The Impact of Stereotype Threat on Female Students' Learning Experiences in STEM: Mechanisms and Coping Strategies

Jiaxuan Yu[1]and Yu Zhang[2, *]

[1]Qingdao No.9 High School, Qingdao, Shandong, 266000, China

[2]Suzhou Foreign Language School, Suzhou, Jiangsu, 215000, China

*Corresponding author: UU012666@outlook.com

Abstract. Globally, women have long had low participation in science, technology, engineering, and mathematics (STEM) fields, particularly during higher education and career development stages. Despite gender equality policies implemented in many countries, gender stereotypes still subtly influence women's subject choices and career paths. This qualitative study explores how gender stereotype threat shapes female students' STEM learning experiences and identifies their coping mechanisms, drawing on sociological frameworks. Through in-depth interviews with five Chinese high school/pre-university students, the study reveals that hegemonic gender stereotypes permeate educational, familial, and social fields. These stereotypes manifest as gendered differential treatment, attributional bias, and normative societal expectations, triggering self-identity threat among female students. However, participants exhibited agency through adaptive identity work: using academic achievement to counter stereotypes, seeking social capital, and disregarding gendered microaggressions. Supportive familial social capital and female role models emerged as critical buffering factors. The study emphasizes the need for structural transformation alongside individual-level support to advance gender equity in STEM education.

Keywords: stereotype threat, gendered education, STEM education, identity work, social capital.

1. Introduction

Despite global efforts toward educational gender equity, women remain underrepresented in STEM fields—a pattern rooted in sociocultural structures rather than ability differences. A growing body of multinational research indicates that gendered achievement gaps in mathematics emerge early and widen through cumulative disadvantage [1].

In China, while female higher education enrollment now exceeds that of males, a pronounced gendered disciplinary stratification persists in core STEM fields such as physics and engineering [2]. The commonly - seen stereotype that "girls lack the aptitude needed for STEM" is constantly strengthened via familial expectations, teachers' implicit bias, and media portrayals. It serves as a strong structural limitation that stops female students from pursuing and sticking to STEM paths of learning.

Based upon Claude Steele's stereotype threat theory, this study resolves to answer three questions: (1) How do female students perceive and internalize gendered stereotypes in STEM contexts? (2)What is the impact of these stereotypes on their academic experiences and self-identity? (3)What identity work strategies do they construct to tackle these threats? The objective of this research is to investigate the psychosocial barriers and resilience mechanisms in STEM education via a qualitative lens.This study intends to scrutinize the psychosocial barriers and resilience mechanisms in STEM education via a qualitative analysis.

2. Literature Appraisal and Theoretical Setup

2.1. Stereotype Threat Existing in Educational Contexts

Stereotype threat touches on the psychological risk of confirming a negative stereotype about one's social group, which can paradoxically degrade performance and exacerbate anxiety in stereotype -

relevant situations [3]. Since Steele and Aronson's foundational work, extensive research has demonstrated how this phenomenon adversely affects stigmatized groups—including women in mathematics—leading to underperformance, domain disidentification, and behavioral avoidance [4].

2.2. Gender-linked Stereotypes and STEM

STEM fields are commonly culturally built as masculine zones, valuing traits like rationality and objectivity that are stereotypically linked to men.Female students in these areas consequently confront a double bind: they need to prove their intellectual ability while simultaneously managing societal femininity norms.This tension mandates strategies for identity construction, for example distancing from feminine stereotypes or compensating via remarkable effort.This tension calls for identity work strategies, like distancing oneself from feminine stereotypes or compensating via exceptional effort.

2.3. Theoretical Framework

This study is primarily grounded in stereotype threat theory and draws on recent advances in understanding its mediating psychological mechanisms to explain the challenges faced by female students [5]. An intersectional lens acknowledges that gender experiences are not monolithic but are shaped by multiple overlapping factors, including academic background, familial social capital, and institutional context. Furthermore, the researchers integrate the latest elaborations of Self-Determination Theory to analyze how the fulfillment — or frustration — of students' basic psychological needs (autonomy, competence, and relatedness) influences their motivational dynamics and coping strategies in the face of stereotype threat [6].

3. Methodology

3.1. Participants and Sampling

Five female students (aged 15-18) were picked by purposive sampling (see Table 1). They embody diverse educational routes, like sustained STEM participation (3 students), a move from STEM to arts (1 student), and blended experiences (1 student). This approach ensured diverse experience representation while enabling depth of analysis.

