The Glass Ceiling Academy: Where Women Can Look, But Not Touch

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Abstract

This review paper explores persistent gender inequality in academia, with a focus on STEM fields, where women encounter systematic barriers hindering their career advancement. By synthesizing findings from existing literature and data, we analyze key factors such as citation bias, peer review challenges, the *leaky pipeline* phenomenon, and the impact of motherhood on career trajectories. The reviewed studies highlight that, despite increased participation by women in the early stages of academia, they remain significantly underrepresented in senior roles, primarily due to biases in evaluation, funding allocation, and institutional support. These results underscore the urgent need for policy and cultural shifts to support women's equal participation in academic and scientific careers.

1 Introduction

Gender inequality is often dismissed or even *"joked about"* as a relic of the past, as if society has completely moved beyond it. However, significant barriers for women persist today in nearly every domain, limiting their opportunities for advancement and recognition. Historically, women were denied access to education, professional opportunities, and basic political rights—such as the right to vote, granted in Spain only in 1931 [20]. It was not until the early 20th century that women could access higher education and enroll in universities, with pioneers like Concepción Arenal leading the way. Despite these advances, systemic barriers remain pervasive in academia, including underrepresentation, unequal access to resources, and limited recognition for women's contributions [26]. Issues like the *Matilda Effect* and the *leaky pipeline* continue to hinder women's progress and advancement in academic and scientific fields [16], underscoring that gender inequality is far from resolved.

Education is a striking example of gender inequality, especially when examining the clear contrast in women's representation at different teaching levels. In Spain, women constitute over 72% of the workforce in lower-level educational institutions, but this drops significantly to about 43% at universities [9]. This disparity suggests that women are more frequently funneled into roles traditionally associated with caregiving, such as early childhood education (97% of women in *Educación Infantil*) and primary education (82%). Similarly, women are overrepresented in special-needs education (81%), yet underrepresented in higher-level positions, with only 37% of women securing an Associate Professor position or higher at public universities [9]. This highlights how deeply entrenched gendered expectations and societal roles still influence women's career paths.

These challenges extend into research and science, with systematic exclusion persisting well into the 20th century. Historically, female scientists were rarely recognized, and many were forced to conduct research through unofficial channels or attribute their work to male colleagues. This phenomenon is known as the *Matilda Effect*, named after Matilda Joselyn Gage, the first woman to raise awareness about the systematic ignorance of female contributions in science throughout history [16].

This has left female scientific talent forgotten, unable to become role models for future generations who have been let to think that science is a man's matter, evidently through the fact that the presence of female scientists in school textbooks is around 7% [18]. Such statistics perpetuate stereotypes and explain why only 36% of students in STEM (Science, Technology, Engineering, Mathematics) majors are women [6]. Another well-known phenomenon is the *leaky pipeline* [5], which refers to the progressive reduction of women's participation in academia and research, often due to a lack of institutional support, family-related pressures, and implicit biases in hiring and promotion processes (see Fig. 1).

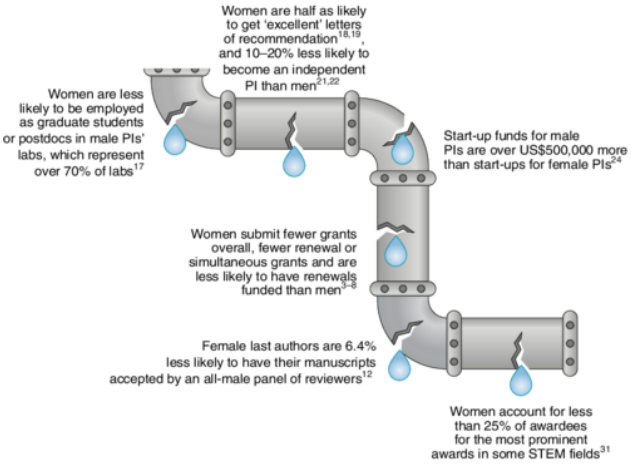

Figure 1: The STEM *leaky pipeline* [13].

This study aims to provide a comprehensive analysis of gender disparities in academia, focusing on the systemic barriers that hinder women's progress, particularly in STEM fields. While the review addresses the global challenges of gender inequality, recognizing

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it as a pervasive issue across academic systems worldwide, it also incorporates select examples from the Spanish academic context to illustrate specific phenomena. By emphasizing the global scope while including these Spanish cases, we aim to provide a comprehensive understanding of the universal nature of these barriers, complemented by insights into regional contexts. This approach enables us to draw general conclusions while offering nuanced perspectives on how cultural and institutional factors can influence gender disparities in specific settings.

