

”Ima Nmadu”: Building Academic Success Through Relationships—A Black Civil Engineering Ph.D. Student’s Autoethnographic Insights

Miss Mary Ifeoma Nwanua, University of Florida

"Ima Nmadu": Building Academic Success Through Relationships - A Black Civil Engineering Ph.D. Student's Autoethnographic Insights

Mary Ifeoma Nwanua

Division: Graduate Studies

Abstract

The need to diversify the engineering workforce is a national imperative, emphasizing broadening participation and fostering inclusivity. Achieving this goal necessitates comprehensively examining the educational pathways that nurture and launch talented individuals into engineering careers. The 2020 National Science Board, "Science and Engineering Labor Force," Science & Engineering Indicators reveals a persistent underrepresentation of Black students in engineering disciplines. Within this group, there is further heterogeneity, with Black students of international origin often being overlooked. This study narrows its focus on these international Black students to understand their unique experiences better.

The systemic and cultural racial biases inherent within educational institutions contribute to the marked dearth of Black students in engineering doctoral programs. Even as research begins to unravel the experiences of Black Ph.D. students in engineering – from motivations and persistence to encounters with racial microaggressions – the disparity remains, underscoring the need for deeper exploration.

Utilizing autoethnography, this study illuminates the journey of a Black female engineer from Nigeria during her inaugural semester in a U.S.-based civil engineering Ph.D. program. The research hinges on two pivotal questions: what early challenges did she confront, and how did she traverse them? To answer these questions, reflective journals and audio diaries maintained consistently by the researcher were employed. These data sources were subjected to inductive coding via Dedoose to tease out dominant themes.

This research findings highlight critical challenges this international student faces, from grappling with communication barriers and acclimatizing to the U.S. academic landscape to technological adjustments and fostering trust in her academic environment. Intriguingly, the student drew upon her deep understanding of social connections, commonly called 'Ima Nmadu' in Nigeria, which translates to "It's not what you know, it's who you know." Coupled with keen self-reflection and unwavering dedication, these networks became pivotal in surmounting the identified challenges.

The intertwined roles of social and navigational capital become evident, proving indispensable in shepherding students through the tumultuous initial phases of graduate school. By unveiling and addressing Black international Ph.D. students' distinct challenges, this study amplifies the clarion call for fostering participation and inclusivity in engineering doctoral programs.

Introduction

Promoting diversity within the engineering workforce is a critical national priority, underscoring the need for broader participation and the cultivation of inclusivity [1]. The infusion of diversity

into the field of civil engineering in the United States yields numerous advantages, including a multifaceted project perspective, heightened project value, the enrichment of knowledge, talent, and ideas, access to expansive networks, and the production of superior final products necessary for global competitiveness in infrastructure [2]. Consequently, achieving this imperative requires a comprehensive examination of the educational pathways that nurture and propel promising individuals into engineering careers.

In the current landscape, the retention of students within engineering programs poses a significant challenge, given the notable attrition rates [3], [4], [5], [6]. Engineering programs, acknowledged for their intensity and stress levels [7], grapple with a diversity problem [8]. This issue, often attributed to the perceived masculinity of the field and the presence of a 'chilly climate' [9], tends to exclude women and people of color. The 2020 National Science Board's "Science and Engineering Labor Force" report within Science & Engineering Indicators highlights a persistent underrepresentation of women and Black students in engineering disciplines. Furthermore, Black students face a higher attrition rate compared to their peers of other races [4]. Given these stark statistics, the retention of the Black population in graduate and undergraduate engineering programs becomes imperative for establishing a diverse and robust workforce [8], [10].

The systemic and cultural racial biases inherent within educational institutions contribute to the marked dearth of Black students in engineering doctoral programs. Even as research begins to unravel the experiences of Black Ph.D. students in engineering – from motivations and persistence to encounters with racial microaggressions – the disparity remains, underscoring the need for deeper exploration. This group has additional heterogeneity [11], particularly overlooking Black students of international origin. The tendency to group these students often obscures the nuanced experiences of various smaller ethnicities within this larger category. Research by Lee and Rice [12] reveals distinctions in the experiences of international students compared to the general Black population, emphasizing the importance of recognizing their intersectionality. Furthermore, there is an advocate for more intra-study within the Black student population to capture nuanced experiences that might be overlooked when treated as a monolithic group [13], [14]. In response to this call, this study narrows its focus to international Black students, aiming to uncover their unique academic experiences.

International students are crucial in enriching US academic institutions by bringing diverse knowledge, skill sets, and multicultural perspectives. According to the National Science Board (NSB) [1], they constitute a significant proportion of STEM doctoral degree holders, contributing approximately 30% to the US STEM workforce. However, the experiences of international students, especially those of color, differ from their US national and green card counterparts, often encountering marginalization due to racial and ethnic biases. These negative experiences can adversely impact their success and retention in academic settings [12]. Within the broader context of international students of color in engineering, Sub-Saharan Africa, particularly West Africa, represents one of the fastest-growing populations [15], [16]. Despite their substantial presence, a limited study focuses on understanding and documenting their educational experiences.

Recognizing the intersectional status of international students of color in engineering programs, recent studies have begun to delve into their unique experiences [13], [17], [18], [19]. These

students face challenges adjusting and acculturating to a new environment, suggesting potential moments of marginalization throughout their academic journey. Research indicates that attrition can occur at any stage of an engineering graduate program [4], emphasizing the need to comprehend experiences at all program stages. This study seeks to contribute to the engineering education literature by providing insights into the challenges faced by an international African female student during her inaugural semester in a doctoral program. It aims to uncover her navigational strategies to persist amid her experiences while integrating into the academic setting.

To explore this experience, the study draws upon social capital theory [20], [21] as an asset-based approach to capturing the resources within an International African female student's social network that are crucial for navigating the challenges she encountered during the inaugural semester of the civil engineering PhD program at a top-ranking R1 public institution. This autoethnography proposes that understanding the social capital available to an African student woman can enhance comprehension of how mentors and support networks can improve the experiences and retention of international students of color in engineering programs. This research revolves around two central questions: What early challenges did she confront, and how did she navigate and overcome them?

Background of the Study

International Black PhD Students in Engineering

International students play an essential role in the United States higher education system, contributing significantly to economic vitality and diversity. Their presence enhances awareness of global issues, fosters intercultural learning, and supports the industry and academic workforce [22]. Given the shortage of engineering faculty and US graduate students in US engineering schools, international students are crucial in closing the shortage gap by serving as research and graduate assistants, thus driving research productivity [23]. The Institute of International Education (IIE) Open Doors Report indicates that the United States hosts over a million international students, 55% in STEM fields. Engineering programs attract 19% of international students, an increase of 7.8% from the 2021/2022 IIE report [15]. Nigeria is the seventh leading country of origin among Sub-Saharan African students [15].

Furthermore, engineering graduate programs in the United States report a significant presence of international students in enrollment and degree awards. Statistically, International students accounted for 56.7% of enrollment in the engineering doctoral program and 58.8% of engineering doctoral degrees awarded [24]. Additionally, women and Black/African Americans account for the minority when viewed through the lens of gender and race both in enrollment and degree awards, underscoring a need to examine their unique experiences in the program. Black/ African Americans account for 4.7% of the total doctoral enrollment quota and 4.2% of the total quota awarded for doctoral degrees in engineering [24]. Extending the analysis, this data underscores the need to investigate the challenges faced by international students, specifically those of color. This subgroup embodying multiple identities represents a minority within the broader minority [11], [25], emphasizing the significance of illuminating their experiences.

Challenges and Barriers Faced by International Black Students in Engineering

International students face significant challenges in adapting to a new environment. Some of these include communication barriers, racial biases, financial concerns, and cultural disparities that contribute to feelings of isolation, loneliness, and exclusion [26]. Additionally, these students experience substantial challenges adjusting to a new academic setting, housing, and cultural differences [27]. During this acculturation period, they struggle to cope with stressors related to the individualistic culture in the United States and access resources crucial for creating a supportive and inclusive environment [27], [28], [29]. International students enrolled in doctoral programs face additional challenges resulting from stress-induced activities, such as time management, deadlines, and the rigorous nature of the program [30].

Black doctoral students in engineering face numerous challenges as minorities within the program, potentially impacting their sense of belonging and leading to their attrition [31]. Retaining these students is vital for their contributions to diversity in academia and industry. Diversity in engineering allows room for creativity, diverse perspectives on engineering problems, more design options, and better work quality [32]. Black doctoral students face challenges such as a lack of social support systems ranging from peer to institutional support [14]. They also experience ethnicity-related struggles, such as racial stereotypes and discriminatory assumptions and stereotypes (e.g., lacking intelligence or being unfit for the program), which contribute to the feeling of exclusion [34], [35]. Underrepresentation among students and faculty of color exacerbates their feelings of isolation and imposter syndrome [36], which, in adverse cases, could negatively affect mental health [37]. Additionally, Black or African American women in engineering experience challenges arising from racial and gender bias, such as sexual harassment, discrimination, and stress-induced fatigue [38]. Likewise, the masculine nature of engineering programs echoes the feeling of being othered or alone, resulting in isolation [9].

International students with multiple marginalized identities, particularly Black international students (e.g., African students), face heightened challenges. These students transition from a majority in their home country to a minority in the United States, which brings awareness to their altered reality [39], [40]. African students, for instance, encounter racial discrimination in various forms, such as derogatory statements, prejudiced treatment, and ill assumptions from peers and faculty, impacting their sense of belonging [13], [40], [41]. They also express frustration with perceived superficial diversity efforts in academic institutions, unsupportive mentors, isolation, and code-switching [42]. Having lived in communalism, these students struggle to adapt to the individualistic and competitive environment, compounding their challenges [42].

Within engineering, international women face compounded challenges due to their double or triple identity as international individuals, women, and sometimes, individuals of a specific racial or ethnic background [18]. Given the muscularity of the engineering profession reflected in its gender disparity, these women grapple with isolation, loneliness, and marginalization [18], [43], [44]. Gender discrimination and verbal or sexual assaults exacerbate their struggles, leading to exclusion from gatherings [43]. Further, the limited representation of female faculty hinders their ability to establish social networks and find mentors [18], [43].

In response to the growing demand for more in-depth studies on the experiences of Black or African students, Adeniranye and Berhane are currently conducting ongoing research to illuminate

the transition and lived experiences of a West African Engineering Graduate Student in the United States. This research aims to provide a narrative exploration through the lens of Yosso's Community Cultural Wealth, offering insights into the unique challenges and cultural dynamics shaping the educational journey of this individual from his undergraduate study to his advanced study in the United States [19].

Recognizing the parallel nature of the Adeniranye & Berhane research, this current study proposes a shift to an autoethnography approach to examine the author's challenges [19]. This autoethnographic study presents an asset-based approach, utilizing social capital theory to explore the author's social network resources. She aims to illuminate how social capital can effectively assist international students in navigating potential challenges, particularly during their inaugural stage in the civil engineering doctoral program.

Overcoming and Navigating Challenges in Engineering Graduate Programs – Social Networks

Navigating challenges faced by graduate students is essential to their persistence and retention within the degree program. Within the literature, social networks have been identified as a coping mechanism or tool for international students [40], [41], [45], international female students [43], underrepresented graduate students [35], [46], [47] utilize to overcome their challenges and persist in the program.

