

Female International Students in Engineering Graduate Programs: Transnational Pursuit of Professional Success with the Burden of Intersected Marginalities

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Abstract

This work in progress presents preliminary findings from our phenomenological research aimed at elucidating the key facets of the acculturation process and program experiences of female international students in engineering graduate programs. Using Interpretive Phenomenological Analysis (IPA), we interviewed 10 international female students currently enrolled in three different engineering graduate programs at an urban research institution in the Southeastern United States. Our preliminary IPA analysis yielded four themes; 1) presence of dynamic and comprehensive transnational social networks that inspired and enabled participants' pursuit of professional careers through U.S. higher education, 2) an established ethnic/cultural community on campus that serves as a safe haven; 3) segmented cultural assimilation characterized by the lack of meaningful cultural exchange and mingling; 4) experiencing intensified vulnerability grounded in overlapping marginal identities (gender and nationality/legal status in US).

Keywords: International students, female students, engineering graduate program, intersectionality

Introduction

As the world becomes increasingly interconnected, universities and colleges across the United States have attracted many international students [1] who, in turn, play a significant role in supplying a high-skilled workforce in science, technology, engineering, and mathematics (STEM). For example, during the 2022–2023 academic year, 1,057,188 international students were enrolled in either undergraduate or graduate degree programs in the United States [1], (2024). Of this group, 55% of the students majored in STEM; 44% were graduate students. Women's low participation and high attrition in many STEM disciplines have been a topic of great importance in the United States. Women comprise 35% of the STEM workforce, 26% in Computer and Materials Sciences, and 16% in engineering, despite the fact that women make up nearly half of the general workforce [2]. Recent NSF data indicate that international female students enrolled in U.S. STEM graduate programs play a pivotal role in replenishing a highly skilled workforce, as the current void of female talent persists in STEM pathways [3] [4].

Female international students are a unique subgroup embodying multiple layers of marginality as racial/ethnic minority women in male-dominated STEM disciplines and foreigners facing linguistic and legal obstacles [5]. However, STEM disciplines have long been criticized for their low representation of women and, therefore, have actively recruited female talent at all levels [6]. With the growing presence of international students and faculty members in many STEM fields, we believe that female international students in engineering may have distinctive experiences that set them apart from other international students reported in most previous studies [7].

Our phenomenological research aims to elucidate the key facets of the acculturation process and program experiences of female international students in engineering graduate programs. Two research questions guided our investigation. 1. What are the major characteristics of the participants' acculturation and graduate program experiences? 2. How are multiple intersected marginalities (gender, race, foreign nationality) reflected in their current program experiences and career trajectories?

Methods

This study adopted Interpretive Phenomenological Analysis (IPA), grounded in interpretive/hermeneutic traditions and valuing ideographic properties [8]. IPA focuses on people's sense-making of their lived experiences situated in a specific social and cultural context. It aims to elucidate common threads in people's experiences and sense-making grounded in shared environments, relationships, and processes; it also recognizes the possibility of individuals' unique and divergent interpretations of the same or similar life events and environmental structures [8]. All these properties make IPA a flexible, effective, and relevant inquiry approach for exploring the dynamic, fluid experiences of individuals during a significant transition or self-redefining moment.

The research team consists of three individuals, all with transnational backgrounds. The lead investigator is an Asian American faculty member with expertise in research on international students and qualitative methods. The second author is an engineering faculty member specializing in construction management; she works intensively with international students in her graduate program. The third member is an engineering graduate student working as a research assistant in the second author's program. Each team member conducted 3-4 interviews and participated in the initial data analysis led by the lead investigator.

The sample includes 10 international female students enrolled in three different engineering graduate programs at an urban public university. All interviews were guided by a semi-structured interview protocol listing 11 key questions organized under acculturation experience, graduate program experience, and gender and cultural identities. All interviews were individual interviews via Zoom and recorded for later verbatim transcription. The length of interviews varied between 40 and 80 minutes. All participants received a \$20 Amazon gift card after completing their interviews.

Reflecting our methodology, we applied interpretive thematic analysis, starting with careful reading of all transcripts to capture recurring points, patterns, and themes in each participant and across the entire data set. In the first stage, we created an individual participant summary to understand each participant as a whole person. We then identified salient points from each interview and checked whether other interviews yielded similar findings. The research team met biweekly during the summer, developed the initial code list collaboratively, and completed an initial coding process based on the shared code list. In this work in progress, we will present four preliminary findings that the team agreed on during discussions and initial coding.