2 Methodology

This study analyzes gender inequality in academia through a literature review, focusing on sources that address systemic barriers affecting women's progression in academic careers. We surveyed major databases like Web of Science, Scopus, and Google Scholar to collect recent, peer-reviewed studies.

Inclusion criteria required studies to focus on publishing, citation practices, research funding, and gender representation within STEM fields [9, 21]. Studies were prioritized based on whether they provided empirical data, robust statistical analyses, or theoretical insights with practical implications. Exclusion criteria involved studies lacking peer review, those based on anecdotal evidence, or with limited generalizability due to small sample sizes or methodological flaws.

To enhance validity, we included studies with realistic and representative experimental designs [8], defined as those that accurately reflect the population and contextual dynamics under investigation. These designs typically employed large, diverse samples, longitudinal data, or field experiments that account for institutional and cultural variability. This approach ensures a broad yet reliable overview of persistent structural inequalities in academia, enriching the analysis of factors influencing gender disparities.

3 Results and discussion

3.1 Climbing the Academic Ladder

Despite progress, a significant gender gap persists in academia, with men still more likely to achieve tenure than women [24]. Key indicators of academic success—such as publishing, funding, and promotion—shape career advancement, yet women remain underrepresented in each area. For instance, women comprise only 37% of authors, 28% of reviewers, and 26% of editors, highlighting their limited presence in influential academic roles [15].

Research shows that articles authored by men not only receive more citations but are often perceived as higher quality, particularly in male-dominated fields, creating a citation bias that bolsters men's reputations as experts [3, 17, 19, 25]. This disparity in citations undermines women's professional visibility and impacts their career advancement in areas where citations are crucial, such as hiring and tenure evaluations.

Gender bias extends into peer review and publishing, where women, particularly in fields like neuroscience [10] and communication science [23], receive harsher critiques and lower evaluations, reducing their opportunities for publication in high-impact journals. Similar biases in medicine show a preference for male-authored work, further entrenching male advantage in high-profile publications [4].

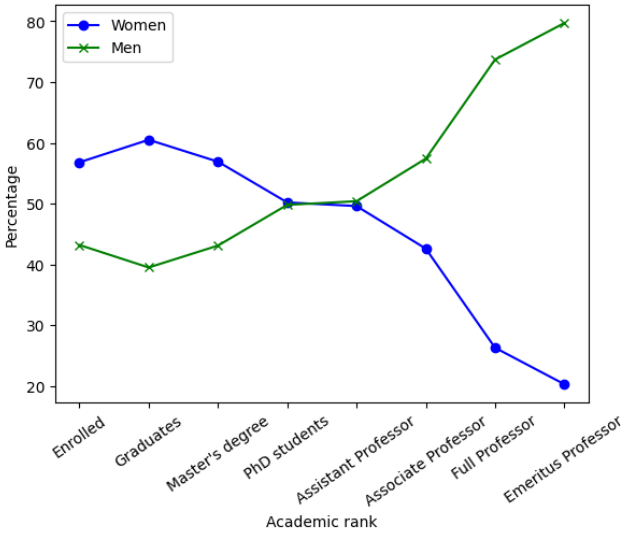

Figure 2: The *leaky pipeline* effect at Spanish universities (2021-2022) [21].

Funding inequalities compound these challenges, as early-stage research grants frequently go to male researchers. For example, the *League of European Research Universities* and the EU project *GRANteD* both indicate that female applicants experience more scrutiny and rejection, with a 75% initial rejection rate despite often stronger performance in later funding stages [12, 14]. Male-dominated review panels have also been shown to score female applicants lower, perpetuating underrepresentation in major research funding.

In Spain, career progression in academia involves completing six-year research periods, or *sexenios*, to meet benchmarks in productivity and impact. For accreditation, the maximum score that can be achieved for Assistant Professors and Full Professors is two and four years, respectively [2]. Data from the University of Granada shows that 611 women hold more than one *sexenio* compared to 1,087 men [8], a gap reflecting additional barriers faced by women, particularly those with children. These findings underscore the dual challenges of career advancement and balancing motherhood, which disproportionately impact women's academic trajectories.