Parental and social support from undergraduate faculty mentors has been identified as an essential way of navigating engineering program challenges [35]. Likewise, International students can navigate challenges through participation in social activities, networking, and leadership roles [43]. International students also utilize their peers, 'social agents,' to navigate graduate school obstacles [18]. Good mentoring relationship also results in a successful navigational experience for underrepresented students [47]. Additionally, seeking support within social networks of friends, family, and organizations came in handy for students when faced with difficult times [41]. African International students also found the support from their local communities on campus helpful in gaining guidance and support [40]. Also, Sub-Saharan students utilize self-efficacy, self-affirmation, and determination strategies to navigate their educational environment [45].

Mary's Inaugural Semester Experience

In the fall of 2023, in August, Mary, a young Nigerian woman, embarked on a new chapter as she began her Ph.D. journey at a large, Predominately White R1 Public University in the US. This journey marked the start of exciting adventures for her, adjusting to new cultural norms and academic patterns and overall experience outside her comfort zone.

During her initial weeks in the lab, while presenting social-cultural theories and relating them to the professional formation of engineers, her professor and senior lab mates encouraged her to journal her graduate school experiences. This suggestion was further reinforced when her senior lab mate sent a series of reflective prompts to help guide her journaling. Soon after, the call for papers for the ASEE 2024 conference emerged. Inspired by a previous lab mate's research work in

the lab focused on autoethnography, Mary decided to participate in the conference by sharing parts of her journey given the call to support and retain Black graduate students in engineering.

To decide on what area of her experience she would share using autoethnography, Mary sifted through her journals and secondary archives, such as emails, WhatsApp messages, and pictures. This process led her to formulate research questions focusing on her challenges and strategies for overcoming them. Additionally, her choice of Social Capital theory as the research theoretical framing was influenced by her reliance on the support of those she knew, a concept known colloquially as "Ima Nmadu" from her native culture in Eastern Nigeria that helped her navigate through many of her challenges.

Theoretical Framework

Social Capital theory, a sociological framework employed to emphasize the significance of social connections and networks, has been defined by scholars like Bourdieu [48], Burt [49], Lin [21], [50], Coleman [51], and Putnam [52]. However, this study explicitly embraces the concept articulated by Lin. According to Lin's perspective, social capital refers to the resources within a social network that can be accessed or mobilized for expressive and instrumental actions to accrue benefits. These social connections can offer advantages such as information, influence, social credentials, and identity reinforcement, contributing to potential gains [20], [21]. Lin's conceptualization of social capital comprises four key components: availability/embeddedness, accessibility, activation, and returns. These components serve as the foundation for the codebook used in this study. Availability refers to assets and resources like human capital, trust, and norms within an individual's social network. Accessibility indicates the opportunity or openness to this network, and activation involves mobilizing or utilizing the resources received from the accessible social network. The accrued benefits from activating these social resources are termed returns [20], [21].

"Ima Nmadu," also known as "connection" among the Igbo people of Nigeria, holds a significant cultural resonance. It goes beyond mere networking; it embodies the idea that success, access, and opportunities are often rooted in the wealth of one's social network rather than individual knowledge or skills. In Nigerian society, particularly outside the academic realm, the emphasis on social connections becomes evident during crucial life events such as job searches and political appointments. "Ima Nmadu" emphasizes the profound reliance on relationships above intellectual prowess for accruing benefits [53]. "Ima Nmadu" can be a crucial tool in the United States, offering a lens through which an international African female Ph.D. student can navigate challenges.

In engineering education, researchers have utilized social capital theory to explore concepts including leadership [54], mentorship [55], career success [56], the engineering design team [57], and recruitment and retention of students [58], [59], [60], [61]. In the context of marginalized students' recruitment and retention, Martin et al. [58] used social capital theory to examine the social resources within first-generation undergraduate students' social ties, shedding light on how these resources contribute to their persistence in their engineering major. Expanding on this study through narrative analysis, Martin [59], using social capital theory, delved into how first-generation engineering students gained awareness of, access to, and activated their social capital, influencing their choice to pursue an engineering degree. Similarly, a parallel study [60] focused

on the experiences of Hispanic women in engineering majors, employing social capital theory to identify the available social network for these students and how the resources within these networks are mobilized and utilized. Additionally, using social capital, Mondisa [55] effectively identified the factors and strategies for mentoring minoritized students. The application of social capital theory proves instrumental in studies related to recruiting and retaining underrepresented populations in engineering, emphasizing that a student's social ties play a tremendous role in their academic success and persistence within an educational institution.

In this autoethnographic study, social capital theory is the theoretical framework for understanding the social interaction available and accessible to an international African woman and how these interactions contribute to success in her inaugural semester within the civil engineering graduate program. Social resources, characterized by their availability, accessibility, activation, and returns, were operationalized to create the study's codebook. Overall, the social capital theory provides the lens by which graduate students and their supporters can grasp the human capital directly or indirectly connected to international students, understand the provided resources, explore how these resources were mobilized and utilized to navigate the challenges they faced in their inaugural semester and examine the resulting benefits accrued.

Methods

Autoethnography as a Method

This autoethnographic study aims to illuminate the journey of a Black female engineer from Nigeria during her inaugural semester in a U.S.-based civil engineering Ph.D. program. Various scholars, including Wall [62], [63], Chang [64], Ellis [65], [66], and Denzin [67], have defined autoethnography. However, this paper adopts Chang's definition of exploring and analyzing autoethnographic methodology. Autoethnography is a methodology that uses personal experience to understand the experiences of others within a broader cultural context. Personal narratives serve as a lens through which a researcher interprets and analyzes the cultural meaning of others' events, behaviors, and thoughts directly and indirectly connected to the self. Autoethnography provides advantages such as simple data gathering, readability, and relatability [64]. Significantly, aspects that might have remained undiscovered when explored primarily through alternative research methods become illuminated through autoethnography, which ultimately answers the call for more person-centered studies on international students in engineering [68].

Autoethnography, as a research method, offers several benefits. It allows for greater control over the perception of oneself and others, potentially transforming the researcher and the audience. Unlike conventional scholarly writing, it is more reader and researcher-friendly as it appeals to both parties [64]. Autoethnography differs from ethnography (i.e., the study of individuals, people, and cultures) in that it allows exploration of familiar topics, primarily the researcher self, rather than unfamiliar terrain. Despite its advantages, autoethnography can introduce biases if researchers overly rely on personal experiences without considering the cultural context [64]. To mitigate these risks, Chang advises researchers to avoid pitfalls such as excessive focus on the self, reliance solely on memory, neglect of ethical practices, inappropriate labeling, and prioritization of narratives over cultural interpretation is essential [64].

The goal of autoethnography is not objectivity like quantitative research but rather a nuanced understanding of personal experiences within cultural contexts. Hence, researchers are encouraged to ask themselves critical questions about their motivations, goals, and the scope of their study before selecting this method [64]. In autoethnography, data collection involves multiple sources, including data from lived experience (i.e., memories, reflections, and journal entries) and external data from interviews, documents, and artifacts. These various sources prevent over-reliance on a single data source, ensuring the research's reliability. Chang also cautions that researchers must ensure they utilize external data directly published on or relevant to the researcher [64].

Data collection and analysis in autoethnography can co-occur, allowing for in-depth exploration of the research focus. Data analysis involves categorizing collected data through coding and connecting fragments to address research questions [64]. This process requires zooming in on individual data fragments and zooming out to understand their broader context. After that, data interpretation commences, which involves examining data through a cultural lens and relating it to existing literature and social science theories [64]. A limitation of this interpretation is its inability to generalize its findings, given its focus on the researcher's experiences. However, its findings can contribute meaningfully to broader knowledge by offering personal insights resonating with readers' experiences and cultural contexts that may be transferable to populations with shared identities and backgrounds [64]. Findings from autoethnography can be presented in various forms, including creative, analytical, confessional, emotive, descriptive, and interpretive writing styles. Each form allows for a unique exploration of personal experiences within a cultural context [64].

Data Collection

Following Chang's guidance, this study incorporated primary and secondary data sources [64]. The primary data source was a virtual diary journal maintained by the author, Mary, throughout her inaugural PhD semester, from August to December. Data collection involved the weekly audio recording of her personal experiences, reflections, and interactions as she navigated her first semester in the US academic environment. Using the Microsoft Word speak-to-text feature, Mary maintained an audio diary to capture, fully express, and control her thoughts easily without restrictions on idea flow [69]. This diary comprises over 10,000 words, with weekly entries reflecting on and recalling experiences using prompts from a senior labmate. These entries, collated from August to December, covered various aspects of her life, including her lab and classroom experiences, social interactions outside the institution, and residential experiences. Mary documented events daily using her sticky notes to mitigate recall biases and conducted weekly audio recordings [64], and each audio entry was dated and time-stamped. Reflective prompts on challenges faced, support received, feelings, and success guided the audio diary recordings. Questions such as "What challenges did you encounter this week?" "What thoughts, feelings, and emotions arose for you this week?" "Who provided support for you this week?" "In what ways were you supported?" and "If you had the opportunity, what would you change?" Secondary data sources utilized by the author included textual artifacts such as emails, WhatsApp messages, and LinkedIn messages, as well as other artifacts like photo albums, audio and video recordings from Zoom and Teams, and literature reviews on international and first-year students. Literature reviews as a data source enabled Mary to contextualize her experience within broader public history. These sources were employed to enrich and ensure the reliability of the data

collected for the research study, aligning with Chang's advice on autoethnography methodology [64]. Adherence to ethical standards was upheld by ensuring a responsible representation of Mary's personal experiences and using pseudonyms to safeguard confidentiality. Additionally, she exercised caution to avoid overemphasizing the self over the cultural context of the studied phenomena [64].

Data Analysis

After compiling the journal entries, Mary used Dedoose, a qualitative analysis software, to analyze the data, memo, and extract dominant themes. Memo proved valuable to the author, allowing the articulation and clarification of her subjective perspectives on the researched phenomena within her narratives [70]. She analyzed her collated data inductively and deductively to examine her challenges and navigational strategies employed during her inaugural semester. All diary entries were initially imported into the qualitative software Dedoose for deductive and inductive analysis to identify codes and develop themes. Utilizing the six stages of thematic analysis suggested by Braun & Clarke [71], Mary began coding her autoethnography dataset by first familiarizing herself with it by reading through it to identify meanings and patterns. She maintained a consistent memo habit as she read, noting any observed meaning or changes in thought.

For the first research question on challenges, Mary inductively coded her diary entries to uncover emerging codes, and the challenges identified were compiled into a "code book" in Microsoft Word containing codes, descriptions, and exemplar quotes. She shared her codebook weekly for feedback and validation with her lab mates, a Nigerian graduate student sharing her cultural identity and educational experience, and a senior lab mate, a seasoned qualitative writer with multiple peer-reviewed publications. After subsequent meetings, an interrater agreement was reached, and themes were developed based on the collated codes, with input from lab mates. For the second research question on navigational strategies, deductive coding was employed using Lin's social capital theory [21], [50]. Mary followed the same process she used for the first research question: Initial coding was refined through peer debriefing sessions, leading to agreement on themes before the final presentation of the research findings. It is important to note that coding for the first research question was data-driven, while the second was more theory-driven. The coding process continued for two months (i.e., December 2023-January 2024), allowing the author to collect and analyze data concurrently.

