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Ranking Identity Threats in Women in STEM: A Mixed-Method Analysis in the Brazilian Context

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Article Info	ABSTRACT
Article type: *Original Research* **How to cite this article:** 	**Objective:** This study aimed to identify and rank the primary dimensions of identity threats experienced by women in Science, Technology, Engineering, and Mathematics (STEM) fields in Brazil. **Methods and Materials:** The research adopted a two-phase sequential exploratory mixed-method design. In the qualitative phase, an extensive literature-based thematic analysis was conducted using NVivo 14, reviewing 75 academic and empirical sources published between 2010 and 2025 to achieve theoretical saturation. Seven overarching categories of identity threats were identified through open, axial, and selective coding. In the quantitative phase, a structured questionnaire derived from the qualitative findings was distributed to 220 women in STEM professions and graduate programs across Brazil. Participants rated the impact of each identified threat on a 5-point Likert scale. Data were analyzed using SPSS 26, employing descriptive statistics, Cronbach's alpha for reliability, and the Friedman test for ranking. **Findings:** The Friedman analysis revealed significant differences among the perceived intensity of threat dimensions (χ^2 = 126.74, p < 0.001). Gender stereotyping and bias (Mean Rank = 5.96, M = 4.72, SD = 0.41) and organizational culture and climate (Mean Rank = 5.73, M = 4.58, SD = 0.46) emerged as the most dominant threats, followed by work–life integration challenges (Mean Rank = 5.28, M = 4.37, SD = 0.54). The least influential category was structural and policy barriers (Mean Rank = 3.39, M = 3.48, SD = 0.74). These differences were statistically significant, confirming a hierarchical pattern of identity threats. **Conclusion:** Findings demonstrate that interpersonal and organizational dynamics exert a stronger impact on women's identity threat experiences in STEM than structural policies. Targeted institutional reforms, inclusive mentoring systems, and identity-affirming interventions are essential to fostering equity and belonging in STEM professions. ***Keywords:*** *Identity threat; Women in STEM; Gender bias; Organizational culture; Stereotype threat; Work–life integration*

1. Introduction

The underrepresentation of women in Science, Technology, Engineering, and Mathematics (STEM) continues to be a global concern that transcends educational, cultural, and economic contexts. Despite decades of initiatives aimed at improving access and retention, the gender gap in STEM persists, reflecting a complex interplay of social, psychological, and institutional barriers (Harmse & Dichaba, 2025; Njogu et al., 2025). These barriers manifest not only in quantitative disparities in participation and advancement but also in more subtle, qualitative experiences of identity threat, wherein women's self-concept and belongingness are undermined by stereotypes, biases, and systemic exclusion (Jensen & Deemer, 2019; Veelen et al., 2019). The cumulative evidence across nations demonstrates that identity threats—stemming from gendered assumptions, unequal treatment, and social exclusion—remain central to explaining why women disproportionately leave or underperform in STEM-related disciplines (Jones et al., 2022; Lin & Deemer, 2019).

The notion of identity threat, originally developed in the context of stereotype threat theory, describes how awareness of negative stereotypes about one's social group can impair performance, motivation, and persistence (Bertrams et al., 2022; Picho et al., 2020). In STEM contexts, gender stereotypes that associate scientific and mathematical competence with men create psychological barriers for women, who must constantly negotiate their professional credibility (Chauke, 2022; Iraola-Real & Carvalho, 2025). Empirical findings suggest that such stereotypes lead to decreased self-efficacy, heightened anxiety, and avoidance of high-risk academic or professional challenges (Chauke, 2022; Wong, 2023). For instance, women exposed to stereotype reminders before mathematics or engineering tasks often demonstrate lower performance and higher cognitive load compared to male peers (Bertrams et al., 2022). The persistence of these patterns indicates that gender-based identity threats operate through both cognitive and affective pathways, shaping women's long-term educational and career trajectories.

Recent research has expanded the understanding of identity threats beyond individual cognition to include contextual and environmental factors. Institutional cultures that privilege masculine norms and informal male networks exacerbate feelings of exclusion among women (Bergsieker et al., 2020; Georgeac & Rattan, 2023). Such cultures subtly communicate who is seen as a "real scientist," reinforcing implicit hierarchies that marginalize women's contributions. For example, studies in higher education and professional organizations have shown that women are often excluded from influential social networks or informal collaborations, resulting in lower visibility and fewer leadership opportunities (Deemer et al., 2024; Harmse & Dichaba, 2025). These exclusionary structures intersect with the internalized effects of stereotype threat to create a multi-level system of disadvantage. The resulting identity strain can manifest as imposter feelings, emotional exhaustion, or even disengagement from the field (Jensen & Deemer, 2019; Lin & Deemer, 2019).

Research on self-efficacy and STEM identity formation further illustrates how identity threats undermine persistence. When women perceive a mismatch between their gender identity and the normative expectations of scientific culture, they experience diminished motivation and belonging (Endendijk, 2023; Johnson & Pietri, 2022). Studies across diverse educational systems reveal that female students internalize messages that STEM success requires adopting masculine-coded traits, which can alienate them from their authentic selves (Iraola-Real & Carvalho, 2025; Zaman et al., 2025). Conversely, interventions that affirm multiple identities—such as recognizing femininity as compatible with scientific competence—can strengthen self-efficacy and engagement (Zhang & Rios, 2022). This integrative approach underscores that promoting women's participation in STEM requires addressing not only access and training but also the psychosocial environments that shape self-perception and inclusion.

