based distribution of work, often directing women towards tasks traditionally considered more ‘feminine’. This phenomenon can increase the gender pay gap, given that male-dominated occupations are better paid (Bishou and Alkardry, 2018). Vertical occupational segregation refers to the obstacles women encounter in advancing their careers. Metaphors such as the glass ceiling have been used to illustrate the hidden barriers that hinder women from reaching senior leadership roles (Peterson, 2016). The labyrinth metaphor highlights the extra challenges women encounter in securing leadership positions (Eagly and Carli, 2007). Moreover, the glass cliff metaphor implies that women are more likely to be appointed to leadership roles in situations where the risk of failure is elevated (Alhalwachi and Costandi, 2016; Ryan and Haslam, 2005). The glass obstacle course metaphor discusses workplace gender disparities linked to sexism, the lack of female role models, and difficult work–life balance decisions (De Welde and Laursen, 2011).

The gender division of labor perpetuates inequalities by assigning women roles primarily related to caregiving and life generation (Brunet and Santamaria, 2015; Carrasco, 2006). This situation results in a “double presence” (Balbo, 1994), where women take on a higher proportion of unpaid caregiving and household responsibilities, along with paid work, in comparison to men, who are less engaged in these areas. Federici (2014) argued that women’s entry into the workforce has resulted in a new type of patriarchy, where women have two jobs as producers (in the market) and reproducers (at home), challenging the notion of their “economic freedom” as an illusion incapable of altering their reality.

Classical thought, neoclassical economic theory, institutional market segmentation theory, and Marxist-feminist theory attempt to explain the gender division of labor. Classical thought posits a “natural” division of labor based on physical differences between the sexes, with men as primary breadwinners and women as household caretakers. According to neoclassical economic theory, gender division of labor is a household strategy driven by a cost-benefit analysis (Becker, 1981), where women do more unpaid domestic work because they have less economic potential than men (Goren, 2017). Institutional theory emphasizes understanding decisions within their cultural and historical contexts and their relationship to institution (Doeringer and Piore, 1971). This approach argues that discrimination arises from the economic system, where men are predominantly employed in the primary sector, which requires higher skills, while women are relegated to the secondary sector with less specialized tasks (Goren, 2017). Finally, Marxist-feminist theory views the gender division of labor as a product of capital dynamics, presenting women’s efforts to combat it as a form of class struggle (Goren, 2017).

Underrepresentation of women in STEM
Various approaches have been used to study the phenomenon of underrepresentation of women in STEM. Initially, a biological perspective was considered, but it was discarded due to insufficient evidence (Vázquez-Cupeiro, 2015). Psychological studies have delved into the underrepresentation of women scientists in STEM, focusing on individual factors such as self-confidence, self-efficacy, beliefs and preferences (Morales and Morales, 2020). This approach attributes women’s low participation in STEM to personality (Kimingo et al., 2016), self-efficacy (Sax et al., 2016), personal preferences (Morales and Morales, 2020), occupational expectations and stereotypes (CONCYTEC, 2015), and role incongruence (Linda et al., 2016). The epistemology of science approach establishes that scientific organizations are not gender neutral, as social research is shaped by male perspectives (Vázquez-Cupeiro, 2015), leading to a male-dominated hegemonic presence within the field (Francis et al., 2017; Light et al., 2022; Ashencaen and Shiel, 2019; Sagebiel and Vázquez, 2010). The sociocultural approach argues that underrepresentation can be explained by a complex network of interdependent factors (Avolio et al., 2020). Gender stereotypes persist within the field, potentially contributing to
women’s limited participation in STEM (Linda et al., 2016; Sagebiel and Vázquez, 2010; Vázquez-Cupeiro, 2015; Morales and Morales, 2020; Caprile, 2012), with discrimination and bias further exacerbating these challenges (LaCosse et al., 2016). Similarly, family demands, marriage and motherhood contribute to women exiting “the science pipeline” (Goulden et al., 2011, p. 141). Wage gaps and reduced opportunities further disadvantage women in STEM (Arredondo et al., 2019; Morales and Morales, 2020), alongside the lack of institutional policies (Vázquez-Cupeiro, 2015) and role models (Young et al., 2013).