Table 1. Participants Demographic

Name	Learning Background	Family Background
Kim	11th grade; prefers science subjects for their logical and clear answers; finds solving problems more rewarding than memorizing arts content.	Family is neutral and supportive; mother enjoys science and data-related topics; no gender bias at home.
Sya	Senior year (Grade 12); previously in a science class in regular high school; currently studying A-levels focusing on Regular Math, Advanced Math, and Physics; prefers science for its logical thinking and less memorization-heavy style.	Parents are open-minded and supportive; no bias against girls studying science; home environment emphasizes encouragement and minimizes gender differences.
Njy	10th grade; switched from a science-focused to a more arts-oriented track; interested in physics and chemistry since middle school and performed well in them.	Parents don't mind girls studying science but expect her brother to do so; generally supportive.
Dwmn	Studied in a science class for some time; noticed that boys often outnumbered girls in class.	Mother supports girls studying science, but father still holds the belief that men should study science and women should study arts.
Wzh	10th grade; noticed stereotypes early since elementary school.	Parents used to think girls perform worse academically, but stopped saying so after high school; mother is strong in science and serves as a role model.

3.2. Data Collection

The researchers held semi-structured interviews via online platforms, and every interview lasted 30-45 minutes.The interview focused upon experiences involving stereotypes, emotional reactions, identity negotiation plans, and support frameworks.All the interviews were put on recording, transcribed word by word, and anonymized to safeguard secrecy.All interviews were taped, transcribed exactly as uttered, and anonymized for the sake of confidentiality.

4. Findings

4.1. Pervasiveness and Early Internalization of Gendered Stereotypes

All participants reported encountering the "girls lack STEM aptitude" stereotype throughout their educational journeys, often describing it as "ambient background noise" that became gradually internalized. This phenomenon manifested across different educational stages and contexts. Kim reflected, "Teachers never said it directly, but I felt 'they think boys are better at STEM'—it became a silent constraint that made me question myself." This sentiment was echoed by Wzh, who noted early awareness "like back in elementary school."

More evident reinforcement originated from institutional actors, as Dwmn recalled: "My math teacher always said that girls can't perform well in those subjects.".Should a girl fail to do well, she'd state it's because girls aren't skilled in science.These consistent communications, be they implicit or explicit, created what Njy characterized as instances of self - doubt, "wondering if I'm actually not good at science," despite her solid academic achievements and real interest in physics.These consistent communications, whether implied or stated clearly, generated what Njy described as instances of self - doubt, "wondering if I'm really not good at science," despite her high academic standing and real enthusiasm for physics.

4.2. Gender-related Disparate Treatment and Microaggressions

The classroom scenario turned out to be a key site where gender - based expectations were bolstered through both structural arrangements and interpersonal meet - ups.Kim put forward a vivid instance of role segregation: "In physics labs, teachers enabled only boys to operate the equipment, saying 'girls are too careful for this'; we were given the job of recording data—like our role was pre-decided."This disparate treatment extended into the realm of academic evaluation, where attributional bias was regularly noted in participants' accounts.This disparate handling spread to academic appraisal, where attributional bias was regularly detected in participants' accounts.

The data showed a consistent pattern in which female success was ascribed to "hard work" and perseverance, whereas male achievement was presented as arising from "innate talent" or "natural ability".Kim spotlighted this disparity in teacher feedback: "If I score highly, the teacher might say I'm extremely hard - working and naturally clever. But when a boy does well, they might say he has shrewd thinking and talent." This bias enhances the problematic dichotomy that ties raw intellectual brilliance to masculinity, gently undermining female students' sense of belonging in STEM fields.This bias exacerbates the problematic divide that connects raw intellectual brilliance with masculinity, thereby gently weakening female students' sense of belonging in STEM fields.

4.3. Family Dynamics and Intergenerational Attitudes

Parental attitudes created significantly different home environments that played a crucial role in either mitigating or reinforcing societal stereotypes. Some participants benefited from consistently supportive families. Kim described her parents as "pretty neutral and supportive whatever I want to do," while Sya noted her "pretty open-minded" parents "don't have any bias about girls studying science." Wzh's mother served as a powerful counter-stereotype: "My mom's awesome at science, so I've never really bought into those stereotypes."

However, other participants navigated more complex familial landscapes where traditional gender norms persisted. Dwmn experienced direct intergenerational bias: "My dad still sticks to the stereotype that guys should study science and girls should become art students." Similarly, Njy observed differential expectations within her family: "My parents don't really have an issue with girls studying science, but they expect my brother to study it." These contrasting experiences highlight how family serves as both a potential buffer against and a conduit for societal stereotypes.