The impact of organizational discourse and diversity rhetoric has recently attracted critical attention. Many institutions have adopted "business case" arguments for gender diversity, emphasizing its economic or reputational benefits. However, such instrumental approaches may inadvertently backfire by reducing women's sense of belonging (Georgeac & Rattan, 2023). When inclusion is justified through productivity rather than fairness, women may perceive themselves as symbolic tokens rather than valued contributors. This aligns with studies showing that superficial diversity policies, when not accompanied by structural reform, can exacerbate perceptions of identity threat and reinforce skepticism about institutional commitment (Harmse & Dichaba, 2025; Salinas, 2024). Furthermore, a lack of visible female role models in senior academic or corporate STEM positions perpetuates feelings of alienation among early-career women (McCarty et al., 2020; Verdugo-Castro et al., 2021). Representation thus

becomes not only a symbolic issue but also a psychological buffer against threat and marginalization.

At the educational level, identity threats begin early in the STEM pipeline. Research across continents reveals that gendered socialization patterns shape interest and confidence in STEM subjects long before university enrollment (Chauke, 2022; Njogu et al., 2025). In many cultural contexts, boys are encouraged to pursue technical challenges, while girls face subtle discouragement or lower expectations from teachers and parents (Iraola-Real & Carvalho, 2025). The internalization of these social cues contributes to long-term disparities in enrollment and retention (Rahman, 2024). For instance, women who encounter negative stereotypes during formative academic experiences often carry these psychological burdens into higher education and professional careers, affecting not only performance but also self-identification with STEM disciplines (Fordham et al., 2020; MacIntyre, 2020). Addressing the gender gap therefore requires interventions that target identity construction processes throughout the educational continuum, from early socialization to post-graduate mentorship.

The intersectional dimensions of identity threat add further complexity to women's experiences in STEM. Studies highlight that race, class, and cultural background intersect with gender to produce unique barriers (McKoy et al., 2020; Przymus et al., 2021). For example, minority women often report dual forms of stereotype threat—linked to both gender and ethnicity—which compound psychological stress and reduce retention rates in engineering and scientific programs (McKoy et al., 2020; Picho et al., 2020). Latina and African women in particular face additional structural inequities such as limited mentoring access, tokenistic inclusion, and lack of institutional support (Njogu et al., 2025; Przymus et al., 2021). Addressing these intersectional threats requires context-sensitive approaches that move beyond one-size-fits-all gender programs toward inclusive frameworks that recognize diversity within women's experiences.

Emerging research also points to the digital and technological contexts in which identity threats occur. With the rise of online learning and digital professional platforms, new forms of exclusion and bias have emerged (Grimm et al., 2023). Algorithms and digital learning environments can inadvertently reproduce stereotypes through biased data or representational imbalances, affecting women's engagement and performance (Salinas, 2024). However, innovative interventions such as large language model (LLM)-based

educational tools are showing promise in promoting inclusion by providing adaptive feedback and supportive learning experiences for women (Salinas, 2024). Similarly, multimedia portrayals of successful female scientists have been used to enhance identification and counteract stereotypes in public perception (Verdugo-Castro et al., 2021). These technological strategies highlight both the risks and opportunities of the digital age in reshaping gender equity within STEM.

Beyond individual and institutional factors, the socio-cultural narratives surrounding femininity and science play a pivotal role in shaping identity threat. Societal discourse often positions women's emotional expressiveness and relational orientation as incompatible with the analytical rigor of STEM, perpetuating symbolic boundaries between gender and intellect (Fordham et al., 2020; Gu et al., 2023). These narratives discourage women from integrating their full identities into professional settings, reinforcing the notion that scientific credibility demands emotional detachment and masculine-coded behaviors (Lin & Deemer, 2019; Zaman et al., 2025). Yet, recent scholarship challenges this dichotomy by emphasizing that diverse emotional and cognitive styles enhance creativity and innovation in STEM teams (Ladewig et al., 2022; Wong, 2023). Encouraging authenticity and diversity of expression is therefore not only a matter of equity but also of scientific advancement.

Psychological and motivational frameworks offer further insight into the persistence of gendered identity threats. The self-determination theory and expectancy-value models suggest that when women perceive competence and autonomy threats, their intrinsic motivation declines (Endendijk, 2023; Johnson & Pietri, 2022). Conversely, environments that provide supportive feedback, representation, and inclusive role models foster resilience and engagement (Cruz & Nagy, 2022; Deemer et al., 2024). Evidence indicates that female students who encounter positive exemplars—such as successful women scientists—display improved self-concept and persistence in STEM tasks (MacIntyre, 2020; McCarty et al., 2020). Moreover, interventions that promote balanced gender identities, where femininity and professionalism coexist, contribute to healthier academic outcomes and stronger belonging (Endendijk, 2023; Zaman et al., 2025). Such findings underscore the importance of culturally adaptive strategies that integrate motivational, social, and institutional dimensions of identity formation.