Underrepresentation of women academics in STEM

Research provides evidence of different factors affecting women’s career advancement in academia, especially in elite academic and research leadership positions, and tends to assign women to less advantageous roles such as teaching and administration. The literature also highlights the barriers in male-dominated academic environments like STEM careers (Bird and Rhoton, 2021) and the obstacles specific to minority groups, particularly women of color (Domingo et al., 2022; Holly and Jamison, 2019).

Eslen-Ziya and Yildirim (2022) surveyed 200 women academics globally, revealing a strong correlation between perceived workplace hierarchy and women’s perceptions of gender challenges and future expectations. Sünner and Eslen-Ziya (2023) conducted a survey of 212 women academics across different disciplines and countries and found that problems persist regarding the gender division of academic tasks and the unequal division of domestic care work. Roberto et al. (2019) identified the existence of male-privileged power hierarchies within Italian academic institutions. Similarly, Ashencaen and Shiel (2019) examined a comparable trend in UK universities, highlighting that women frequently hold feminized teaching and administrative positions, which are considered less conducive to career progression than elite, male-dominated research roles. Furthermore, Howe-Walsh and Turnbull (2016) examined the underrepresentation of women in senior science and technology roles in UK academia, revealing that women may experience alienation in a male-dominated environment characterized by “old boy” networks. In Canada, Gardiner and Finn (2023) examined the barriers faced by three women leaders at a university striving to combat gender-based violence on campus. They found that entrenched hierarchical cultures perpetuate this phenomenon, which often obstructs women leaders from implementing innovative solutions. These leaders may experience isolation, inadequate support, and burnout. In Australia, Bowyer et al. (2022) analyzed the career trajectories of academic mothers and advocated for changes to traditional male-dominated patterns by promoting gender equality policies and practices within academia. In Mexico, Maheshwari et al. (2023) studied factors influencing women academics, examining both enablers (family support, societal impact, professional growth aspirations and role models for younger women) and barriers (work–life balance, fear, inadequate institutional support and social stigma). In Zimbabwean universities, Muchabaiwa and Chauraya (2022) highlighted the lack of gender policies hindering women academics’ progress. They suggested the necessity of implementing policies addressing issues such as insufficient funding for research, inadequate training in scientific writing, and the additional burden of domestic responsibilities. Finally, recent research has examined the gendered impact of COVID-19 on the work of faculty members, revealing a disproportionate effect on women (Mickey et al., 2023; Dunn et al., 2022; Murdie, 2020), particularly women of color (Blell et al., 2023).

Bird and Rhoton (2021) surveyed 53 women academics in the US who received the National Science Foundation’s Advance IT grant to explore perceptions of institutional gender barriers and biases. The results showed that almost a third of participants believed women scientists’ opportunities and advancement depended primarily on meritocratic processes. Ceci et al. (2014) cautioned against attributing women’s underrepresentation in
STEM solely to biases, suggesting pre-university factors and field specialization likelihood also play significant roles. Given the mixed evidence, future studies in this area are needed.

Methodology
The study used a phenomenological approach (Moustakas, 1994) to explore the experiences of Peruvian women academics in their STEM career choices and advancement. This method was selected for its capacity to understand, describe and interpret the phenomenon based on the participants’ knowledge, meanings and experiences (Creswell, 2013), facilitating the reconstruction of their academic trajectories. Finally, it prioritized women’s voices to gain a deeper understanding of their experiences as academics in STEM (Moustakas, 1994).

Study context
Peruvian society follows a traditional patriarchal structure with stereotypical gender roles, with machismo influencing historical power dynamics between men and women (Public Opinion Institute, 2014). This is evident in gender disparities in time allocation, especially in domestic and care activities predominantly undertaken by women (Avolio and Moreno, 2023). Colonization has intertwined gender inequality in Latin America with racism, classism, among other inequalities (Lugones, 2008; Espinosa, 2022), permeating various aspects of society. Academia in Peru reflects these disparities (Alcázar and Balarín, 2018) especially in STEM (Avolio et al., 2020), a field where gender gaps are emphasized.