Additionally, Mary applied Chang's ten strategies for practical data analysis to ensure the reliability of the analysis process [64]. The derived themes facilitated a comprehensive understanding of the individuals involved, the methods employed, and the tangible benefit accrued by the author from utilizing her social network to navigate the challenges encountered during her Ph.D. inaugural semester in civil engineering.

Data Validity

The author applied Chang's five standard checks, including "Authentic and Trustworthy Data," "Accountable Research Process," "Ethics Toward Others and Self," "Sociocultural Analysis and Interpretation," and "Scholarly Contribution," to determine the quality of the autoethnographic data collected [72]. Due to the qualitative nature of the study, she actively practiced reflexivity to

transparently disclose her beliefs, assumptions, and biases that could shape and influence data interpretation. Emphasizing reflexivity, Mary incorporated a positionality statement in the research paper. This statement delved into her ontology and epistemology, shedding light on the value system, beliefs, and experiences that may have influenced her findings [73]. She also used a 'thick, rich, and detailed explanation' approach to uphold data credibility when presenting themes. This approach involves a detailed description of the research context, methods, and findings to enhance credibility and transparency. For example, she provided a detailed narrative or contextual description for all exemplar quotes in the findings section, with each quote meticulously dissected. This was done to ensure comprehensibility and readability for readers, allowing them to grasp the unfolding scenario behind each quote fully [73].

Mary's labmates, the Nigerian Ph.D. student and the seasoned qualitative writer, did peer debriefing for quality checks to ensure the accuracy of her data interpretations and findings. She also maintained a detailed audit trail of her research process to ensure the repeatability of her step-by-step procedures by a different researcher [73]. In this research, the author, Mary, uses herself as an ethnographic exemplar to gain a cultural insight into the lived experiences of international Black students in civil engineering doctoral programs. Autoethnography enables a dual role as both an insider and outsider, eliminating the need for the author to engage in a prolonged immersion typically required in ethnographic studies for a deeper insight into the data collected [64].

Positionality Statement

As an international Black doctoral student, my nationality, race, and experiences in the US academic setting profoundly influenced my research journey. Growing up in a close-knit community has taught me the importance of relationships, which motivates my research on students' potential to leverage social networks for success. Born, educated, and raised in Nigeria, I bring a unique insider perspective to the study. My intersectional identity as a Nigerian, Black woman doctoral student allows me to connect with and understand the experiences of international graduate students in civil engineering programs. Having earned my bachelor's and master's degrees in Nigeria, I also bring an outsider perspective, acknowledging cultural differences in the educational system.

To maintain objectivity in this autoethnography, I frequently self-reflect to maintain transparency while using my identity to gather comprehensive, thick, and rich data on international students' experiences. My dual perspective as an insider and outsider to the research allows me to uncover details that might otherwise remain hidden. In my data analysis, I collaborated with my lab mates, Rater A (a white female senior graduate student) and Rater B (a male Nigerian PhD student), who, despite some similarities, provided outsider perspectives as doctoral students in the civil engineering program at the University of Florida. Raters A and B read through my journal entries and memos, asked follow-up questions, and provided future reflection prompts. This diversity in viewpoints and consistent debriefing with my Mentors throughout analysis enriches and enhances the credibility and reliability of my data interpretation.

Findings

Research Question 1: What early challenges were encountered during the inaugural semester of a Ph.D. degree in civil engineering?

Below is a table displaying the challenges Mary encountered during the inaugural semester of her Ph.D. journey. The first column lists the challenges identified through coding, representing broader themes of smaller subcodes. The second column describes the challenges of the research topic. The third column presents exemplary quotes illustrating each challenge. Each challenge is supported by at least two quotes from primary and secondary data sources to provide a comprehensive understanding. It is important to note that some challenges may include quotes with subtitles for complete elucidation, such as living in a new environment. This ensures a thorough exploration of various aspects of the theme. According to coding procedures outlined by [74] each theme contains multiple codes that Mary and her lab mates carefully reviewed and agreed upon.

Challenges outlined in response to RQ1:

Challenges	Description	Exemplar Quotes
Isolation	a sense of confinement to a specific location and exclusion from a specific social group or activity.	<p>Being confined to a single place can be isolating, especially when you find yourself daily within the lab, with similar faces doing similar routines. Unlike my experiences in undergrad and master's programs where I could mingle with others, I feel 90% of the time spent in a Ph.D. is restricted to a space. I often feel limited in interacting with my lab mates and others [Diary_7th November 2023].</p> <p>My initial weeks in the United States were like stepping into a whole new world, and trust me, it was no walk in the park. The stress levels are not because you did something so intense– it is more about adapting and navigating this new territory that can be a maze. You face a new system, trying to understand how everything functions and make sense of the differences between people, even those sharing your skin color. It is like decoding a cryptic message – you are just trying to figure it all out, bit by bit. The worst is that you start having different emotions you cannot explain, and often, you find yourself sobbing for no reason [Diary_14th September 2023].</p>
Poor Work-Life Balance/ Stress	Excessive time requirements for engineering Ph.D. academic programs hinder participation in activities they find fulfilling. Such as stopping the gym from doing research, staying away from the choir, and having little time for sleep	Joining the African choir seemed like an excellent way to relax, but after attending multiple times, I realized it was encroaching on the time I needed for work, reading, rest, and cooking. Consequently, I decided to try the gym, which initially felt therapeutic. However, keeping up became challenging, as the time I allocated for the gym clashed with tasks that needed attention. This raised questions about how I could maintain a social life during my PhD. Seeking advice from those ahead in the PhD journey, I discovered that many in engineering had little to no life outside of their research [...] The demanding schedule can make basic activities challenging; sometimes, you only want to use your little time for much-needed rest. When friends invite me for socials, I have to think about it and choose between catching a little rest

		<p>or going out to exhaust myself and coming back and having to jump into work meetings to cover lapses [Reflection on photo album_4th December 2023].</p> <p>November has been one of the most challenging months in my life, primarily as the semester draws to a close. Research-wise, progress is elusive, and the workload, with numerous assignments and deliverables, is exhausting. The pressure was overwhelming, and stress and fatigue set in [Extract from recorded peer mentoring Teams meeting_17th November 2023].</p>
<p>Imposter Syndrome</p>	<p>The pronounced feelings of inadequacy, insecurity, and self-doubt due to a lack of representation.</p>	<p>I often wonder how many black women are in civil engineering, especially in the civil engineering PhD program. I have not encountered many, except for a few instances during a general engineering program where I saw a few. It makes me question if I am the only one or maybe just a minority among others. This feeling constantly pressures me to prove myself among my male counterparts and peers. It is an unspoken reality, making me feel responsible for doing extra work to establish my presence [...]. Being the only woman may seem significant, but there is much work behind the scenes, and it can take a toll on one's health [Diary_1st December 2023].</p> <p>It is funny how being from Africa comes with a distinctive label. When people realize you are not from around here, they start making assumptions. It used to get under my skin, making me wonder if it was about fitting in with the American way or just boxing people into stereotypes. This makes me feel extra conscious, and most of the time, I prefer to be in my own company because I do not want to start explaining myself or feeling out of place [Diary_16th September 2023].</p> <p>Being a student in this new program and environment brings about certain feelings, like not feeling enough, especially when seeing people of different races doing well. They have everything figured out and know all the ropes, while I come from a background where research is done but not as intensely as here. It makes me question if I am capable and if there was a mistake in accepting me. These feelings of not being good enough are some of my biggest challenges in this journey [Diary_20th October 2023].</p>
<p>Living in a new environment</p>	<p>The challenge of adapting to a new environment.</p>	<p>i. Adapting to new technology</p> <p>.</p> <p>The classes in the U.S. involve weekly guided readings, multiple assignments, and strict deadlines—all conducted online. This necessitated a level of tech-savviness and proficiency with online platforms [Diary_11th September 2023]</p>

ii. Transportation

For international students like me, transportation has its unique challenges. In Nigeria, having a personal car is optional for students, and public transportation is the most relied on. However, the situation is different in the United States because owning a car is crucial for getting around and performing everyday tasks. Without a car, international students must rely on public transportation, primarily buses, which can be troubling, especially on weekends when buses run on limited and restricted service. The worst is if there is an emergency, such a bus system cannot be relied on. Plus, we are on a budget; we cannot keep spending money on Lyft and Uber, which could have been a second option but comes with an expensive cost. Acclimating to this new system, my present reality is somewhat tricky. I cannot leave home at my convenience, but the bus system predicts my movement. In the United States, owning a car is a common and practical choice, but it is sometimes not feasible for international students, particularly those on a tight budget; I think it would have been good if I knew how to ride a bicycle [Self-reflection on photo album_7th December 2023].

iii. Phone Specification

We know we ought to have a phone, but I think less emphasis is usually placed on the type of phones needed. [...] Due to budget constraints, many of us from countries like Nigeria had to settle for basic phones while back home, and then we came here thinking we could use some phones at least for a while until we could save up a phone of our choice. Unfortunately, these phones did not work with our SIM cards, and we spent extra money to buy compatible phones. It is a pity we were not informed; we would have planned for it and saved our little penny. The unexpected cost incurred is not cool [Diary_21st September 2023].

iv. Food

The food system in this place is quite different, especially with the presence of sugar in almost everything, unlike Nigeria, where I come from. Food with high sugar content seems more affordable than healthier foods. Also, finding African stores is challenging, and it tends to be expensive when you do find one. Adjusting to the local food is another struggle, as the taste is different, and the food here is bland and lacks the spices we have back home. Most foreign foods common here are Chinese, Italian, and typical American cuisine, making it difficult to find African dishes [Self-reflection_25th October 2023].

v. Housing

Navigating housing as an international student in the United States can be incredibly challenging and stressful. Issues such as finding a suitable house within budget, security deposits,

		<p>and understanding lease agreements add to the complexity. It is not just about the financial aspect but about being careful with the lease agreement you enter. Also, housing here means you must share the accommodation with flatmates, often strangers the lease office pairs with you. Hence, there is a risk of being paired with those whose personalities or habits may not align with yours. The housing process here can be a big headache, requiring significant time to adjust and call the place home [Diary entry after an incident at apartment complex_10th November 2023].</p> <p>vi. Health Insurance</p> <p>The United States healthcare system is notably expensive and a significant adjustment for me. Even with student health insurance, the coverage may be limited, leading to paying substantial out-of-pocket expenses. This stark contrast to the healthcare system in Nigeria, where health is cheap and affordable, and if you are on NHIS insurance, it often covers more, is challenging. It is burdensome when I even have to wait for specialized treatment or services. Then, the overall cost of utilizing such services is a financial burden as a student from a country where I could easily afford health services; managing health concerns becomes a balance between staying healthy and the financial strain of medical expenses. It is a reality I have had to adapt to, praying and reminding myself to prioritize staying well in this costly healthcare environment [Diary entry after hospital visitation_28th December 2023].</p>
Communication	the challenge of expressing thoughts concisely, overcoming intonation and dialect fears, and moderating speech pace for enhanced understanding.	<p>Also, I came into school fully aware that how I speak would differ from how people speak here. I know I speak well, but then it is what it is. In Nigeria, we speak British English, but our intonation is distinct. There are different tribes and dialects, so our dialects creep in and intertwine to shape how we speak. Coming here, I felt self-conscious about my accent. They pronounce words differently, and I was determined not to get lost in translation. I also realized that many of the Nigerians and Africans I met would change how they spoke when speaking with a White student. This was a further task for me. So, I had to consciously practice pronunciations in my head, conscious of being understood. I did not want to be judged or misunderstood. Being black and African, I felt an added pressure to represent myself well. Maybe it is just in my head, but I wanted my words to be clear, confident, and not stereotyped [Diary_22nd September 2023].</p> <p>Communication here is quick and to the point. Unlike Nigeria, where we tend to explain everything, they get straight to it here. I had to slow down my speech and learn to be clear and concise. It was an adjustment. Sometimes, people would ask me to repeat, making me question my speaking abilities [WhatsApp chat_26th August 2023].</p>
Building trust		