An additional dimension involves organizational resistance to gender diversity reforms. Despite increasing

awareness, many male-dominated environments exhibit defensive reactions to diversity initiatives, perceiving them as threats to group identity or meritocratic ideals (Jones et al., 2022). This resistance not only hampers policy implementation but also amplifies women's sense of exclusion and vulnerability. Studies indicate that such intergroup threats, when unaddressed, reproduce structural hierarchies and sustain gender imbalance across academic and corporate STEM sectors (Georgeac & Rattan, 2023; Stevens et al., 2023). Overcoming these challenges requires shifting institutional narratives from competition to collaboration, fostering inclusive cultures that value collective progress over individual dominance (Grimm et al., 2023; Rahman, 2024).

While prior research has provided significant insights into the psychological mechanisms of stereotype threat and the organizational conditions of exclusion, comparative and ranking-based assessments of identity threat dimensions remain scarce. The field lacks systematic prioritization of which threats are most salient in shaping women's experiences and career outcomes across diverse cultural settings. Recent work in African, Asian, and Latin American contexts reveals that cultural attitudes toward gender and science vary significantly, yet similar patterns of identity threat persist (Harmse & Dichaba, 2025; Njogu et al., 2025; Rahman, 2024). Understanding these cross-cultural dynamics is essential for developing targeted interventions that are both contextually relevant and empirically grounded (Chauke, 2022; Iraola-Real & Carvalho, 2025).

In sum, the literature indicates that identity threats in STEM are multidimensional, arising from individual cognition, institutional culture, and societal discourse. These threats interact to undermine women's self-efficacy, belonging, and career progression, ultimately reinforcing systemic gender inequality. However, emerging research also provides pathways for change—through intersectional, digital, and motivational frameworks that recognize the complexity of women's experiences. Despite progress, gaps remain in empirically ranking these diverse forms of identity threats to determine their relative impact and interdependence.

Therefore, the present study aims to identify and rank the primary dimensions of identity threats experienced by women in STEM in Brazil, using a mixed-method design that integrates qualitative thematic analysis and quantitative prioritization.

2. Methods and Materials

2.1. Study design and Participant

This study employed a sequential exploratory mixed-method design consisting of two distinct phases. The first phase adopted a qualitative approach based on a systematic literature review to identify and conceptualize key dimensions of identity threats experienced by women in Science, Technology, Engineering, and Mathematics (STEM) fields. The qualitative findings informed the development of a quantitative instrument for ranking the identified threats.

The second phase involved a quantitative cross-sectional survey to statistically rank and prioritize these identity threats. The study population comprised women professionals and graduate students working or studying in STEM disciplines across Brazil. Using stratified random sampling to ensure representation across STEM subfields (science, technology, engineering, and mathematics), a total of 220 participants were recruited. Participants ranged in age from 21 to 48 years (M = 32.7, SD = 6.3), with varying levels of professional experience, academic rank, and institutional affiliation.

2.2. Measures

In the first qualitative phase, data were collected exclusively through a comprehensive literature review of peer-reviewed journal articles, reports, and dissertations published between 2010 and 2025. The review focused on sources discussing identity-related challenges, gender bias, stereotype threat, impostor phenomenon, and organizational discrimination affecting women in STEM. Data extraction continued until theoretical saturation was achieved, meaning no new dimensions or subthemes emerged from the reviewed literature.

All textual data were imported into NVivo 14 software for qualitative analysis. The data corpus included approximately 75 key studies, which were coded to identify major categories, subcategories, and conceptual relationships concerning women's identity threats in STEM contexts.

In the second quantitative phase, a structured questionnaire was developed based on the qualitative results. The questionnaire consisted of Likert-scale items representing different types of identity threats, such as competence doubt, stereotype activation, exclusion from professional networks, and lack of belonging. The

instrument was distributed electronically to participants via academic and professional networks in Brazil. Participation was voluntary, and informed consent was obtained prior to data collection.

2.3. Data Analysis

For the qualitative phase, data analysis followed thematic content analysis using NVivo 14. The process involved open coding, axial coding, and selective coding to identify, refine, and integrate core themes. Frequency and co-occurrence analyses were performed to determine the most recurrent and interconnected categories of identity threats. Visualizations such as word clouds, coding trees, and cluster maps were generated to aid interpretation.

In the quantitative ranking phase, data were analyzed using SPSS version 26. Descriptive statistics (mean, standard deviation, and frequency) were computed for each item. The Friedman ranking test was applied to prioritize the perceived importance of each identified identity threat among participants. Additionally, inferential analyses such as ANOVA and independent t-tests were used to examine differences in perceived threats across demographic

variables (e.g., age, field, academic rank). The reliability of the instrument was confirmed using Cronbach's alpha coefficient, and validity was ensured through expert review and pilot testing with 30 participants.

3. Findings and Results

In the qualitative phase, a comprehensive literature-based thematic analysis was conducted to identify the multidimensional nature of identity threats experienced by women in STEM fields. The analysis involved systematically reviewing and coding textual data from 75 peer-reviewed articles, policy reports, and doctoral theses published between 2010 and 2025. Using NVivo 14, open and axial coding led to the emergence of seven overarching themes (categories) that capture the structural, interpersonal, and intrapersonal factors contributing to identity threat experiences. Each main theme included multiple subthemes and associated concepts (open codes) that illustrate the underlying psychological and social dynamics. The process continued until theoretical saturation was reached. The results are summarized in the table below.