3.2 The *Leaky Pipeline* in Academia

The *leaky pipeline* metaphor captures the progressive attrition of women as they advance through academic stages, illustrating how gender disparities deepen along the academic career path [5]. Although women often enter academic programs in equal or even higher numbers than men, particularly at the undergraduate and doctoral levels, their representation sharply declines in senior positions [7]. As they progress toward roles such as associate professor, full professor, and leadership, the proportion of women decreases significantly, while the proportion of men increases, producing a widening gender gap that resembles the shape of scissors, as shown in Fig. 2.

This dropout is due to a combination of structural, social, and institutional barriers, including limited access to research funding, biases in hiring and promotion processes, and the demands of work-life balance, which disproportionately impact women, particularly those with family responsibilities. The *scissors* effect reflects a systemic issue in academia where each level of progression sees more women *leak out* of the academic pipeline, leading to a substantial gender imbalance in leadership and tenured roles [22].

3.3 Causes of dropout

The data reveal a complex interplay of factors driving high dropout rates among women in academia, including a shortage of female role models, family planning pressures, and persistent gender biases. One significant factor is the "dream gap"—the divergence between young girls' early ambitions and the societal expectations that often discourage them from pursuing paths in STEM or academia. This gap is amplified by the lack of visible female role models in senior academic roles, limiting students' sense of belonging and making it harder for young women to envision successful careers in these fields [1]. As a result, female students and early-career researchers may feel out of place or unsupported, which reinforces a cycle where they are more likely to leave academia prematurely.

Family planning and societal expectations create additional challenges. Studies show that female postdocs with children are nearly twice as likely as their male counterparts to leave research careers, with many women in demanding fields like physics and biology having fewer children than their male colleagues—and often fewer than they desire [11]. For many, motherhood entails career interruptions or reduced hours, which hinder progress toward promotion and tenure.

The dropout rates are also influenced by persistent gender inequalities in financial compensation and career progression, especially at senior levels. In 2006, for instance, female scientists in the EU public sector earned 25–40% less than men, with a similar 40% gap seen in US physics and astronomy [7]. Although the pay gap has narrowed somewhat for younger scientists, structural inequalities mean that senior-level disparities persist, with full professors in the US experiencing an 8% pay gap. This is partly due to women's higher representation in non-tenure-track or lower-status roles, which come with lower salaries and fewer resources, making it harder for women to build the financial and institutional support needed to sustain long-term academic careers.

4 Conclusion

Gender inequality in academia remains a pervasive and global challenge, undermining the full participation of women, particularly in STEM fields. Despite increased representation at the early stages of academic careers, systemic barriers—such as biases in citation practices, publication processes, research funding allocation, and leadership visibility—continue to impede women's progression to senior positions. These obstacles not only hinder individual careers but also deprive the academic community of diverse perspectives and innovation.

Addressing these disparities requires a multifaceted and sustained effort at institutional, national, and global levels. Equitable evaluation processes, transparency in hiring and promotion criteria, and robust structural support for work-life balance are foundational steps. Mentorship programs and targeted initiatives to retain female talent, particularly during critical career transitions, are crucial to bridging the gaps along the academic pipeline. Furthermore, amplifying the visibility of female role models through awards, public recognition, and curriculum reform can inspire future generations and challenge persistent stereotypes.

Beyond these foundational steps, institutions must actively combat biases by embedding equity into their cultures. Practical strategies include unconscious bias training for decision-makers, developing family-friendly policies such as flexible working arrangements and on-site childcare, and creating clear pathways for career advancement that acknowledge diverse experiences and trajectories.

Equally important is ensuring that women researchers can embrace motherhood, including multiple pregnancies, without jeopardizing their productivity or career opportunities. Policies such as extended parental leave for both parents, funding extensions for researchers with caregiving responsibilities, and flexible tenure-clock policies are critical in mitigating the career disruptions often associated with parenthood. By normalizing and supporting these life choices, academia can create an environment where women no longer face a trade-off between family and career, fostering a more inclusive and sustainable academic community.

While this review highlights global trends, it also draws on specific examples from the Spanish academic context to illustrate these challenges and underscore the need for localized solutions. Recognizing the universality of these issues, coupled with region-specific insights, offers a nuanced understanding of how cultural and institutional factors shape gender inequality in academia.

Ultimately, achieving gender equity in academia is not only a matter of justice but also a necessity for fostering an innovative, inclusive, and thriving academic environment. By implementing comprehensive strategies and fostering systemic change, institutions can help close the gender gap and ensure that academia benefits from the full range of talent and perspectives available.

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