	<p>The struggle to form a relationship marked by openness and transparency of their academic struggles with mentors.</p>	<p>In this environment, you are encouraged to ask questions freely, and they expect you to seek clarification without hesitation. However, coming from a different setting, I am accustomed to avoiding questions that might be perceived as challenging or questioning authority. Back home, you follow instructions without questioning, fearing consequences. Here, it is different; they want you to share your struggles and are genuinely interested in helping. It is a dilemma for me – how much should I disclose? However, opening up is essential; keeping to myself leads to unnecessary struggles and repeated mistakes. The system here values transparency, urging us to trust our mentors and PIs. It is a challenge because I grew up being told to trust no one, but adapting to this new approach is crucial for success. It is about learning to open up, which I did not grow up doing [Self-reflection_24th November 2023]</p>
<p>Navigating a Ph.D. program at a top-ranking Public R1 US Institution</p>	<p>Challenges due to the academic setting's unpredictability, rigor, and complexity.</p>	<p>The reality of the PhD journey often feels quite different from my expectations. It is like running in a circle with no clear endpoint, a continuous spiral where progress is unpredictable. You may feel you are making strides one moment, only to feel a setback after a review. It is overwhelming, especially when initial feelings of progress turn into criticism. I often sit and wonder what exactly is expected of me, what I should be doing, and if I will ever reach a point where I am told I am on the right track [...] As a first-semester, first-year Ph.D. student, perhaps such uncertainty is expected, but incoming Ph.D. students should prepare for a journey that feels like a merry-go-round. Understanding this might save them from heartbreak, tears, and the frustration of not figuring everything out [...] The PhD journey is an unpredictable adventure with layers of challenges. When I hear others say they have "mastered out," I empathize because the expectations are high, and learning to navigate everything while trying to be productive and contribute is a continuous effort [Peer mentoring meeting 15th December 2023] .</p>

Table 1: Challenges encountered by an International African Woman during the inaugural semester of a Ph.D. degree in civil engineering.

Research Question 2: How were the challenges encountered during the inaugural semester of a Ph.D. degree in civil engineering navigated?

To dive deeper into this study's findings, the author generated a deductive codebook (Table 2) using Lin's social capital theory [20]. This codebook contains the four elements of the social capital theory (availability, accessibility, activation, and returns) alongside its operationalized definition and an exemplary quote to support the element.

Code	Definition	Operationalized Definition	Exemplar Quotes
Availability/Embeddedness	Availability to collective assets or resources embedded in a social structure (Human assets, trust, norms, etc.)	Diverse relationships within international students' social networks that are available to them (such as connections with peers, professors, and professionals) - whom you have available - in the lab - through an African church - an organization supporting international students	“Moreover, my small family group from the organization supporting international students I established earlier played a pivotal role. While an organization supporting international students initially helped me adjust to a new phase of life, it continued to be a support system during challenging times. The group organized various activities to alleviate stress, and though I could not participate in all of them, the Thursday family group meeting became a highlight. Every Thursday evening, I looked forward to gathering with international friends, sharing laughter, studying the Bible, and discussing our challenges. This routine provided a sense of community and solace, helping me navigate the tough November times [Diary_29 th November 2023].”
Accessibility	Opportunity/Access to Networks (Network locations and resources, structural and positional variations)	The extent of opportunities (or lack of) and access international students have within their academic and social environment (Such as locations, e.g., academic clubs, community events, professional organizations, and other spaces facilitating network connections; resources, e.g., mentorship, support, information; diversity of relationship, e.g., peers, advisors, role models).	“Fortunately, my lab provided resources such as peer-to-peer mentoring and advice for course planning, which proved invaluable [WhatsApp chat_31st August 2023].”
Activation	Mobilization or use of such social resources by individuals in purposive actions. Resources include contacts and contact resources (in this case, the influence from networks for engaging in out-of-class activities)	International students intentionally mobilize and utilize social resources within their academic setting.	“...I felt that my white, fourth-year female lab mate was more proficient in this aspect. Seeking assistance, I approached her during our peer mentoring meetings, expressing my struggle crafting a qualitative research question [Diary_4 th December 2023].”

Returns (grey color) (i.e. Putting the advice into action & ii.) Benefits derived)	Effects of Capital gained from a social network (economic, physical, intellectual, i.e., wealth, power, reputation, life satisfaction, career success, knowledge)	The tangible and intangible outcomes international students derived from the capital gained through active engagement in social networks within the academic setting (such as knowledge acquisition, academic success, well-being, support, and expansion of network)	“The support networks within my country’s student community and my continent’s student society proved instrumental in helping students assimilate into campus life. These groups offer guidance on where to go, what to do, and what to avoid. I highly recommend that new students actively seek out and engage with such communities, often accessible through WhatsApp platforms, to benefit from shared information and experiences [Diary 22 nd September 2023].”
---	---	---	---

Table 2: Codebook

Three themes were identified to address the second research question, focusing on how the author navigated challenges during the inaugural semester of her Ph.D. journey at a top-ranking Public R1 US Institution. Simultaneously, these themes aim to explore the identified social capital that proved beneficial in navigating this challenging journey. The author, recognizing the importance of those within her social network, colloquially referred to as “Ima Nmadu” (i.e., Whom You Know), emphasizes its essential role in overcoming barriers during the inaugural semester.

The author leveraged the resources within her available and accessible social network, such as peer mentors, advisors, and her local students’ community, to navigate her challenges [Theme 1].

Mary, a first-year Ph.D. student in civil engineering, overcame challenges during her inaugural semester by leveraging her social network. This network included her family, peer mentors, advisors, an organization supporting international students, and members of her country’s student community, accessible through platforms like WhatsApp and LinkedIn. Mary effectively utilized these connections as she transitioned into this new phase of her life in the United States. These “Ima Nmadu” played a crucial role in addressing challenges related to transportation, settlement, acclimatization to the environment, and fitting into her academic studies, research lab, and community.

As an international student far from her home country, Mary highlighted the significance of social connections in helping her navigate the challenges of adapting to a new environment. Mary, being a novice, faced uncertainties about ‘where to stay,’ ‘where to go,’ ‘what to do,’ and ‘how to meet essential needs’ for a smooth transition. Her social network provided guidance, enabling her to integrate fully into the environment and acclimatize smoothly. She recounted one such experience to illustrate the valuable support she received from her social connections.

They (an African church) organized a seminar for new international students from my country and continent. The session aimed to guide us through essential aspects of graduate school and campus life. We received practical advice on various topics, including grocery shopping, where to find affordable items, sourcing local foodstuffs, understanding local laws for safety, and managing money, time, and stress. The seminar also covered strategies for

navigating classroom challenges, emphasizing effective time management. One key takeaway was learning to balance my schedule to avoid burnout while ensuring productivity. We were briefed on the local culture, including potential triggers for conflict, helping us acclimate to the environment. This seminar proved immensely valuable as it addressed crucial aspects of daily life, such as opening bank accounts and understanding the bus system—an area I struggled with in my initial weeks in the United States. The information provided was practical and tailored to help us succeed throughout our academic journey [Extract from feedback form_7th October 2023].

Mary discovered this church, specifically for students and families from her country, through her interactions with other students on WhatsApp. By participating in the seminar organized by the church on Zoom, she gained valuable insights into navigating the challenges of her new environment, including understanding local laws, discovering mentorship opportunities, and helpful tips for succeeding academically. Furthermore, Mary emphasizes the crucial role played by her advisor in assisting her during the initial phase, particularly in overcoming challenges related to securing suitable accommodation. She shared, “fortunately, my advisor had connected me with members of my lab, a fourth-year, white female Ph.D. student, and a Nigerian, second-year male Ph.D. student, who helped me through this process by giving suggestions and critically checking my interests [Self-reflection on advisor’s mail of 21st March 2023].” Recognizing the caution exercised by international students to prevent falling victim to scams [75], she emphasized the importance of the trustworthy connections her advisor facilitated in finding the apartment where she eventually settled.

In her journal entries, Mary also highlighted how an international Christian organization supporting international students played a vital role in her settlement during her initial phase in the United States. Recognizing the challenges associated with finding accommodation and navigating the expenses, she emphasized the support and relief provided by this organization during her first week. Moreover, Mary shared her ongoing positive experiences with this organization supporting international students, noting its role in offering solace, a platform for sharing stories and cultural experiences, and a sense of community for international students. She said, “every Thursday evening, I looked forward to gathering with international friends, sharing laughter, studying the Bible, and discussing our challenges [Diary_29th November 2023].” This organization became a valuable avenue for Mary to connect with others, fostering a feeling of home away from home in an environment that initially emphasized individuality.

Mary acknowledged the assistance she received from her social network but also pointed out that, despite their availability, some connections needed to be made available. While they provided her with essential information, they lacked specific vital resources that could have significantly eased her journey. Mary detailed one such instance in her journal: “...despite a PowerPoint presentation I received from them (her department), I struggled with certain aspects. There was only a little the PowerPoint could assist with [Extract from Teams recording_7th September 2023].”

As she transitioned, Mary, in her journal entry, expressed feeling isolated and inadequate as a female student of color in the male-dominated engineering department. However, within her

country's student community, she found a sense of belonging and support, addressing challenges related to trust and isolation through the communal nature of this social group.

[...]I could overcome it because I belong to this WhatsApp group of scholars from my country, and from the look of it, many of us who just recently relocated to the United States are all expressing the same feelings, so it was easier to relate with them, learn from those who were here before us and overcome my insecurities and identity crisis [Self Reflection on her WhatsApp messages_20th December 2023].

Mary grappled with self-doubt and imposter syndrome, questioning her place in the academic setting. However, through her engagement with her country's student community, she discovered shared experiences and stories of overcoming similar challenges. As she connected with other students within this group who had navigated identity crises and imposter syndrome, she found the willpower and support to help her overcome these feelings and recognize them as part of a shared journey. In addition to this community, Mary mentioned that the support of her lab mates, who doubled as her peer mentors (a fourth-year white female and a Nigerian male, second-year Ph.D. student), played a crucial role in helping her overcome the self-imposed challenges and feelings of inadequacy. Mary highlighted the importance of having an advisor who, being a person of color, shared similar experiences in navigating the challenges of a Ph.D. journey. Her advisor's shared experiences and insights were a source of strength and motivation for her to navigate the complexities of the new academic semester. Journaling her narrative on overcoming her identity struggles, Mary shared that, despite the availability of some individuals within her social network, not everyone was readily accessible:

My advisor connected me with another professor who shared a similar identity and was involved in a related work area. Following this introduction, it was up to me to continue the conversation. I contacted the professor, introduced myself, and requested a meeting. Unfortunately, despite two attempts to communicate, all my messages went unanswered, leaving me unable to tap into the potential resources or benefits that could have come from establishing a connection with her [Diary_31st October 2023].