Peru is a relevant context to study due to its evolving labor market dynamics. The country’s labor force participation rate has risen from 53.62% in 2000 to 66.1% in 2022 (World Bank, 2023), marking a substantial increase of 16% points in female participation from 2000 to 2019. This growth is among the highest globally in terms of percentage points, second only to Malta, and it ranks as the highest in Latin America during this period. Moreover, since 2000, Peru has maintained the highest female labor force participation rate in the region, with other countries like Argentina (50.8%), Brazil (53.5%), Chile (48.8%), Colombia (50.9%), Ecuador (54.7%), and Mexico (45.6%) trailing behind (World Bank, 2023). Another significant aspect is the underrepresentation of women in STEM. Despite the increase in female students in undergraduate programs from 2005 to 2018, where women made up 53.7% of all Peruvian students (SUNEDU, 2020), their involvement in STEM fields and academia remains significantly limited. In 2016, only 32.9% of students were in STEM programs, with women comprising 29.2% of them (SUNEDU, 2016a). Among a group of male and female high school graduates, only 26% pursued STEM careers and out of this group 32% were women (SUNEDU, 2016b). Another significant factor is the scarcity of women in education, especially in STEM. In 2020, out of 63,601 university professors in Peru, 66.6% were men and 33.4% women (SUNEDU, 2021). Additionally, RENACYT (2023) reported 6,111 researchers, with 4,157 (68.02%) men and 1,954 (31.98%) women. In the health sector, there are 577 women and 841 men. In natural sciences, there are 409 women and 954 men. In agricultural sciences, there are 117 women and 367 men. In engineering and technology, there are 279 women and 911 men (RENACYT, 2023).

Participants and data collection
The study focused on full-time women academics working in STEM faculties in Peru’s three largest cities: Lima, Arequipa, and Trujillo (Table 1). Participants, who were selected by their respective university faculties, comprised 21 individuals from 7 universities (3 private and 4 public). They voluntarily responded to in-depth semi-structured interviews. Each face-to-face interview, lasting about 60 min, followed an interview guide that included open-ended questions. Three field experts validated this guide, which was then pilot-tested before the main interview phase commenced. The universities gave permission to conduct the interviews, and
participants signed informed consent forms, agreeing to the confidentiality of their information. All interviews were audio-recorded during the sessions and later transcribed for analysis.

**Data analysis**

The data analysis followed Moustakas’ (1994) process. Transcripts were read several times, significant statements related to the phenomenon were identified (horizontalization process) and extracted as “horizons” (Moustakas, 1994). In the subsequent reduction and elimination phase, sentences lacking essential experiential moments were removed (Moustakas, 1994). This process was repeated until the thematic grouping was complete. Codes were used to categorize women’s experiences, with two researchers conducting cross-check analysis and coding. Textual and structural descriptions were crafted to better understand the phenomenon. Finally, these descriptions were used to explain the essence of the participants’ STEM career experiences.

Several strategies were employed to ensure the study’s trustworthiness (Guba and Lincoln, 1994). Participants were assured of their ability to stop interviews at any time to ensure credibility. Furthermore, the authors, possessing research expertise, directly conducted the fieldwork. Throughout the study, the results were periodically reviewed and compared with the existing literature to ascertain consistency. Additionally, background data were collected to describe the study context and the phenomenon, thereby ensuring transferability. To ensure dependability, a thorough methodological description of the phenomenon was provided, and the chain of evidence was verified using Atlas TI. Finally, measures were taken to ensure confirmability, including data collection protocols, a database of interviews, and a position statement to clarify the authors’ beliefs.