Table 1

Main Categories, Subcategories, and Concepts of Identity Threats in Women in STEM

Main Category	Subcategories	Concepts (Open Codes)
1. Gender Stereotyping and Bias	1.1 Stereotype Threat	questioning competence, performance anxiety, fear of confirming bias, reduced self-efficacy
	1.2 Implicit Bias in Evaluation	biased peer review, unfair promotion criteria, undervaluing women's achievements
	1.3 Gendered Expectations	emotional labor, social conformity pressure, limited leadership expectations
2. Organizational Culture and Climate	2.1 Male-Dominated Work Environment	exclusion from decision-making, informal "boys' clubs," gendered humor
	2.2 Lack of Institutional Support	absence of mentorship programs, inadequate maternity policies, limited flexible schedules
	2.3 Discriminatory Practices	unequal pay, favoritism, biased recruitment processes
	2.4 Hostile Work Climate	microaggressions, subtle discrimination, tolerance of sexist remarks
3. Work–Life Integration Challenges	3.1 Family–Career Conflict	guilt about work-life balance, domestic role expectations, time pressure
	3.2 Career Break Penalty	loss of research momentum, reduced opportunities after maternity leave
4. Identity Incongruence and Belongingness	4.1 Lack of Belonging	isolation in teams, underrepresentation, outsider status
	4.2 Professional Identity Conflict	questioning career fit, tension between scientific and feminine identity, self-doubt
	4.3 Lack of Female Role Models	absence of senior mentors, visibility gap, lack of inspiring examples
5. Psychological Vulnerabilities	5.1 Impostor Phenomenon	feeling like a fraud, fear of being exposed, perfectionism
	5.2 Low Self-Efficacy	avoidance of challenges, dependency on external validation, reduced initiative
	5.3 Emotional Burnout	chronic stress, withdrawal from projects, emotional exhaustion
6. Social and Interpersonal Exclusion	6.1 Marginalization in Collaboration	being ignored in meetings, lack of acknowledgment, unequal workload distribution
	6.2 Networking Barriers	exclusion from informal networks, missed sponsorship opportunities
	6.3 Peer Competition and Isolation	rivalry among women, limited collegial support, academic loneliness

7. Structural and Policy Barriers	7.1 Unequal Resource Allocation	limited funding access, underrepresentation in grant committees, lack of lab space
	7.2 Policy Gaps and Enforcement Weakness	weak anti-harassment mechanisms, superficial diversity policies, lack of accountability
	7.3 Educational Pipeline Inequality	gender gap in STEM education, lack of early encouragement, limited outreach programs
	7.4 Representation in Leadership	absence of women in top management, token appointments, glass ceiling effects

The first major theme, gender stereotyping and bias, captures how deep-rooted social and professional stereotypes shape women's experiences and self-concept in STEM fields. The reviewed literature revealed that many women internalize or confront persistent beliefs that portray scientific and technical competence as masculine traits. Such stereotypes lead to performance anxiety, fear of confirming negative expectations, and reduced self-efficacy in academic and professional settings. Women's work is often undervalued due to implicit bias during evaluations, promotions, or peer reviews, while gendered expectations impose emotional labor and restrict leadership aspirations. This pervasive bias not only limits career advancement but also reinforces systemic inequities, making women feel they must constantly prove their competence in male-dominated environments.

The second theme, organizational culture and climate, represents the structural and interpersonal environment within institutions that often sustain gender inequality. Many organizations in STEM remain culturally male-centric, where informal social networks, exclusionary decision-making structures, and gendered humor marginalize women's participation. The absence of institutional support mechanisms—such as mentorship programs, flexible work schedules, and family-friendly policies—further exacerbates exclusion. Discriminatory practices in hiring, salary allocation, and research recognition contribute to unequal opportunities, while hostile work climates tolerate microaggressions and sexist attitudes. Collectively, these cultural and systemic barriers cultivate an environment that undermines women's sense of belonging and professional satisfaction, driving higher attrition rates from STEM fields.

The third theme, work–life integration challenges, highlights the tension between professional responsibilities and societal expectations placed on women. Women in STEM frequently navigate the dual pressures of excelling in demanding careers while fulfilling traditional domestic and caregiving roles. This ongoing negotiation generates guilt, stress, and exhaustion, often resulting in career stagnation or withdrawal. Career breaks due to maternity leave or family obligations tend to incur professional penalties, such as loss of research momentum or exclusion from major projects. These structural disadvantages make reentry into competitive scientific domains difficult and reinforce the perception that women's careers are secondary to their family roles, further perpetuating gender disparities in leadership and tenure positions.

The fourth theme, identity incongruence and belongingness, addresses the internal and social conflict many women experience in reconciling their professional identity with prevailing gender norms. Women often report feelings of alienation in teams where they are underrepresented or perceived as outsiders. The absence of female mentors or role models intensifies the sense of isolation and limits opportunities for career guidance and inspiration. Many women experience tension between their scientific identity and femininity, questioning whether they truly belong in their chosen field. This incongruence undermines professional confidence and leads to withdrawal from collaborative networks, which in turn perpetuates the gender imbalance in high-impact research and leadership roles.