She recounted this specific situation where she expressed her need to connect with someone knowledgeable in her field, distinct from her advisor. Unfortunately, she initiated contact with the individual but has yet to receive a response, hindering her ability to utilize valuable resources that could have been obtained through this connection.

Mary acknowledged the complexity and the struggles she faced as a new student getting involved in research in an environment different from where she came from. However, despite this experience, she highlighted the positive impact of the lab where she works, emphasizing how it was accessible, making her feel comfortable and equipped to face the challenges of her journey. She journaled, "Luckily, I am in a lab with a supportive culture, allowing me to share my feelings. They provide strength and advice and help me identify where I may be going wrong [Fall Performance Evaluation_14th December 2023]." While applauding her lab's inclusive culture, she noted, "Fortunately, my lab provided resources such as peer-to-peer mentoring and advice for

course planning, which proved invaluable [...] they also prepared a semester plan for me, outlining relevant coursework [WhatsApp chat_31st August 2023].”

Amidst the various support systems accessible and available within Mary’s social connection, she also journaled days when she felt overwhelmed by ongoing activities around her, such as the nature of academic settings, lab work, and research, experiencing emotional lows. During such times, she relied on her family as a source of strength to navigate the semester:

Having something or someone close to lean on during this chaotic phase is a saving grace. For me, that lifeline was my family. After each day's struggle, I would dial them up, spill my guts, and tell them about every detail of my day. Explaining how things here operate, how the pace differs from home, and all the emotions that I feel –is therapeutic [Diary_28th September 2023].

This underscores the significance of having familial support within one's social network. She also mentioned the availability of her Nigerian best friends and her flatmates, who occasionally supported her emotionally during their social night, where they gathered to play games, chat, and feast.

Leveraging her social connections, Mary successfully navigated the initial stages of her doctoral journey. “Ima Nmadu” serves as a support system and offers navigational and aspirational capital, proving effective in fostering success, especially for students of color [76].

The author activated her social capital by proactively seeking assistance, talking to her advisors, peer mentors, and family, using social media to connect with people, participating in seminars conducted by her local student community, engaging with others in her small family group, and utilizing resources provided by her social network [Theme 2].

In her journal, Mary recalled how she activated her social capital by deliberately seeking help, participating in activities organized by her country's students’ community and her department, and engaging with an organization supporting international students upon arriving in the United States. She also highlighted instances where she proactively used social media to identify and connect with individuals who later became integral members of her social network. She noted:

Before I left Nigeria, I did not want to be stranded or feel lost, so my advisor connected me to two of my lab mates, a fourth-year white female and a second-year Nigerian male student. I knew I had to get a few people to pair with in my accommodation. So, I surfed LinkedIn to check for current female students in my school who could give me the best advice and tips for accommodation suitable for a lady. I also kept surfing other WhatsApp platforms until I found three students who eventually became my flatmates [Self-reflection_15th September 2023]

In her quest for suitable accommodation, Mary recognized the importance of finding compatible roommates to avoid potential challenges when paired with others by the apartment lease office. She intentionally sought advice from her lab mates and took proactive steps to search for other Nigerian or African students in her school online through social media platforms. An example of such mail is presented below:

Hello Rose, please I would love to find out a few things about accommodation: How does it work? Although my lab gave a few suggestions [...], are there any cheaper ones? [Likedin_11th August 2023]

By doing so, Mary activated her social network and established new connections that led her to two Nigerians and a Kenyan, who eventually became her roommates. Mary emphasized that her close relationship with her best friends (a female and a male), who are Nigerians, developed during her proactive search for students attending the same school on her local community student WhatsApp group. Through her engagement with the group and asking questions, she was introduced to her male Nigerian best friend, who connected her with her female Nigerian best friend. This intentional activation of her social capital led to friendship and established a robust support system where they continued to encourage and support each other.

Mary highlighted the importance of conversing with her peer mentors when facing challenges or difficulties in understanding coursework, completing assignments, or navigating academic responsibilities. By actively seeking guidance and support from her mentors, she effectively activated her social capital, which benefited her educational journey:

Feeling stuck, I sought help during my peer-to-peer mentoring session with my peer mentor/lab mate (a Nigerian second-year male student). He had taken a similar course earlier, so I explained my difficulties, and he shared the materials they used in his class. He even took the time to explain some concepts, making it much more straightforward for me. After studying the shared material, I found it easier to understand the class material [Diary_22nd September 2023].

Here, Mary explained the significance of her interactions with her peer mentors in overcoming academic challenges during this inaugural stage of her PhD program. By building relationships and seeking assistance from her peer mentors, she gained valuable resources and guidance, enabling her to navigate and understand challenging concepts in her classes. Mary activated her social capital to solve her academic challenges. One such occasion was when she was faced with a difficulty in her research method class; she sent a message to her senior lab mate who had previously completed this same course:

Hi, I am struggling with my qualitative research methods class; the paradigms are difficult to understand. Also, please help break down the systematic review into layman's language. Do I also need to carry out data collection on this? Or does it entail just reviewing existing materials on keywords? [Whatsapp_10th September,2023]

Furthermore, Mary highlighted the crucial role of the weekly mentor-mentee meetings with her advisor in helping her activate her social capital. These regular sessions played an incredible role in helping her start her social capital. During these meetings, she could ask questions, seek guidance, and overcome identity crises and self-doubts. Additionally, Mary mentioned that these weekly interactions were instrumental in helping her come to terms with her research project. She stated:

During the early stage of my study, I was grappling with various aspects of my research and personal identity, leading to much uncertainty. I had numerous unanswered questions, so I approached my advisor and shared my challenges [Extract from Teams recording_13th December 2023].

Mary actively engaged in activities organized by various student organizations and communities within her reach to activate her social capital. She attended seminars organized by her country's student community and an organization supporting international students; she participated in church activities and engaged in departmental events and faculty-led socials. Mary also volunteered during a career fair organized by her faculty, where she gained valuable insights into industry information and connected with individuals from other departments and the engineering industry. She journaled:

I received an e-mail asking for students to volunteer to be part of the team that would function during the engineering career fair. That would be a good way for me to learn more about the department and the industry and how to position myself for the industry. I also decided to get to meet other students, given that I was restricted or bound within the sphere of my lab and the familiar faces I already knew from my lecture [Diary_25th September 2023].

Mary, still reflecting on this moment, stated that she immediately activated her social capital by responding to the mail:

Dear [...], My name is Mary, and I am a first-year Ph.D. student in civil engineering. I want to volunteer during the career fair event in this area: Registration/ Event Opening – multiple shifts run from 5:15 pm to 6:30 pm [Email_25th September 2023].

Mary further explained that through volunteering and participating in these extracurricular activities, she discovered other social groups like her small family group, Youth Life Club, the National Society of Black Engineers, and the Society of Women Engineers, learning about their activities and potential benefits for her during and after her studies.

Mary also mentioned activating her social network by proactively utilizing its resources. She stated that she intentionally reached out to her network and put the acquired resources into practice, yielding beneficial results during the inaugural semester. She emphasized the importance of seeking responses and using the obtained resources to achieve her desired outcomes. Mary noted that “Ima Nmadu,” i.e., whom you know, is valuable, but its benefits are realized through active utilization. She diligently made the most of every resource, information, or attention gained from individuals within her social connections.

Through effective utilization of advice from individuals within her social network, Mary successfully mitigated the challenges of jet lag during her initial arrival in the United States. She journaled in her diary, “Nevertheless, I was determined to overcome the jet lag, so I put into action the advice Ebere gave me by keeping myself occupied playing music, reading a novel, and chatting [Diary_19th August 2023].” Furthermore, Mary noted that leveraging resources from her country's student community and guidance from her peer mentors enabled her to navigate class integration

and challenges with assignment completion. Additionally, Mary's active utilization of information gained during her weekly mentor-mentee relationship with My advisor contributed to her comprehensive understanding of the research expectations, facilitating successful delivery in her inaugural semester. Recounting one of such moments, she stated:

My advisor and female peer mentor (a fourth-year white Ph.D. female) advised me to break my activities into manageable chunks that can be executable and trackable. My female peer mentor inspired me to use a planner. She always had a weekly planner, so I imbibed such into my routine. So, I decided to adapt it to what works for me. Instead of relying solely on a physical planner, I use alarms on my phone to remind me of daily tasks. Breaking down my weekly goals into daily tasks has been more manageable this way [Reflection on lab meeting_18th October 2023].

In the described scenario, Mary detailed how peer-to-peer mentoring and the mentor-mentee relationship played a pivotal role in activating her social capital and offering her the benefits of effective time management. She noted that observing her female peer mentor and putting into action the advice she received from her advisor and peer mentor allowed her to systematically monitor her activities, maintain productivity, and achieve a balanced school-research-life dynamic. Mary emphasized that her intentional steps of consulting, seeking advice, volunteering, and participating in activities are crucial in activating her social capital. Beyond this, she highlighted the significance of actively utilizing embedded resources to overcome or navigate difficulties and manage situations.

The author leveraged the resources within her social network to gain returns, including valuable information and support, expanding her social network, and attaining academic success and well-being, which helped her overcome the challenges [Theme 3].

Mary reflects on how activating her social capital has resulted in significant returns during her inaugural semester. She recounts that her transition and acculturation into the new environment was much easier with the help of those she knew. She stated, “Even with the presence of these individuals, I still had my lows, but I wonder what it would have been like without them; they are my game-changer.” Here, Mary described how the existence of social capital in her academic journey made a significant difference in her experience; she pinpoints that even with the availability and accessibility of her social network, she faced significant challenges, but their presence helped her navigate these challenges.

Mary also shared how her activated social capital resulted in acquiring knowledge that was needed and helpful for her during her inaugural semester. While journaling, she reflected on various occasions where she felt at a deficit due to information asymmetry, recognizing that the strategies she used while studying in her home country differed significantly from the demands of her current environment. Mary, realizing the need for a deeper understanding of the workings of her new academic and research environment, actively engaged her social capital. She acquired fresh information, gained insights, and deepened her knowledge by seeking assistance and asking questions. This proactive approach allowed Mary to gain valuable knowledge that proved

beneficial in navigating both academic challenges and the intricacies of her new environment. Recalling one notable scenario, she shared:

My peer mentor (a fourth-year, white female PhD student) kindly offered to help and searched for materials we had used in our reading group. She pointed out a research question from one of the papers, shared it with me and suggested that I use it to frame my qualitative class final exercise [Peer mentoring meeting_4th December 2023].

In the mentioned scenario, Mary faced a challenge while preparing for her final exercise in a qualitative class. This exercise involved creating a paper focused on developing an introductory section for a chosen topic using a qualitative research design typical of thesis chapter 1, which includes qualitative research questions. Despite finding her classes helpful, Mary needed help formulating a suitable research question for this qualitative paper, given that she had more experience in quantitative research design. To overcome this challenge, she contacted her peer mentor, a fourth-year white Ph.D. female student proficient in qualitative methods. By activating her social capital, Mary gained the necessary knowledge and resources to complete the assignment. Reflecting on this experience, Mary highlighted how the knowledge accrued from this peer mentor resulted in significant academic success in the course:

To my delight, I recently received the results of my qualitative final paper after using the resources she (her fourth-year white female peer mentor) provided. I scored a full mark on that paper; my professor commented that my research question was well drafted. I am excited about my growth and the outcome. I may have passed without consulting her, but my score may not have been this great. I am elated at this win [Class final project_18th December 2023].