<table>
<thead>
<tr>
<th>Participant (pseudonym)</th>
<th>University (pseudonym)</th>
<th>Academic department</th>
<th>City</th>
<th>Type</th>
<th>Maternity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Alejandra</td>
<td>University A</td>
<td>Physics</td>
<td>Lima</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>2 Cristal</td>
<td>University B</td>
<td>Mathematics</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>3 Pamela</td>
<td>University A</td>
<td>Physics</td>
<td>Lima</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>4 Tracy</td>
<td>University A</td>
<td>Mechanical Engineering</td>
<td>Lima</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>5 Maritza</td>
<td>University C</td>
<td>Industrial Engineering</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>6 Claudia</td>
<td>University B</td>
<td>Statistics</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>7 Brenda</td>
<td>University A</td>
<td>Mechatronics</td>
<td>Lima</td>
<td>Private</td>
<td>Not a mother</td>
</tr>
<tr>
<td>8 Alma</td>
<td>University A</td>
<td>Electrical Engineering</td>
<td>Lima</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>9 Rosalí</td>
<td>University B</td>
<td>Geological Engineering</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>10 Sandra</td>
<td>University D</td>
<td>Industrial Engineering</td>
<td>Lima</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>11 Karen</td>
<td>University B</td>
<td>Biological Sciences</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>12 Cyntia</td>
<td>University B</td>
<td>Biological Sciences</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>13 Julia</td>
<td>University B</td>
<td>Geological Engineering</td>
<td>Lima</td>
<td>Public</td>
<td>Not a mother</td>
</tr>
<tr>
<td>14 Giovana</td>
<td>University B</td>
<td>Occupational Health and Safety Engineering</td>
<td>Lima</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>15 Rouse</td>
<td>University E</td>
<td>Civil Engineering</td>
<td>Arequipa</td>
<td>Private</td>
<td>Mother</td>
</tr>
<tr>
<td>16 Yolanda</td>
<td>University F</td>
<td>Physics</td>
<td>Arequipa</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>17 Isabela</td>
<td>University E</td>
<td>Electrical Engineering</td>
<td>Arequipa</td>
<td>Private</td>
<td>Not a mother</td>
</tr>
<tr>
<td>18 Barbara</td>
<td>University F</td>
<td>Physics</td>
<td>Arequipa</td>
<td>Public</td>
<td>Not a mother</td>
</tr>
<tr>
<td>19 Justina</td>
<td>University F</td>
<td>Physics</td>
<td>Arequipa</td>
<td>Public</td>
<td>Not a mother</td>
</tr>
<tr>
<td>20 Marleny</td>
<td>University G</td>
<td>Chemical Engineering</td>
<td>Trujillo</td>
<td>Public</td>
<td>Mother</td>
</tr>
<tr>
<td>21 Sonia</td>
<td>University G</td>
<td>Biological Sciences</td>
<td>Trujillo</td>
<td>Public</td>
<td>Mother</td>
</tr>
</tbody>
</table>

**Source(s):** Authors’ own work
Results
The results were grouped into four categories: individual, family, social, and labor-economic.

Individual factors

Personal tastes and preferences/attitudes towards STEM. Women academics mentioned that their career choice in STEM was influenced by their preference, which was closely intertwined with their interest in teaching. These preferences and attitudes towards STEM and teaching demonstrate their confidence in their skills and knowledge in this field (Morales and Morales, 2020).

I chose this profession because I like the countryside and nature (Alejandra). Since I was a child, my dream was to be a teacher and I always thought: If I can’t be a teacher, I’ll be a statistician. In the end, I think I did what I wanted to do and I became a professor (Andrea). It is easy (to become a professor), if you are prepared. We are as capable as men to teach easy, difficult or intermediate courses. We all have the same abilities (Ana).

These career preferences were formed in high school and were solidified during undergraduate studies, especially when mentored by “good teachers”. Alternatively, familial influence also played a significant role in cultivating their affinity for science. Participants did not mention negative childhood experiences that could contribute to unconscious biases or stereotypes about their STEM skills, as indicated by Morales and Morales (2020).

In secondary school I liked chemistry, I had a good teacher (Maria). I always liked maths and science. When I was 17, I went to university and studied physics because I really liked science (Pamela). I’ve always liked the sea since I was a child, but I’ve also lived surrounded by doctors (Yolanda).

Vocation. Vocation refers to the predisposition for a particular career. Participants cited vocation as the driving force behind their choice of a career in university teaching, noting that salary was not a relevant factor for them. Their sense of calling and their personal preferences had more influence on their decisions.

I have never met a millionaire physicist. As long as my basic needs are met, I’m fine. I know this is not common, but I feel good when I am conducting research. I feel financially comfortable and I’m fine (Rosa).