Preliminary findings

Our initial analysis of the first ten participants yielded four themes: 1) presence of dynamic and comprehensive transnational social networks that inspired and enabled participants' pursuit of professional careers through U.S. higher education; 2) an established ethnic/cultural community on campus that serves as a safe haven; 3) segmented cultural assimilation characterized by the lack of meaningful cultural exchange and mingling; 4) experiencing intensified vulnerability grounded in overlapping marginal identities (female in men's engineering world, foreigner with no right to work, financial constraint, physical safety). Below, we will explain each thematic finding with supporting quotes from participants.

Transnational social networks as a conduit for professional advancement

Participants testified to the presence of dynamic and comprehensive transnational social networks that inspired and enabled their pursuit of professional careers through U.S. higher education. This phenomenon was most explicit among students coming from a specific region of a South Asian country. More than half of the participants knew a current or a former student at the same institution, or someone who worked and lived in the area. Those without such direct personal connections to the university accessed the university's website and contacted ethnic student groups or organizations to seek information and support. They benefited from the transnational social network that facilitated a natural flow of information as they planned for and embarked on graduate education in the United States. Some students even teamed up with their close friends back home when planning graduate education in America; they arrived on the same campus, which naturally created an on-site support system from the very beginning. Anjali was one such student, as reflected in her comment: "Fortunately, the friends I've come with are close friends of mine."

On-campus ethnic/cultural community as a safe haven

Not surprisingly, participants found that having a supportive community that offered help made their transition smoother and less turbulent. Ethnic and cultural communities are considered an important support system for almost all students. Responding to the question about what helped her adaptation upon arrival, Sarita mentioned:

One thing is the community of your own country, I guess. That helps a lot because they explain, like, if you do so in one year, the second year is like this in the US. This is the struggle phase, and after you pass this phase, then your life will be easy. So if somebody gives that kind of motivation, it helps a lot... I feel like communicating with people from the same background. It helps me to stabilize a little bit.

Still, the participants also expanded the boundary of their support community beyond their specific ethnic and cultural identities. They readily formed an expanded community with others who shared some aspects of life, work, and legal status as newcomers. Sarita found that other international students in her lab naturally offered another layer of support, encouraging each other and sharing tips and resources crucial to her functioning. She said:

In our lab, there were 6 PhD students, and all are from different countries. I think that also helps because all people come from different backgrounds. We used to talk a lot [about] how they adapt. And there are like 2 or 3 seniors ahead of me. And then I used to ask, like, “did you feel the same thing the way I'm feeling? or it was different? Or am I the only person who finds it so difficult in every situation?”

Segmented cultural assimilation

One salient finding from the interviews was participants’ highly segmented cultural transition, often characterized by a lack of meaningful intercultural exchange and mingling. This phenomenon is most evident in a specific program where a large number of international students come from a specific region or country. While these students benefited from shared cultural and ethnic identities, languages, and social support, it was a double-edged sword in their personal and professional development. Those who came to America, aspiring to experience something new and different, found the surprisingly homogeneous class makeup disappointing. Anjali delivered the point very clearly.

I think it's sad that I do not have new, I don't have new understanding of cultures, like the way I wanted it. So my contact with any other race usually comes [through] my part-time [job], but unfortunately not [in] my classroom, which these two are my only ways of meeting people. I like the idea of networking. I love the idea of understanding culture. So, I was very excited to do that when I came to the US. But that was not there. But that does not really affect my education system or my program. I think personally, it's helpful that the people who I meet in my classroom right now are all international Indian students. ...So if I need them, they're immediately around me. If I have a doubt in my software, I can immediately run to them. Apart from that, I think I would personally like it if I had, like, local Americans in my classroom, or some international students from other countries come in and stay in my classroom, so we can understand [others]. In some of the classes, we have a lot of interaction, right? We talk about how construction is in our country. So, every time there's a discussion like that, I feel like all of us are just telling the professor something. But we have no new information coming from other students, because it's mostly just us. Maybe such exposure to new kinds of lifestyles, especially in terms of construction or architecture, would help us understand more challenges.