In her final paper, Mary achieved a full mark by activating her social capital. She expressed gratitude to this peer mentor, an individual within her social network, for her invaluable support and assistance in achieving this feat.

Furthermore, Mary highlighted that by activating her social capital, she experienced an expansion of her social network. She recalls instances where challenges arose and approaching the people within her network for help led to valuable referrals to other individuals. These referrals, characterized by their immense experience on her subject of concern, provided her with the help she needed and added to the number of resourceful individuals in her social network. In her journal, she notes:

[...] My fourth-year white female peer mentor mentioned she had a friend, a doctoral graduate, who had experience in similar work. Interestingly, we had read her friend's article during our reading group that week. So, she offered to connect me with her friend, which she did, and she drafted an email introducing me and explaining that I needed her assistance [Diary_12th October 2023].

After Mary's senior lab mate initiated a connection between Mary and her doctoral graduate friend, she further activated this capital by scheduling a meeting to gain the knowledge she needed while expanding her social connections. Here is a sample mail sent by Mary after an already-established connection:

Hi [Mary's senior labmate friend], thanks for getting back to me. I am free on Thursday, 26th October, between 10 a.m. and 11 a.m. Does this time work for you? If yes, I did go ahead and set up a Zoom meeting and calendar [Email_19th October 2023].

Mary described her challenge in formulating focus group research questions for her current project. Struggling with this task, she approached her peer mentor for assistance, but unfortunately, this peer mentor had limited focus group experience. Hence, she connected Mary with her friend, who was well-versed in using focus groups for data collection and had numerous publications. Mary's peer mentor referral provided her with a solution for her challenge and helped her expand her social capital:

In our meeting the following week, my peer mentor's friend provided valuable insights, addressed my concerns, and ensured I felt adequately prepared to formulate the questions. At the end of the meeting, she told me I could contact her anytime if a need arose [Diary_3rd November 2023].

By activating her social capital, Mary gained access to a new network, a Ph.D. graduate making significant strides in the field who helped her structure focus group questions. Another significant return evident in Mary's self-collected data was the support she garnered from activating her social capital. She repeatedly recounted moments and circumstances where she received adequate support, including comfort, strength, and courage to navigate the challenges she encountered in her academic journey. She notes that the individuals who offered this support ranged from her family and lab mates to advisors, best friends, flatmates, and various social groups she was a part of. She recalls one instance:

[...] That is when I realized, "Hey, I could call my peer mentor (a Nigerian, second-year male student)!" He has been here since January, so he must know his way around. I connected to the school Wi-Fi and WhatsApp-called him. He asked me to switch to a video call, and I showed him my surroundings. He guided me to my destination, which was a huge relief [Self-reflection on photo album_17th August 2023].

Mary described how she was stranded during her first week at school and struggled to locate a specific area. In this situation, she sought support from her Nigerian male, second-year peer mentor, who had been at the school for a few months longer. This mentor guided her until she reached her destination. Mary also shared instances of being stranded due to limited transportation, and her host family from an organization supporting international students came to her rescue. She said, "I called, and they (her host family) asked me to wait for them, and within 30 minutes, they came for me and took me home [Call log_23rd November 2023]." By activating her social capital, Mary utilized the support embedded within her network to overcome her transportation challenge.

Furthermore, Mary noted that this support significantly impacted her emotional well-being. As an international student with a dual identity as a woman and a student of color, she faced isolation and "felt like an outsider." However, with a supportive social network, she experienced emotional wellness:

And then there is my family, showering me with encouragement, reminding me of my purpose here, and emphasizing that the present struggles are just stepping stones to a brighter future. Their words were all I needed to keep pushing. Besides, who does not want a better

future? Without those pillars to lean on, the emotional whirlwind might sweep me away [Reflection on a WhatsApp mail her sister sent_14th December 2023].

Mary explained that the support she received from utilizing her social capital helped her stay strong, agile, and active in mind and body, preventing her from experiencing the common mental breakdowns many graduate students encounter [37].

Discussion

In this autoethnographic study, Mary, an international African woman, encountered various challenges during her inaugural semester in the civil engineering Ph.D. program at a large Public R1 institution. These challenges include isolation, stress, poor work-life balance, imposter syndrome, adapting to a new environment, communication difficulties, building trust, and navigating the complexities of a PhD program at a top-ranking public R1 research institution. These identified challenges align with existing literature on international students [12], [26], [28], [39], [77], [78], [79], Women in engineering [17], [18], [34], [46], and underrepresented students in engineering [35], [80], [81]. When entering a new environment, international students face various changes and challenges. These include communication intricacies such as accents, pronunciation, fluency in English, isolation, imposter syndrome, understanding the complexities of the US academic setting, and acclimating to a new environment [82]. International students of color may have heightened experiences of isolation and imposter syndrome stemming from their dual minority status ([83], which can compound the complexities of their adaptation journey. Moreover, the literature underscores that underrepresented Ph.D. students in engineering, particularly women [17], [18], [46], may struggle with isolation, feelings of inadequacy, self-doubt, and the pressure to work twice as hard because of underrepresentation [35], [84], discriminatory environments [34], [38], [84], [85], [86], chilly climates [87], lack of peer supports [34], and a shortage of female mentors [18]. Imposter syndrome may result in detrimental effects on students, manifesting as heightened fear, persistent worry, emotional instability, performance anxiety, burnout, and a decline in confidence [83]. These adverse outcomes can significantly impact their academic pursuits, potentially leading to negative consequences such as attrition [34], [84].

Living in a new environment introduces challenges, such as adapting to unfamiliar surroundings [79], [88], learning new technology [77], [78], understanding new cultural norms [26], [88], [89], food [82], [90], housing systems [82], [88], healthcare [82], [88] navigating public transportation [26], [88] and academic settings [79], [82], [88], [89], [91]. While existing literature on international students' challenges often focuses on undergraduate experiences [82], this work highlights the unique experiences and challenges a Black international woman studying civil engineering at an R1 institution encountered in her first semester of her Ph.D. Future research could continue to explore the challenges of graduate students living in a new environment. Also, given the cultural and academic differences between international students' home country and their current environment, technology poses a common challenge, with factors like digital literacy and specific technology use [77] affecting their experiences. Notably, an interesting finding of this study is the unwritten and unspoken smartphone requirements on campus. These were new and unique to Mary's experience, but more research can further explore technology requirements,

access training, and support for international students. Many schools now have written laptop requirements within their policy, but not all schools clearly articulate a smartphone requirement to incoming students.

Telephones are crucial in facilitating swift communication and maintaining connections across regions. In both developed and developing countries, access to telephones is widespread. However, Mary's experience highlighted a challenge not related to phone ownership but to compatibility issues. Upon arriving in the United States, she realized that her phone from her home country was incompatible with US SIM cards, presenting a financial challenge as she had not anticipated the need for a new phone. Recognizing this issue, there is a need to provide information on phone specifications, as not all phones used in certain regions may be compatible with US SIM cards. This awareness can assist international students like Mary in better financial planning, whether by saving for a new phone or adjusting their budget accordingly. By being informed about this potential challenge, students can avoid surprises and be better prepared to address such situations.

Furthermore, research can be conducted to identify phones compatible with international students' home countries, easing their transition to the US and ensuring seamless communication upon arrival. Additionally, Mary noted in her journal entries the need to adapt to new practices regarding phone usage in the US, which differed from her experience in her home country. She found it surprising that she needed a monthly subscription to maintain her phone number, unlike in her home country, where phone numbers are typically retained for life, even without subscription or airtime. This difference underscores the importance of international students being aware of such practices in the US and planning their budgets accordingly during their stay. Overall, being informed about these differences in phone usage and subscription practices can help international students effectively plan and budget for their time in the United States.

School administrators must be transparent in what they require of students regarding technical devices so that they can better prepare themselves. In this study, Mary quickly realized she needed an active smartphone to navigate this setting (e.g., to navigate the bus and public transportation, dual authenticate/login to academic platforms, and communicate and engage in class activities). Higher education institutions need to include in policy statements if there are smartphone requirements. Also, Mary encountered a challenge in adapting to new online technology used within the classroom, mainly due to her schooling background in a public institution in her home country. Platforms like Canvas, typical in the US educational system, were unfamiliar to her. While she was aware of Canvas as a design app, she was surprised to discover the extensive use of another software, Canvas, in academic studies. Adapting to this technology involved unlearning and relearning, with her main challenge lying in understanding its features and navigating through various activities within a limited timeframe. Initially, this led to frustration, impatience, and annoyance. Reflecting on her initial struggles, she recognized that her frustrations stemmed from not wanting to burden those around her who could assist. Therefore, peers and tutors must exhibit patience and support international students like Mary, who may need to become more familiar with such technological advancements in the educational setting.

Additionally, the bus is recognized as a crucial mode of transportation for students on campus. Throughout the literature, scholars describe challenges associated with the unreliability and

inconsistency of bus services [88], public transit in the US [92], and the substantial costs associated with owning and maintaining a car in the US [26]. Due to these transportation challenges that echoed throughout the findings and literature, international students may want to familiarize themselves with alternatives like skateboards, bicycles, and scooters before arriving at US campuses. These alternative transportation options prove instrumental in facilitating movements both within and outside campus.

Communication challenges, often tied to accents, pronunciation, and fluency [26], [83], [89], [91], impact international students' participation in the classroom, which is considered crucial in US academic settings [78]. The stress arising from this challenge may induce feelings of isolation and imposter syndrome [12], [79], [93]. This, in turn, can affect their academic performance [78] and, in adverse cases, alter their zeal to persist in their educational program [94]. Furthermore, cultural communication disparities may lead to miscommunication [95]. Adding nuance to this study is Mary's unique approach to engaging with others who share a different background from hers by constructing and processing her words internally before speaking. This reflects her adaptability in navigating cross-cultural interaction. Building trust emerged as a pivotal aspect in this study, constituting an essential element of Mary's experience and a fundamental aspect of constructing social capital, as well as "Ima Nmadu" in her Nigerian heritage. Establishing trust within a limited timeframe proves to be a challenging endeavor. While there are existing studies on trust-building and mentor-mentee relationships [96], [97], [98] between Ph.D. students and advisors, there is a need for more exploration of how trust can be established across diverse cultural backgrounds.