The fifth theme, psychological vulnerabilities, focuses on internalized emotional and cognitive struggles that emerge as a result of prolonged exposure to structural inequities and social biases. The impostor phenomenon is a common manifestation, where women doubt their competence despite evident achievements and fear being exposed as frauds. Low self-efficacy and chronic stress contribute to emotional exhaustion and burnout, further impairing motivation and engagement. These psychological effects often lead women to avoid high-risk projects or leadership roles, reinforcing the existing gender gap. The emotional toll of navigating continuous scrutiny and subtle discrimination reveals how systemic issues translate into personal psychological distress, affecting long-term well-being and professional sustainability.

The sixth theme, social and interpersonal exclusion, illustrates how exclusionary practices within academic and professional networks restrict women's advancement and visibility. Women in STEM often report being ignored during meetings, assigned peripheral tasks, or denied

authorship recognition, reflecting subtle yet impactful forms of marginalization. The lack of access to informal networks—where critical decisions and collaborations are often forged—limits women's exposure to sponsorship and advancement opportunities. Furthermore, competitive dynamics among female colleagues, sometimes induced by scarcity of leadership positions, lead to academic isolation rather than solidarity. Such relational barriers reduce professional cohesion and limit collective advocacy for gender equity within STEM communities.

The final theme, structural and policy barriers, underscores the institutional and systemic dimensions of identity threat. Unequal distribution of resources, limited access to funding, and lack of representation on grant and policy committees restrict women's capacity to influence structural decisions. While many organizations adopt diversity policies, they often remain symbolic and weakly enforced, failing to produce tangible change. Educational inequalities beginning in early schooling and continuing through tertiary levels perpetuate the gender gap in STEM pipelines. Furthermore, women's underrepresentation in

leadership and governance roles—despite increased participation at entry levels—reflects persistent glass ceiling effects. The absence of strong accountability frameworks for gender equity perpetuates systemic disadvantage and reinforces the structural invisibility of women's contributions to science and technology.

Following the qualitative phase, the second stage of this study aimed to quantitatively rank the identified identity threat dimensions based on their perceived importance and prevalence among women working or studying in STEM fields in Brazil. Using the thematic structure derived from NVivo analysis, a Likert-scale questionnaire was developed and administered to 220 participants across universities, research centers, and technology companies. Participants rated each threat on a 5-point scale (from 1 = Very Low Impact to 5 = Very High Impact). Data were analyzed using SPSS 26, employing descriptive statistics and the Friedman ranking test to establish priority levels of each threat category. The results, summarized below, provide a data-driven prioritization of the identity threats affecting women in STEM.

Table 2

Ranking of Identity Threat Categories among Women in STEM (N = 220)

| Rank	Identity Threat Category	Mean Rank	Mean Score (1–5)	Standard Deviation	Interpretation
1	Gender Stereotyping and Bias	5.96	4.72	0.41	Very High Impact
2	Organizational Culture and Climate	5.73	4.58	0.46	Very High Impact
3	Work–Life Integration Challenges	5.28	4.37	0.54	High Impact
4	Psychological Vulnerabilities	4.91	4.24	0.63	High Impact
5	Identity Incongruence and Belongingness	4.57	4.10	0.58	Moderate to High Impact
6	Social and Interpersonal Exclusion	4.16	3.92	0.61	Moderate Impact
7	Structural and Policy Barriers	3.39	3.48	0.74	Moderate Impact

The quantitative results demonstrate a clear prioritization of the identity threat dimensions identified in the qualitative phase. Gender stereotyping and bias ranked highest, confirming that cultural and evaluative gender biases remain the most pervasive and psychologically taxing barrier for women in STEM professions. Participants consistently reported that stereotype-based judgments and implicit biases directly affect their confidence, recognition, and promotion opportunities. Organizational culture and climate followed closely, indicating that male-dominated environments, lack of mentorship, and informal exclusionary dynamics continue to shape women's workplace experiences negatively. Work–life integration challenges were also ranked highly, reflecting the ongoing struggle to balance professional advancement with domestic and familial expectations. Psychological vulnerabilities such as impostor feelings and

burnout emerged as a mid-level but persistent threat, often functioning as downstream consequences of systemic inequality. Identity incongruence and belongingness received moderate-to-high scores, suggesting that many women experience ongoing self-doubt and alienation within their professional communities. Social and interpersonal exclusion was perceived as moderately impactful, primarily due to reduced access to influential networks and collaborative opportunities. Finally, structural and policy barriers—although significant—ranked lowest, implying that women perceive immediate interpersonal and cultural threats as more pressing than formal policy limitations. Overall, the findings underscore the interdependence between organizational climate, gender norms, and psychological well-being, highlighting the urgent need for

equity-oriented interventions within Brazilian STEM institutions.