Previous studies showed that gender significantly influences career choices, with men and women often opting for stereotypical careers (Morales and Morales, 2020). This study, however, revealed a noteworthy interest among women in STEM fields to pursue academic careers, notwithstanding the precarious employment situation at some Peruvian universities.

Family factors

Care work. While women’s participation in academia is increasing, men continue to lag behind in sharing the burden unpaid work at home. This persistence is attributed to the patriarchal system that imposes a disproportionate burden on women academics, particularly those with children. They not only perform paid work at university, but also do the majority of household duties (Avolio and Moreno, 2023). Participants noted that although their partners support them emotionally and financially at home, their contribution to household chores and childcare remains sporadic and unequal.

It is a generational issue. I have always fought against machismo [1]. Now at least my husband prepares the soup (Alejandra).

Some women also described their partners as “controlling and sexist”.
He doesn’t help and makes it difficult for me. Every time I want to do something new, I immediately think: “What is he going to say now?” Maybe if I was divorced, I would go ahead. Machismo is definitely negative for us. We have to fight against it (Marleny).

Sixteen out of twenty-one participants were mothers, all expressing positive views on motherhood. However, they highlighted the challenge of unevenly distributed domestic and caregiving responsibilities, which significantly impacted their professional activities. This supports the continuing sexual division of labor in society (Goren, 2017), with recent studies indicating that the family formation stage is a critical point where many women exit the science pipeline, especially after becoming mothers (Goulden et al., 2011).

Work–life balance. Due to work overload (paid work and care work), women academics, especially mothers, experience work–life balance issues that impact their physical and emotional health. In Peru, there is a significant gender gap in time usage, with women dedicating 9 h and 15 min more per week to combined unpaid domestic duties and paid work compared to men (Avolio et al., 2020), a finding echoed in this study.

We are mothers, daughters, sisters, friends, and everyone around us deserves a little of our time. I wish I had more time to do everything I want. You do one project and then another, but later you realise that you have neglected your family. You notice that your son is doing badly at school, or that he has a problem with a friend and you didn’t know. We’re not superheroes, but sometimes we think we are (Maritza).

To overcome this difficulty, some women prioritized teaching over spending time with their children.

My professional work affected my personal life. I was an absent mother. (Yolanda)

Participants noted a lack of university policies to achieve work–life balance, especially for those with dependent children, placing the burden predominantly on women (Goren, 2017). This imbalance, according to Howe-Walsh and Turnbull (2016), can affect women’s participation in any organization.

Social factors
Lack of congruent gender roles. This research revealed that there is a significant presence of gender stereotypes impacting the development of women STEM professors (UNESCO, 2021a). Men and women are socialized differently, which leads them to play roles according to their gender (Vázquez-Cupeiro, 2015). STEM careers are often associated with masculinity, leading women to face criticism and a sense of “role incongruity”, where their role in STEM conflicts with cultural gender norms (Carli et al., 2016).

People think we’re strange. They wonder, “Do women study science and maths?” They look surprised. Many people think that scientific careers are only for men (Claudia).

Scientific disciplines, formed under gender regimes, exhibit male dominance with fewer women in disciplines wielding greater power (Vázquez-Cupeiro, 2015). This dominance affects daily work practices, leading to exclusion and segregation (Howe-Walsh and Turnbull, 2016).

Occupational segregation. Gender stereotypes result in occupational segregation, evident both horizontally – with a higher presence of male academics in Peru, particularly in STEM – and vertically. The results revealed a lack of confidence in the knowledge and skills of women academics in STEM (Avolio et al., 2020), which stemmed from students’ sexist attitudes and male colleagues. Women in STEM face the additional challenge of having to constantly prove their skills and knowledge as academics, unlike their male counterparts.

It is more difficult for women academics because students believe that they are less intelligent and less capable than men in science. When women academics feel overwhelmed, students tend to think
they are hysterical but, when male academics feel that way, they don’t think the same (Yolanda). I see the difference in the projects. Students don’t believe you! If a woman professor says $a + b = c$, you have to prove it, if a male professor says it, students keep quiet. They refute you (… ). The same thing happens when we prepare documents with male colleagues, sometimes they don’t believe you and ask other male academics who have done it before (Rosa).