In this autoethnography, Mary, a young Nigerian woman, identified challenges she faced in building trust during her first semester at an R1 public university. These challenges primarily arose in communication, where she needed help with one-on-one interactions with her supervisor and peer mentors. Coming from a background where trust is built through an established social and familial network or a shared cultural understanding, Mary found it difficult to express her concerns and seek clarity in meetings openly. This was exacerbated by her upbringing in northern Nigeria, where reserved communication is more common, serving as a coping mechanism in unfamiliar environments. Mary also noticed differences in trust dynamics between Nigeria and the United States, where trust is more assumed in American contexts. In Nigeria, students typically refrain from challenging their lecturers' opinions to avoid potential victimization. This cultural contrast made it challenging for Mary to adjust to the expectation of open communication in her academic environment. To overcome these challenges, Mary had to step out of her comfort zone and actively participate in classroom activities and meetings. She learned to view her supervisor as a mentor invested in her growth. Mentors overseeing students from different cultural backgrounds should actively engage with them to build confidence and help them understand the cultural expectations within academic settings. Mary's experience highlights the impact of nationality on trust perceptions and communication practices. In the US, where trust is often assumed, international students like Mary may need support navigating unfamiliar sociocultural norms to establish the trust necessary for effective academic communication. Transparent communication of cultural norms can facilitate the acclimatization process for these students and promote their academic success.

Navigating a Ph.D. program at a top public R1 institution, particularly in engineering, poses significant challenges, including stress [28], [99], work-life balance issues [30], and isolation [100], which aligns with works of literature on the difficulty [101] and stress culture [7] of engineering programs. Beyond these inherent challenges, the additional layer of uncertainty in navigating a new country and continent highlights the need for further research on underrepresented populations, specifically international Black women in engineering whose experiences remain understudied. Moreover, the challenges identified in this study can result in the attrition of these students who remain vital to expanding the US workforce. In their research, Berdanier et al. [102] identify factors such as the demanding nature of the engineering program, financial pressures, advisor relationships, stress, isolation, and emotional exhaustion as common reasons engineering students exit Ph.D. programs. These factors can negatively affect their sense of belonging [103], socialization [104], and mental health [105] and lead to attrition [4], [102].

Upon entering the university system, Mary drew inspiration from a cultural slogan in Nigeria, "Ima Nmadu," understanding that her success and ability to navigate her new environment depended not solely on what she knew but also on whom she knew. This implies that social connections are instrumental in a student's academic journey aside from intellectual capacity. Recognizing the importance of networking, Mary effectively leveraged resources within her social circles, including peer mentors, advisors, international organizations, and her local community, to navigate challenges. This approach aligns with existing literature on social capital, highlighting it as a crucial avenue for students in engineering to develop leadership skills, critical thinking abilities, and various professional competencies [54]. Upon arriving in the U.S., the author took a proactive stance, actively seeking assistance and building a supportive community pivotal in her inaugural semester as a Ph.D. student. Likewise, there is also literature that supports the notion that community support aids in developing faster connections and improving emotional and physical well-being [91]. By activating social capital, Mary gained valuable returns, including information acquisition, support, expansion of her social network, academic success, and overall well-being. As evidenced by Mary's experience, these outcomes align with existing research on social capital [20], [21].

The novelty in this study is the experience of a first-year Nigerian female engineering Ph.D. student and how she activated social capital to navigate her unique challenges. Further research is crucial to understand how underrepresented students, particularly women and internationals, develop and utilize their social capital within the engineering PhD academic programs. It is recommended that Ph.D. academic programs and administrators integrate and leverage the discussions on social capital to enhance support systems and networking opportunities. Also, asset-based approaches should be emphasized in future research [106]. Hence, rather than focusing on international students' deficits, particularly those of color deficits, recognize their strengths and the nuance they bring, such as the cultural knowledge of Ima Nmadu emphasizing their ability to navigate challenges through establishing social connections as portrayed in this study. Furthermore, the significance of establishing trust among students from diverse cultural settings for effective communication should be identified and disseminated. Knowledge from this study can provide valuable insights for students and mentors unfamiliar with concepts like Ima Nmadu. Future research could explore areas such as investigating students with a different gender and

cultural background from that of the author, replicating the study across the spring and summer semesters to uncover specific challenges students matriculating in this period may encounter, as the current research was conducted during the fall semester.

This autoethnographic research explores the concept of “Ima Nmadu” in academic success through authentic relationships through the experience of a Nigerian woman in her inaugural semester at an R1 public university in the United States. Utilizing autoethnography, she unveils unique insights that conventional survey methods might overlook. Mary's findings, rooted in her experiences and interactions in her new environment, highlight challenges such as smartphone compatibility and building trust.

Autoethnography, as a method, allows researchers to delve deeply into a subject matter and explore it within a given context. Unlike traditional surveys, such as interviews and questionnaires, autoethnography permits researchers to uncover the complexities and nuances of a subject area [64]. For example, the challenge of smartphone compatibility arose from Mary's personal experiences, suggesting the importance of considering phone specifications in different nationality contexts. Similarly, the challenge of building trust stemmed from Mary's reflection on her interactions within her educational setting, revealing potential cultural influences on interpersonal relationships. These insights underscore the unique contribution of autoethnography in revealing aspects that might go unnoticed by traditional research surveys.

Implications

International PhD Students:

- Familiarize yourself with the US educational system. It relies heavily on class participation, discussions, assignments, etc.
- Be confident in your communication abilities. Speak and relate!
- Build awareness of the importance of activating social capital.
- Participate in workshops or orientations.
- Learn how to navigate challenges through social capital, e.g., contact mentors and individuals on LinkedIn, ask questions, and participate in seminars.
- Research the transportation system to determine where you are going. Consider learning how to ride a bike or drive a car, as public transportation is not as accessible in parts of the USA.
- Learn about the technology requirement and build proficiency: Ask questions about laptop and smartphone requirements.
- Be aware that the phone specifications in the USA differ from those in your home country. Be financially prepared to get a new phone, as most of the phones we use back home (especially in Nigeria) are incompatible with the SIM cards here.
- Flexibility is critical for fully adapting to a unique setting, especially regarding housing, food, and transportation.

- Stay culturally aware, as cultural nuances in this place differ from those in your home country. Understanding cultural nuances can foster better communication and collaboration.
- Search and connect with organizations associated with your home country or culture in your environment, as it is a valuable resource. Establish connections and support systems early on.
- Focus on building and expanding social networks: Engage, participate, and develop your social network. Socialize!
- Be open to seeking help from your peer mentors, lab mates, and advisors when needed.
- Be patient with your growth and give yourself grace. Learn to celebrate little wins.
- Prioritizing time management is vital for a successful work-life balance, so find the best strategy. Ensure you set SMART goals for your activities.
- Find a stress relief technique.
- Believe in yourself and seek support or help when you are psychologically and emotionally down.

Advisors of international Ph.D. Students:

- Create a safe and non-judgmental space for open discussions to help facilitate trust and alleviate feelings of inadequacy.
- Normalize intentionally engaging international students in transparent communication on cultural norms around academic expectations, lab setting, and their new environment.
- Be sensitive to trust issues that may arise due to diverse cultural backgrounds.
- Actively encourage students to leverage their social capital. Emphasize the importance of building and maintaining supportive networks.
- Be accessible and available: Schedule regular check-ins to discuss challenges and offer guidance.
- Encourage Peer-to-Peer mentoring among students within your lab.
- Communicate expectations to new students and provide helpful resources to educate them about the lab's culture and work.
- Have an awareness of the cultural nuances of the international students in your lab to help them navigate issues such as trust and communication stemming from their diverse backgrounds.
- Encourage inclusivity within your lab to foster better collaboration, communication, and a sense of belonging.
- Conduct workshops on achieving a healthy work-life balance tailored to the demands of engineering Ph.D. programs.
- Establish a mentor-mentee relationship and encourage international students to seek help when needed.
- Help International students connect with other experienced mentors who can provide guidance and support.

- Help students recognize their strengths and accomplishments and appreciate their wins and contributions.

Administrators:

- Provide a more holistic onboarding process and resources.
- Offer guidelines on suitable phones and technological specifications, especially for effective communication and actualization of school activities.
- Provide resources or workshops on transportation options within the university or local community.
- Provide comprehensive resources or orientation programs addressing various aspects of living in a new environment, including food, health insurance, and housing information.
- Establish resource centers or offices specifically focused on supporting international students. These centers can provide information, workshops, and assistance tailored to their unique needs.
- Enhance accessibility services for international students, including language support and assistance with pronunciation. This can help ease communication barriers.
- Collaborate with local communities to improve transportation options for international students. Explore partnerships with local businesses to address transportation challenges.
- Build and strengthen the awareness of international students about mental health support services, including counseling and workshops addressing stress, imposter syndrome, and the challenges of living in a new environment.

Limitations

The research employed autoethnography, focusing on the author's experience as an international African Woman in a civil engineering PhD program at an R1 University. As such, the study is inherently subjective to the author, introducing potential biases. However, the author took steps to ensure transparency in methods, ethical consideration, data reporting, and her positionality, aiming to minimize bias in this unique study. It is important to note that the nature of this study, an exploration of the author's experiences, precludes the possibility of achieving statistical significance with its findings. Consequently, the findings cannot be generalized but may be transferable to a broader population with shared identities and experiences. Additionally, the research findings offer insights into the unique and specific experiences of an international African student from Nigeria, contributing a nuanced perspective that may have relevance beyond the author's case. Future work can consider more individual studies on international students from other African countries to understand their unique experiences.

Conclusion

This study delved into an international African woman's experiences as a first-year engineering Ph.D. student at an R1 public research institution through autoethnography. It addressed two research questions, aiming to uncover the challenges she encountered during the inaugural semester of her civil engineering program and the strategies she employed to navigate these

challenges. The first research question identified six key challenges: isolation, imposter syndrome, communication difficulties, adaptation to a new environment, navigating the R1 institution, poor work-life balance, stress, and trust-building. To successfully navigate these challenges, the international African woman relied on Ima Nmadu, a cultural slogan from Nigeria, emphasizing the significance of social connections. The international African woman activated her social capital by engaging in community gatherings from her local students' community and international organizations and seeking guidance from peers, advisors, and individuals within her environment. This activation resulted in notable benefits, including academic success, support, expanded social network, emotional well-being, and information acquisition. This study's finding aligns with existing literature on international students, underrepresented populations, and women in engineering. Notably, it uncovers themes such as trust-building, technology requirements, internalization, and construction of words before speaking, which adds a nuanced perspective to the study. Furthermore, this study emphasizes the importance of social capital in the transition and adaptation of this International African woman's academic journey. This study also recommends that the implications suggested should be a starting point for collaborative efforts among students, advisors, and administrators to address attrition rates, ultimately contributing to an increased, diverse, and improved engineering workforce.

Acknowledgments

The author gratefully acknowledges the National Science Foundation for supporting this work under Grant No. 2140696. Any opinions, findings, conclusions, or recommendations expressed here are those of the author and do not necessarily reflect the views of the National Science Foundation. The author also gratefully acknowledges the contributions made by her advisor Dr. Simmons R. Denise, and her peer mentors, Elizabeth Volpe and Edward Obi-Rapu, for their thoughtful feedback and help in organizing and editing this manuscript.