Figure 1

Vertical Ranking of Identity Threats among Women in STEM
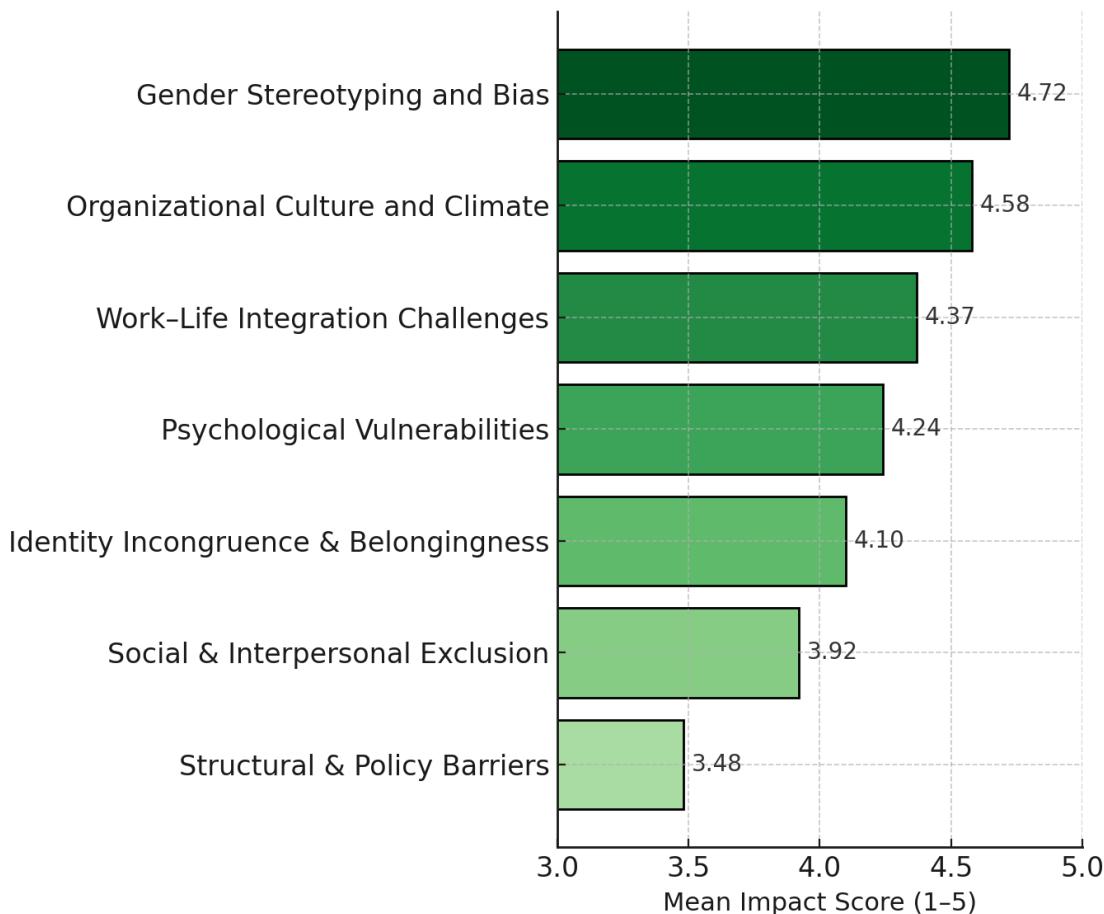
4.   Discussion and Conclusion

The present study aimed to identify and rank the primary dimensions of identity threats experienced by women in STEM fields in Brazil through a sequential exploratory mixed-method design. The integration of qualitative thematic analysis and quantitative ranking revealed seven overarching categories: gender stereotyping and bias, organizational culture and climate, work–life integration challenges, psychological vulnerabilities, identity incongruence and belongingness, social and interpersonal exclusion, and structural and policy barriers. Among these, gender stereotyping and bias and organizational culture and climate emerged as the most influential and pervasive forms of identity threat, while structural and policy barriers ranked lowest, indicating that immediate interpersonal and cultural dynamics have stronger psychological and professional

implications than distant policy factors. These results collectively reflect the layered, intersectional, and context-dependent nature of identity threats faced by women in STEM and align with growing empirical evidence emphasizing how internalized stereotypes and environmental cues shape women's persistence and well-being in scientific domains (Bergsieker et al., 2020; Veelen et al., 2019).

The finding that gender stereotyping and bias represent the most significant identity threat reinforces longstanding evidence that stereotype-based expectations continue to undermine women's confidence, motivation, and career advancement. Research has consistently shown that stereotypes portraying STEM competence as inherently masculine trigger performance anxiety and self-doubt among women, particularly in evaluative contexts (Bertrams et al., 2022; Picho et al., 2020). Similar to the present results, women across educational levels experience heightened

vigilance against confirming negative stereotypes, which not only impedes performance but also depletes cognitive resources (Chauke, 2022; Iraola-Real & Carvalho, 2025). The persistence of this pattern in Brazil underscores the universality of stereotype threat mechanisms, yet the intensity of the perceived bias also reflects sociocultural dynamics specific to Latin American gender norms, where traditional expectations of femininity often conflict with professional identities in science and technology (Gu et al., 2023; Zaman et al., 2025). The literature indicates that women who internalize such stereotypes frequently disengage from STEM-related careers or modify their self-presentation to appear less feminine in professional settings, further illustrating the psychological costs of bias (Fordham et al., 2020; Lin & Deemer, 2019).