These attitudes encourage discrimination, especially against academics who are mothers.

I remember once a colleague had to allocate the workload for graduate courses, and he said, “Oh, no! I just remembered that you have a baby, I’d better not ask you,” and he left. He didn’t even ask me if I could teach the courses or not (Tracy).

Negative stereotypes of women can affect their working lives (Morales and Morales, 2020; Vázquez-Cupeiro, 2015), undermine their social and economic statuses, and perpetuate inequalities (Anker, 1997). Despite these problems, women academics feel confident in their knowledge. In fact, participants perceived gender stereotypes and sexist attitudes as unwarranted social criticisms but maintained positive self-efficacy and self-concept in their STEM careers.

**Economic-labor factors**

*Lack of opportunities.* The organizational structure of the higher education system can create barriers (UNESCO, 2021a). While participants have access to grants and scholarships for research and training, many face financial precariousness within universities. Despite the demand for continuous training and research, women academics often lack the necessary financial resources. Additionally, although research funding is available, it is very difficult to obtain. Another critical issue arises from the limited budget allocated for research and laboratory experiments.

We submit our projects, but we usually don’t get funding. For us, the main limitation to our teaching and research is economic (Sonia). The main obstacles are financial, because sometimes you don’t have all the equipment you need to develop your courses (Ana).

Full-time academics face the challenge of unpaid research hours alongside extensive teaching hours, leading to greater personal and financial sacrifices to achieve research goals.

We want to be full-time academics, get promoted and conduct research, but we can’t. We have families. We got the job through a competitive selection and we have to teach, but that leaves us less time for research and we would have to do it with our own money. Tenured academics are paid to conduct research, but we are not (Alejandra).

*Low salaries.* Participants also mentioned that low salaries could discourage prospective professors (Morales and Morales, 2020).

Salary does not reflect the work we do. The salary is not enough and, in a way, it limits our work. Some universities had the audacity to pay me 25 or 30 soles ($8) an hour and I had to accept it. (Maritza).

Due to low salaries, some academics have to work in several universities or institutions at the same time.

I’d like to earn enough at “X” university and stay in one place (Ana).

*Lack of gender equality policies.* Promoting gender inclusivity in science is both a matter of social justice and a way to unlock women’s potential (Vázquez-Cupeiro, 2015), but this consideration appears overlooked within universities. Participants noted the absence of university policies that either hinder or promote a greater presence of women in STEM, despite the existing gaps and difficulties women encounter.

This institution does not promote women’s participation. It does nothing. […] I think it is indifferent (Sandra).
Some gender equality policies in educational institutions had the opposite effect. Instead of improving their situation, these policies sometimes exacerbated it, leading to assumptions that women were in positions of power solely due to their gender than their abilities.

When institutions started promoting gender policies for women academics, male academics made comments like “we’ve worked hard and now they’re going to take our jobs just because they’re women”. They are excluding us and ignoring our knowledge (Sandra).

Discussion
The study identifies individual, family, social and economic-work factors influencing the career advancement of women academics in STEM in Peru. The results echo Ceci et al. (2014), suggesting that while the male-dominated STEM academic environment impacts women’s progress, it’s not the sole reason for their underrepresentation in academia. The study highlighted factors consistent with occupational gender segregation, where social norms and gender roles limit women academics’ employment options and career advancement.

Morales and Morales (2020) identified individual factors such as vocation, preferences and attitudes towards STEM that influence women academics’ career choices. This study indicates that early exposure to STEM and teaching, influenced by family and school, plays a crucial role in shaping career preferences. It is worth noting that psychosocial characteristics impact the decision to pursue teaching as a career (UNESCO, 2021a).