4.4. Adaptive Identity Work Strategies

In response to these challenges, participants demonstrated remarkable agency through three primary coping strategies that constituted sophisticated forms of identity work:

Confrontational Validation involved using academic achievement as a direct tool to challenge and disprove stereotypes. Kim exemplified this approach: "I just hit back directly, letting the real results shut them up... Getting top grades in math made others stop saying 'girls can't do STEM'." Njy employed similar tactics: "If I do badly, it just makes me want to study harder and beat the boys with my results, proving the stereotype wrong."

Selective Disengagement entailed consciously ignoring negative comments and microaggressions from non-significant others. Wzh described this as "I try not to pay attention to negative comments, ignore the stuff that could affect my mindset." Kim employed strategic dismissal: "For online comments or people who don't really matter, I just treat it like I'm watching a joke." This emotional management strategy allowed participants to conserve psychological resources for their academic pursuits.

Social Capital Mobilization involved actively seeking emotional and academic support from interpersonal networks. Dwmn illustrated this through peer support: "My close friend's amazing at science and helps me with problems, so she's kind of leading by example and breaking those stereotypes." Kim also described "seeking help and support sometimes, and I'll vent to my friends," indicating the importance of social networks in navigating stereotype threat.

4.5. Role Models and Support Systems

The presence of female role models emerged as a crucial protective factor that bolstered resilience and provided alternative narratives to dominant stereotypes. Participants identified supportive mothers, with Wzh's mother being "awesome at science" thus providing a living counterexample to gender stereotypes. Teachers also played pivotal roles, as Kim recalled: "My middle school homeroom teacher never doubted our abilities because of gender, treating everyone equally."

Peer models proved equally significant. Sya noted that in her previous school, "there were a lot of top-performing girls" which "really helped break the stereotype that girls can't do well in science." Digital spaces provided additional resources, with Kim finding inspiration from "women online who are great at science" who "brought me a lot of positive energy." These diverse role models across different domains provided crucial validation and demonstrated the possibility of female success in STEM, thereby fostering a sense of belonging and potential [7-10].

5. Discussion

The findings correspond to existing literature on stereotype threat and widen our understanding of how it works in Chinese educational environments. The study shows how threat presents via everyday interactions and institutional routines, but also highlights participants' power to transform these challenges into motivational resources using strategic identity work.The research reveals how threat becomes apparent through daily interactions and institutional practices, yet it also emphasizes participants' agency in transforming these challenges into motivational resources via strategic identity adjustment.

An intersectional lens reveals that reactions to stereotype threat varied considerably according to students' access to social and cultural capital.Individuals possessing robust family support

arrangements showed more resilience and the ability to adjust, whereas those without these resources faced greater disengagement risks.The teacher behaviors detected during this study underscore the demand for structural interventions—more than just individual attitude change—to disrupt gendered norms in STEM education.Teacher behaviors monitored in this study show the need for structural interventions—beyond individual attitude change—to break gender - related norms in STEM education.

6. Conclusion

This research verifies that gender stereotype threat notably affects female students' STEM experiences, yet also emphasizes their ability for resilience and adaptive identity work.The research illustrates how stereotypes are maintained via diverse channels—educational practices, familial hopes, and social accounts—while also pinpointing potent protective factors including role models and supportive relationships.The study demonstrates the perpetuation of stereotypes via multiple avenues—educational approaches, familial hopes, and social accounts—while also identifying potent protective factors like role models and supportive relationships.

To improve educational equality, several measures are advised:

Educational institutions ought to engage in comprehensive teacher training on implicit gender bias and develop inclusive curricula that manifest women's contributions to STEM fields.Families ought to be motivated to ground educational guidance in students' interests and abilities instead of gender stereotypes, especially when addressing intergenerational biases.Policy measures ought to encourage gender-sensitive educational approaches and back programs linking female students with STEM role models and mentors.Public awareness campaigns ought to confront stereotypical portrayals of women in STEM and emphasize diverse career paths

Although adequate for qualitative depth, the sample size restricts the extent of broad generalizability.Future studies ought to use longitudinal designs to monitor the long - term influence of stereotype threat on STEM pathways across various educational stages.Moreover, looking into the perspectives of teachers and parents would yield valuable insights on the systemic nature of gendered stereotypes in STEM education.In addition, looking into the perspectives of teachers and parents would yield valuable insights into the systemic nature of gendered stereotypes in STEM education.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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