Organizational culture and climate, which ranked second, also emerged as a critical determinant of identity threat. The qualitative phase revealed widespread perceptions of exclusionary workplace environments characterized by male-dominated networks, limited mentorship opportunities, and gender-insensitive leadership. These findings parallel those reported in South African and North American contexts, where institutional cultures rooted in masculine norms perpetuate feelings of isolation and marginalization among women (Bergsieker et al., 2020; Harmse & Dichaba, 2025). Such environments not only reinforce women's outsider status but also subtly communicate that competence and authority are male-coded traits (Georgeac & Rattan, 2023; Jensen & Deemer, 2019). Moreover, the "business case" rhetoric for diversity, which frames inclusion in instrumental terms of productivity or innovation, may exacerbate women's sense of tokenism and conditional belonging (Georgeac & Rattan, 2023). The Brazilian context appears to reflect these global patterns: women in STEM report lower perceptions of institutional fairness and higher exposure to implicit bias in promotion and recognition systems, which can explain the close proximity of this theme's ranking to gender bias. Consistent with research by (Deemer et al., 2024) and (Rahman, 2024), university and corporate climates that fail to provide visible female role models and equitable mentoring systems intensify identity threat and limit persistence.

The ranking of work–life integration challenges as the third most influential category illustrates the enduring struggle of balancing professional and familial responsibilities. Similar results have been observed globally, where women in STEM experience higher rates of role conflict and career stagnation due to domestic expectations (Harmse & Dichaba, 2025; Njogu et al., 2025). This phenomenon is deeply linked to cultural conceptions of women's primary caregiving roles, which shape both organizational expectations and self-perception. The literature confirms that lack of flexible policies and re-entry pathways after maternity leaves can amplify stress and reduce motivation (Chauke, 2022; Rahman, 2024). In Brazil, these challenges may be compounded by the uneven enforcement of gender equity legislation and persistent social norms that undervalue women's professional ambitions. The emotional toll of these conflicts often translates into decreased research productivity and premature career exits, consistent with findings by (MacIntyre, 2020) and (Cruz & Nagy, 2022), who highlight that work–life imbalances disproportionately affect women's engagement in academic and technical fields.

The prominence of psychological vulnerabilities as a mid-ranking but significant theme reveals the internalized dimensions of identity threat. Many participants expressed experiences consistent with impostor phenomenon, burnout, and low self-efficacy—symptoms that have been widely documented among women in competitive STEM environments (Bertrams et al., 2022; Lin & Deemer, 2019). The self-doubt that accompanies stereotype exposure can evolve into chronic psychological strain, particularly when combined with institutional neglect or social exclusion (Endendijk, 2023; Jensen & Deemer, 2019). The findings align with motivational frameworks suggesting that perceived threats to competence and belonging erode intrinsic motivation and resilience (Johnson & Pietri, 2022; Wong, 2023). Moreover, the impostor feelings reported in this study echo evidence from international samples showing that women often attribute their successes to external factors such as luck rather than skill, perpetuating cycles of underconfidence (Fordham et al., 2020; McCarty et al., 2020). These psychological effects underscore the interplay between individual cognition and broader systemic inequities, suggesting that interventions must address both mental health and structural reform to mitigate identity threat sustainably.

Identity incongruence and belongingness, ranked fifth, captures the tension women experience in reconciling their gender identity with the cultural image of a scientist. Participants' narratives reflected internal conflict about whether they "fit" within their professional communities, often citing a lack of relatable role models or mentors. This aligns with findings that underrepresentation in professional and academic settings amplifies feelings of isolation and

self-questioning (Endendijk, 2023; Zaman et al., 2025). When women perceive their authentic selves as incompatible with success norms, they may either assimilate into masculine-coded cultures or disengage from STEM entirely (Jensen & Deemer, 2019; Veelen et al., 2019). Conversely, exposure to diverse and successful female exemplars has been shown to foster stronger identification with STEM and mitigate identity incongruence (McCarty et al., 2020; Verdugo-Castro et al., 2021). The Brazilian results therefore suggest a need for proactive mentoring and representational strategies to strengthen collective belonging among women in scientific careers.

The themes of social and interpersonal exclusion and structural and policy barriers, which ranked lowest, nonetheless reveal important nuances about the perceived proximity of threat sources. The moderate ranking of social exclusion suggests that women are increasingly aware of overt exclusionary practices but may underestimate their cumulative impact. Exclusion from informal collaboration, invisibility in authorship, and lack of access to professional networks continue to disadvantage women subtly yet persistently (Bergsieker et al., 2020; Harmse & Dichaba, 2025). These micro-level dynamics, though less visible than institutional discrimination, play a crucial role in sustaining gender hierarchies (Grimm et al., 2023; Jones et al., 2022). The lowest-ranked category—structural and policy barriers—likely reflects relative improvements in formal equity frameworks, such as gender-sensitive recruitment or funding initiatives. However, the persistence of gaps in implementation and enforcement still contributes to broader patterns of inequality (Georgeac & Rattan, 2023; Rahman, 2024). This discrepancy between policy presence and practical impact echoes findings across Latin American and European studies, which highlight that symbolic compliance often fails to produce substantive cultural change (Harmse & Dichaba, 2025; Salinas, 2024).