Family dynamics significantly impact the advancement of women academics’ careers, particularly in terms of work–life balance, especially for those with children. Goulden et al. (2011) noted that family formation poses a significant barrier for women in reaching leadership positions. The unequal distribution of household responsibilities, often perpetuated by partners’ macho attitudes, exacerbates this challenge (Bowyer et al., 2022; Federici, 2014; Goulden et al., 2011). Such dynamics, rooted in the structural gender division of labor (Goren, 2017; Sánchez, 2012), align with Federici’s (2014) exploration of modern women’s oppression. Women academics juggle professional and domestic roles, a phenomenon known as the “double presence” (Balbo, 1994), which poses significant challenges. Balancing domestic responsibilities with university work leads to health implications and difficulty managing both roles. This strain may impede women’s progression to leadership roles (Howe-Walsh and Turnbull, 2016; Bowyer et al., 2022). In STEM, where competition for research funding and experiment oversight is intense, this challenge becomes even more intricate (Howe-Walsh and Turnbull, 2016; Dunn et al., 2022). Life-work balance can be a barrier to women’s career advancement, often requiring significant family support (Maheshwari et al., 2023). Unfortunately, men’s limited involvement in domestic and care work is often attributed to societal expectations influenced by a dominant patriarchal system (Avolio and Moreno, 2023). Women face social stigma, reinforced by the expectation that caregiving is primarily their responsibility (Maheshwari et al., 2023). This gender barrier is notably challenging for women in STEM academia, significantly affecting their productivity and limiting their opportunities for career advancement (Sümer and Eslen-Ziya, 2023; Dunn et al., 2022; Murdie, 2020).

This study aligns with previous literature on the impact of gender stereotypes in STEM that promote discrimination (Vázquez-Cupeiro, 2015; Sagebiel and Vázquez, 2010; Caprile, 2012; Morales and Morales, 2020; Ashencaen and Shiel, 2019). Masculinity dominates the perception of science, associating it with traits like rationality and strength, reinforcing role incongruence between gender and professional stereotypes (Linda et al., 2016). This research identifies stereotypes originating from students in regard to women academics’ skills, as well as segregation and stereotypes from male academics, leading to discrimination. This includes questioning their abilities, attributing performance issues to motherhood, and sometimes
labeling them with negative character traits. These “social stigmas” directly attack their competence (Maheshwari et al., 2023). However, gender stereotypes and professional identities are changing within science (Caprile, 2012). In Peru, women professors’ participation in some scientific fields has increased compared to previous years, albeit at a slow pace. This study showed women academics’ positive self-efficacy and self-concept when facing different forms of violence, thus demonstrating their confidence in their abilities at work. These findings align with previous studies (Morales and Morales, 2020; Sax et al., 2016; Kimingo et al., 2016) that highlight women academics’ capabilities.

Labor-economic problems in universities include precariousness, such as obtaining research funding and limited budgets for laboratories. Low salaries are another concern, leading many women academics, especially those with part-time contracts, to work across multiple institutions simultaneously. Full-time academics conduct unpaid research without extra compensation, which significantly impacts their work–life balance. Reducing gaps in STEM, which are influenced by payment considerations, necessitates collaboration with both individuals and institutions (Holly and Jamison, 2019; Morales and Morales, 2020; Arredondo et al., 2019). Although gender pay gaps are legally prohibited, subtle forms of discrimination may contribute to their persistence. Women in STEM may face undervaluation of their work, resulting in fewer full-time contract offers. Additionally, domestic and care duties, typically assumed by women, restrict their capacity to engage in activities that could enhance their pay or pursue higher-paid roles. This is exacerbated by the lack of childcare policies within universities, a problem not necessarily experienced by male STEM faculty. Finally, universities seemed indifferent to reducing gender gaps and stereotypes. This indifference is linked to institutional barriers and can lead to occupational segregation (Anker, 1997), thus perpetuating a “cold” work environment (LaCosse et al., 2016).

A conceptual framework of nine factors influencing women academics in STEM (Figure 1) includes individual factors such as personal preferences, STEM attitudes, and vocation. It

**Source(s):** Authors’ own work

---

**Figure 1.** Conceptual framework of the factors that influence the career advancement of women academics in STEM.
also consists of family factors, like caregiving responsibilities and life balance, social factors such as gender roles incongruence and occupational segregation, and economic-labor factors like opportunities, low salaries and lack of gender equality policies.