Experiencing intensified vulnerability through overlapping marginal identities

While determined, proactive, and resourceful, the participants’ narratives were full of evidence revealing their intensified vulnerability as women in male-dominated fields and enduring their precarious legal status and uncertain career trajectories in America. Beyond financial constraints common to all international students (and even domestic students), the participants expressed a high anxiety about their physical safety. Esther stated, “Safety is a big concern for females,” and “I sometimes felt really scared in certain places. I wanted to go out alone and explore, but I couldn’t because people around me seemed shady or harmful, and I didn’t feel comfortable going out.”

Diana, a Civil Engineering student, was afraid of using public transportation. “Because one time, it happened that someone followed me from our campus to my residential area. Then I had to walk here and there so that the follower wouldn’t follow me to my home.” Diana also experienced a sense of isolation and lack of support when she dealt with female-specific health issues and pregnancy, which others, especially male peers, might not fully recognize. She lamented:

I would say people should be more understanding. For example, I always have very painful periods every month, and I need to take one day off because of that. That’s one thing I’ve found hard to communicate with professors. I think people should be more understanding about health situations—especially since, biologically, we are different. I don’t see myself as less capable at work because I’m a woman, but the truth is my body sometimes needs rest. They should understand and allow for that. It shouldn’t be seen as getting “extra” breaks because I’m a girl.

The participants’ overlapping disadvantages as international female students in male-dominating fields were most evident in their job-seeking process. Prisha, a master’s student in construction management, explained her struggle:

I was fortunate enough to get the internship. But yeah, that was the difficult part. I had to apply for a lot of things where they ask where you come from, and all of that. I don't know what other people are thinking, and why they are rejecting you, on what basis. But I used to think that since it is a male-dominated [field] and the program is construction. So they would hire a lot of males than females, because in the long run they are required in construction. It's a heavy-duty [job], right? The heavy civil [engineering], and all of it. So, they would feel like the girls can't do a part. And international means they'll have to, like, sponsor the worker for the position. So, I think that they would prefer that. That's why they give a lot of rejections. That's what I think... ... But this is difficult, though, to find an internship; I attended all of the career fairs. The best thing we can [do] is approaching directly to the companies, but it's their decision in the end if they want to hire you or not. So that's what I struggle [with] there.

Padma, another participant, shared a challenge during her employment process. As a new graduate, she applied for a job and successfully received a job offer. A couple of days later, however, the hiring company retracted its offer, citing concerns about her ability to work in a harsh environment. To demonstrate her ability to adapt to difficult working conditions, Padma completed a 3-month unpaid on-site internship. She finally secured the previous job offer. Through this experience, Padma recognized the persistent gender stereotype in her field, as none of her fellow international male graduates faced the same ordeal in their job searches and hiring processes.

Discussions

Preliminary findings from this study largely resonate with the common threads in previous studies, which have shown the intensified challenges faced by international graduate students. Still, this study further delineates the arduous journey of one of the most disadvantaged student

groups in American higher education—international female students in STEM graduate programs who face multiple marginalized identities grounded in their gender, legal status, and race/ethnicity [9].

Our study is well situated in the context of today's ever-evolving globalized social and knowledge network, which effectively disseminates information and helps people connected with each other pursue their professional careers across borders. Also, it is important to note that our study is grounded in a post-pandemic America. The impact of the COVID-19 pandemic has been profound and irreversible in many sectors of American society. During the pandemic and subsequent years, racially charged incidents targeting Asian immigrants and Asian Americans increased significantly [10]. Because many female international students studying in the United States are from Asian countries [11], these events directly affected their experiences. Overall, the preliminary findings indicate the participants' growing awareness of the less welcoming US social and political environment and their deepening dilemma as individuals who embody multiple intersecting marginalities in the STEM profession. Therefore, exploring the lived experiences of this unique group of Asian female international students in post-pandemic America would be a valuable addition to the existing literature.

Due to the in-progress nature of our study and its current small sample size, we could not conduct more precise, in-depth analyses, such as comparisons of participants across different engineering fields with varying levels of women, or international students' enrollment. We plan to increase the sample size and engage in further systematic analysis to strengthen the trustworthiness of these preliminary findings. We also acknowledge the particularistic nature of our study findings, as it was conducted in a specific institutional context in the southeastern United States. To examine the relevance and transferability of our study's findings, it is necessary to extend the study to other higher education institutions in regions where graduate student demographics and community contexts differ significantly from those at our research site. Furthermore, given the dynamic movement of international STEM graduate students across regions worldwide, it will be important to investigate the experiences of international female students enrolled in STEM graduate programs outside the US.

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