Overall, the comparative results from this study reinforce a hierarchical model of identity threats in which proximal, interpersonal, and psychological factors exert greater influence on women's lived experiences than distal, structural ones. This aligns with cross-national research demonstrating that climate-related variables—such as inclusivity, belonging, and organizational fairness—are stronger predictors of women's persistence in STEM than external policies alone (Deemer et al., 2024; Jensen & Deemer, 2019). Importantly, the current study contributes a context-specific understanding of how these threats manifest in Brazil, a country characterized by cultural collectivism, gendered labor expectations, and emerging equity reforms. While much of the global literature has focused on U.S. and European populations, the Brazilian findings expand the cross-cultural validity of identity threat frameworks and suggest that interventions must be culturally adaptive rather than imported wholesale (Njogu et al., 2025; Rahman, 2024).

Furthermore, the findings highlight the interconnected nature of gender bias, organizational climate, and psychological well-being. The top-ranked threats—bias and culture—operate synergistically, reinforcing one another in a feedback loop that sustains exclusion. Stereotypes create biased evaluations, which in turn shape organizational norms, producing climates where women's presence remains conditional and precarious. This cyclical model echoes the "double jeopardy" hypothesis, wherein being both outnumbered and stereotyped magnifies career disadvantages (Veelen et al., 2019). However, evidence also suggests potential pathways for resilience: self-control capacity, identity affirmation, and exposure to female role models have been found to buffer the effects of stereotype threat (Bertrams et al., 2022; MacIntyre, 2020; McCarty et al., 2020). In light of this, interventions promoting balanced identity integration—where femininity and professionalism coexist—could serve as powerful tools for mitigating identity threat in both academic and corporate settings (Endendijk, 2023; Zaman et al., 2025).

In a broader sense, the study affirms that women's underrepresentation in STEM is not solely a pipeline issue but a climate and identity problem. Institutional efforts to recruit more women will have limited success without addressing the psychological and cultural mechanisms that undermine belonging. Programs that promote inclusive mentorship, gender-responsive pedagogy, and equitable evaluation systems can directly reduce the salience of threat cues (Cruz & Nagy, 2022; Deemer et al., 2024). Moreover, the intersectional insights from prior research emphasize that identity threats are not monolithic: women of color, low-income backgrounds, or minority regions experience compounded threats requiring multidimensional policy responses (McKoy et al., 2020; Przymus et al., 2021). The Brazilian findings contribute to this discourse by illustrating how structural inequities, though formally addressed through policy, remain embedded in everyday organizational interactions that perpetuate gender hierarchies.

Taken together, the results suggest a continuum of threats ranging from explicit stereotyping to subtle exclusion and

self-doubt, each reinforcing the other within the professional ecosystem of STEM. Addressing these threats requires not only policy innovation but also cultural transformation within institutions and broader society. Future frameworks should integrate psychological, educational, and organizational strategies to dismantle the systemic roots of gendered identity threat and foster environments where women's participation and leadership in STEM can thrive sustainably.

5. Limitations and Suggestions

Although this study provides comprehensive insights into the hierarchy of identity threats faced by women in STEM, several limitations must be acknowledged. First, the data collection relied partly on self-reported perceptions, which may be influenced by recall bias or social desirability effects. Second, the participant sample was geographically confined to Brazil, limiting the generalizability of findings across other cultural or institutional contexts. Third, while the mixed-method design allowed for both qualitative depth and quantitative prioritization, it did not incorporate longitudinal tracking, which could capture changes in identity threat perceptions over time. Moreover, the literature-based qualitative phase may have missed emerging post-2025 developments, and the use of online survey formats may have excluded participants with limited digital access. Future studies should therefore employ triangulated designs that combine self-reports, behavioral measures, and organizational data for greater validity.

Future research should extend this investigation cross-culturally to compare identity threat hierarchies among women in STEM across Latin America, Africa, and Asia, enabling a more nuanced understanding of contextual variations. Longitudinal studies could explore how identity threat perceptions evolve throughout women's academic and professional trajectories. Further, integrating physiological and neurocognitive measures could help uncover how stereotype exposure affects stress and cognitive load. Additionally, examining intersectional dimensions—such as ethnicity, socioeconomic status, and sexual orientation—would enhance understanding of how multiple marginalized identities interact to shape experiences in STEM. Future scholars might also explore the role of digital transformation and artificial intelligence tools in either perpetuating or mitigating gendered biases in education and workplaces.

Practically, organizations and educational institutions should implement continuous gender-sensitivity training, transparent promotion systems, and mentoring programs that pair early-career women with senior female professionals. Creating inclusive organizational cultures requires leadership commitment, participatory decision-making, and evaluation criteria that value collaboration and innovation rather than conformity to masculine norms. Flexible work policies, mental health support, and anti-bias mechanisms should be integrated into institutional frameworks to reduce work–life strain and psychological vulnerability. Moreover, promoting diverse female role models through media and institutional campaigns can strengthen identification and belonging among younger women aspiring to STEM careers. By addressing both structural inequities and cultural perceptions, policymakers and educators can transform the STEM ecosystem into one that not only welcomes women but actively supports their sustained success.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Declaration of Interest

The authors report no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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