Conclusions and implications
This research proposed a conceptual framework, comprising nine factors influencing the career advancement of Peruvian women in STEM. The results were methodologically categorized into four interrelated factors: individual, family, social and economic-labor factors. This research highlights significant individual characteristics of women academics in STEM, such as their vocational dedication, specific preferences, and positive attitudes towards STEM. These qualities play a crucial role in empowering them to advance in their teaching careers. Socio-structural and family factors pose challenges, particularly for mothers, due to unequal distribution of unpaid domestic and care work. This imbalance disrupts their professional practice, creates personal-family life disparities, and results in work overload, known as “double presence.” This problem impacts both their personal and professional lives, leaving them with limited or no free time as producers and reproducers. Peruvian culture gender stereotypes persist in universities, leading to discrimination against women academics, especially mothers, due to STEM’s historical association with “masculinity”, which undermines women’s capabilities in this field. To address these challenges, women academics demonstrate significant self-esteem and competence in confronting this discrimination. Finally, there is evidence of precariousness in their jobs. Although there are opportunities for growth in teaching and research, academics struggle to have access to them. Insufficient funding and scholarships, along with limited budgets for research and infrastructure, further exacerbate the challenges faced by women academics. Low salaries force some academics with part-time contracts to teach in different universities during the same academic period. This significantly affects the work-life balance and future of women academics, potentially endangering their health due to heightened stress levels. At the institutional level, there is a lack of gender policies and the few that exist have been used by some men to question the professional skills of women academics. As a result, gender policies have yielded outcomes contrary to the expected positive effects.

The root cause of many of these issues lies in the patriarchal system prevalent in the country, manifested through gender stereotypes, job segregation, and undervaluation of women’s skills. Additionally, the study highlights job insecurity in universities, and governments’ lack of motivation to tackle gender disparities in science.

This study has practical and theoretical implications for women academics. It offers insights for developing public and institutional policies in higher education to improve women academics’ professional performance and well-being. The identified factors can guide these policies and take actions to combat gender stereotypes, which could positively impact women’s teaching, research productivity, and mental health. Higher education institutions could offer flexible schedules, extended parental leave, and spaces for caregiving. This research calls for a reevaluation of patriarchal systems’ influence on personal experiences in academia, emphasizing the importance of eliminating this influence. In terms of its implications to the literature, this research provides empirical evidence for gender-focused STEM studies, and introduces a conceptual model capturing the complexity of women academics’ underrepresentation in STEM. Finally, the study offers empirical evidence in Latin America, an underexplored context within the literature.

Recommendations
This research offers recommendations for policymakers and the academic community. Universities should implement specific policies to eradicate violence, discrimination, gender
stereotypes, and segregation in STEM. These policies should prioritize addressing the gender gap in STEM education from foundational levels to foster equal interest in science among individuals of all genders. Additionally, universities should assist women STEM academics in effectively balancing work and motherhood for their career advancement by allocating more resources to teaching and research.

In terms of recommendations for future research, undertaking further studies on women academics in STEM is suggested. These should consider the range of activities women academics engage in within academia and the specific stages of their careers. With regard to the different activities, future studies can take into account the factors that influence the under-representation of women in teaching, research and academic leadership positions in higher education. With regard to the different stages of women’s careers, future studies could cover the stages of career choice, participation and academic advancement/progress.

**Limitations**
The scope of the study was limited to 21 participants in Peru. The analysis focused solely on the perceptions of women academics, excluding the viewpoints of male academics and students. Finally, the study focused on the experiences revealed by the participants; nevertheless, some details might have remained undisclosed.

**Note**
1. *Machismo*, a common cultural attitude in Latin America, is the perception of masculinity as power, accompanied by a minimal sense of responsibility and consequences.

**References**


IJEM


Doeringer, P. and Piore, M. (1971), *Mercados internos de trabajo y análisis laboral [Internal labor markets and labor analysis]*, Heath, MA.


UNESCO (2021b), “Informe de la UNESCO sobre la ciencia: La carrera contra el reloj para un desarrollo más inteligente”, [UNESCO science report: Against the clock for smarter development], [Report], available at: https://unesdoc.unesco.org/ark:/48223/pf0000377250_sp


**Corresponding author**

Beatrice Avolio can be contacted at: bavolio@pucp.pe