References

- [1] "National Science Board: Vision 2030".
- [2] J. Voeller, "Diversity: The Future of Engineering," *Leadersh. Manag. Eng.*, vol. 2, no. 4, pp. 38–39, Oct. 2002, doi: 10.1061/(ASCE)1532-6748(2002)2:4(38).
- [3] C. Moller-Wong and A. Eide, "An Engineering Student Retention Study," *J. Eng. Educ.*, vol. 86, no. 1, pp. 7–15, 1997, doi: 10.1002/j.2168-9830.1997.tb00259.x.
- [4] M. Bahnson and C. G. P. Berdanier, "Current Trends in Attrition Considerations of Graduate Engineering Students in the United States," *Int. J. Eng. Educ.*, vol. 39, no. 1, pp. 14–29, 2023.
- [5] E. Godfrey, T. Aubrey, and R. King, "Who leaves and who stays? Retention and attrition in engineering education," *Eng. Educ.*, vol. 5, no. 2, pp. 26–40, Dec. 2010, doi: 10.11120/ened.2010.05020026.
- [6] B. Geisinger, D. R. Raman, and D. Raman, "Why they leave: Understanding student attrition from engineering majors," 2013.
- [7] K. J. Jensen and K. J. Cross, "Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion," *J. Eng. Educ.*, vol. 110, no. 2, pp. 371–392, Apr. 2021, doi: 10.1002/jee.20391.
- [8] D. E. Chubin, G. S. May, and E. L. Babco, "Diversifying the Engineering Workforce," *J. Eng. Educ.*, vol. 94, no. 1, pp. 73–86, 2005, doi: 10.1002/j.2168-9830.2005.tb00830.x.
- [9] E. Litzler, S. E. Lange, and S. Brainard, "Climate For Graduate Students In Science And Engineering Departments," presented at the 2005 Annual Conference, Jun. 2005, p. 10.308.1-

- 10.308.16. Accessed: Dec. 06, 2023. [Online]. Available: <https://peer.asee.org/climate-for-graduate-students-in-science-and-engineering-departments>
- [10] L. Anderson and D. Northwood, "Recruitment and retention programs to increase diversity in engineering," in *International Conference on Engineering Education, Manchester, UK, 2002*, pp. 1–5. Accessed: Oct. 31, 2023. [Online]. Available: https://www.researchgate.net/profile/Derek-Northwood/publication/228877031_Recruitment_and_retention_programmes_to_increase_diversity_in_engineering/links/601eea5a299bf1cc26abf298/Recruitment-and-retention-programmes-to-increase-diversity-in-engineering.pdf
- [11] R. T. Barclay and D. Maitra, "Dispelling the Monolith: Exploring the Identities of Black Immigrant Students in Graduate-level Engineering," *Am. Soc. Eng. Educ.*, vol. Paper ID #36488, 2023, Accessed: Oct. 31, 2023. [Online]. Available: https://www.researchgate.net/profile/Debalina-Maitra/publication/372629396_Dispelling_the_Monolith_Exploring_the_Identities_of_Black_Immigrant_Students_in_Graduate-level_Engineering/links/64c0fd8e95bbbe0c6e6045c2/Dispelling-the-Monolith-Exploring-the-Identities-of-Black-Immigrant-Students-in-Graduate-level-Engineering.pdf
- [12] J. J. Lee and C. Rice, "Welcome to America? International student perceptions of discrimination," *High. Educ.*, vol. 53, no. 3, pp. 381–409, Mar. 2007, doi: 10.1007/s10734-005-4508-3.
- [13] B. A. Burt, A. Knight, and J. Roberson, "Racializing Experiences of Foreign-Born and Ethnically Diverse Black Male Engineering Graduate Students: Implications for Student Affairs Practice, Policy, and Research," *J. Int. Stud.*, vol. 7, no. 4, pp. 925–943, Oct. 2017, doi: 10.32674/jis.v7i4.182.
- [14] B. A. Burt, "Broadening participation in the engineering professoriate: Influences on Allen's journey in developing professorial intentions," *J. Eng. Educ.*, vol. 109, no. 4, pp. 821–842, 2020, doi: 10.1002/jee.20353.
- [15] "IIE Open Doors / Academic Level and Places of Origin," IIE Open Doors / Academic Level and Places of Origin. Accessed: Jan. 10, 2024. [Online]. Available: <https://opendoorsdata.org/data/international-students/academic-level-and-places-of-origin/>
- [16] "IIE Open Doors / Fields of Study by Place of Origin," IIE Open Doors / Fields of Study by Place of Origin. Accessed: Feb. 07, 2024. [Online]. Available: <https://opendoorsdata.org/data/international-students/fields-of-study-by-place-of-origin/>
- [17] D. Dutta, "Sustaining the Pipeline: Experiences of International Female Engineers in US Graduate Programs," *J. Eng. Educ.*, vol. 104, no. 3, pp. 326–344, Jul. 2015, doi: 10.1002/jee.20077.
- [18] R. F. de Verthelyi, "INTERNATIONAL FEMALE GRADUATE STUDENTS IN ENGINEERING AT A U.S. UNIVERSITY: SURVIVAL OF THE FITTEST?," *J. Women Minor. Sci. Eng.*, vol. 3, no. 4, 1997, doi: 10.1615/JWomenMinorScienEng.v3.i4.30.
- [19] D. I. Adeniranye and B. T. Berhane, "Understanding the Academic Journey of an International West African Engineering Graduate Student in the United States," in *2023 ASEE Annual Conference & Exposition, 2023*. Accessed: Oct. 31, 2023. [Online]. Available: <https://peer.asee.org/understanding-the-academic-journey-of-an-international-west-african-engineering-graduate-student-in-the-united-states>
- [20] N. Lin, "Building a Network Theory of Social Capital'," *Connect. 221 28 -51 ©1999 NSNA*, 1999.
- [21] N. Lin, *Social capital: a theory of social structure and action*. in *Structural analysis in the social sciences*, no. 19. Cambridge, UK ; New York: Cambridge University Press, 2001.
- [22] D. M. Peterson, P. Briggs, L. Dreasher, D. D. Horner, and T. Nelson, "Contributions of International Students and Programs to Campus Diversity," *New Dir. Stud. Serv.*, vol. 1999, no. 86, pp. 67–77, 1999, doi: 10.1002/ss.8609.
- [23] E. G. Barber and R. P. Morgan, "The Impact of Foreign Graduate Students on Engineering Education in the United States," *Science*, vol. 236, no. 4797, pp. 33–37, 1987.
- [24] American Society for Engineering Education, "Profiles of Engineering and Engineering Technology, 2022. Washington, DC.," Profiles of Engineering and Engineering Technology,

2022. Washington, DC.”. Accessed: Nov. 27, 2023. [Online]. Available: <https://ira.asee.org/wp-content/uploads/2022/11/Engineering-and-Engineering-Technology-by-the-Numbers-2021.pdf>(<https://ira.asee.org/wp-content/uploads/2022/11/Engineering-and-Engineering-Technology-by-the-Numbers-2021.pdf>)
- [25] E. A. Cech and T. J. Waidzunus, “Navigating the heteronormativity of engineering: the experiences of lesbian, gay, and bisexual students,” *Eng. Stud.*, vol. 3, no. 1, pp. 1–24, Apr. 2011, doi: 10.1080/19378629.2010.545065.
- [26] C. Gautam, C. L. Lowery, C. Mays, and D. Durant, “Challenges for Global Learners: A Qualitative Study of the Concerns and Difficulties of International Students,” *J. Int. Stud.*, vol. 6, no. 2, pp. 501–526, Apr. 2016, doi: 10.32674/jis.v6i2.368.
- [27] W. Barnes and M. C. Loui, “The adjustment experience of first-year international undergraduate students in engineering,” *IEEE*, 2012, pp. 1–6. doi: 10.1109/FIE.2012.6462245.
- [28] C. P. Chen, “Professional Issues: Common Stressors Among International College Students: Research and Counseling Implications,” *J. Coll. Couns.*, vol. 2, no. 1, pp. 49–65, 1999, doi: 10.1002/j.2161-1882.1999.tb00142.x.
- [29] W. J. Heggins and J. Jackson, “Understanding the collegiate experience for Asian international students at a midwestern research university,” *Coll. Stud. J.*, vol. 37, pp. 379–391, Jan. 2003.
- [30] E. Martinez, C. Ordu, M. R. Della Sala, and A. McFarlane, “Striving to Obtain a School-Work-Life Balance: The Full-Time Doctoral Student,” *Int. J. Dr. Stud.*, vol. 8, pp. 039–059, 2013, doi: 10.28945/1765.
- [31] C. G. P. Berdanier, C. Whitehair, A. Kirn, and D. Satterfield, “Analysis of social media forums to elicit narratives of graduate engineering student attrition,” *J. Eng. Educ.*, vol. 109, no. 1, pp. 125–147, Jan. 2020, doi: 10.1002/jee.20299.
- [32] William W. Wulf, “Diversity In Engineering,” *Leadership Manage. Eng.*, 2001, 1(4): 31-35. Accessed: Nov. 29, 2023. [Online]. Available: <https://ascelibrary.org/doi/epdf/10.1061/%28ASCE%291532-6748%282001%291%3A4%2831%29>
- [33] B. A. Burt, K. L. Williams, and W. A. Smith, “Into the Storm: Ecological and Sociological Impediments to Black Males’ Persistence in Engineering Graduate Programs,” *Am. Educ. Res. J.*, vol. 55, no. 5, pp. 965–1006, Oct. 2018, doi: 10.3102/0002831218763587.
- [34] Q. R. Alexander and M. A. Hermann, “African-American women’s experiences in graduate science, technology, engineering, and mathematics education at a predominantly white university: A qualitative investigation,” *J. Divers. High. Educ.*, vol. 9, no. 4, p. 307, 2016.
- [35] B. A. Burt, K. L. Williams, and G. J. M. Palmer, “It Takes a Village: The Role of Emic and Etic Adaptive Strengths in the Persistence of Black Men in Engineering Graduate Programs,” *Am. Educ. Res. J.*, vol. 56, no. 1, pp. 39–74, Feb. 2019, doi: 10.3102/0002831218789595.
- [36] E. O. McGee, D. Naphan-Kingery, F. N. Mustafaa, S. Houston, P. Botchway, and J. Lynch, “TURNED OFF FROM AN ACADEMIC CAREER: ENGINEERING AND COMPUTING DOCTORAL STUDENTS AND THE REASONS FOR THEIR DISSUASION.,” *Int. J. Dr. Stud.*, vol. 14, no. 1, 2019, Accessed: Dec. 02, 2023. [Online]. Available: https://www.researchgate.net/profile/Dara-Naphan-Kingery/publication/331823367_Turned_Off_from_an_Academic_Career_Engineering_and_Computing_Doctoral_Students_and_the_Reasons_for_Their_Dissuasion/links/5c8e4b6ca6fdcc3817593188/Turned-Off-from-an-Academic-Career-Engineering-and-Computing-Doctoral-Students-and-the-Reasons-for-Their-Dissuasion.pdf
- [37] S. J. Bork and J.-L. Mondisa, “Engineering graduate students’ mental health: A scoping literature review,” *J. Eng. Educ.*, vol. 111, no. 3, pp. 665–702, Jul. 2022, doi: 10.1002/jee.20465.
- [38] E. O. McGee and L. Bentley, “The Troubled Success of Black Women in STEM,” *Cogn. Instr.*, vol. 35, no. 4, pp. 265–289, Oct. 2017, doi: 10.1080/07370008.2017.1355211.

- [39] D. C. Awuor, "Understanding Black-African International Students' Experiences in United States Colleges and Universities through Social Identity Theory," *J. Int. Stud.*, vol. 11, no. 2, pp. 514-, 2021, doi: 10.32674/jis.v11i2.2741.
- [40] C. A. George Mwangi, N. Changamire, and J. Mosselson, "An intersectional understanding of African international graduate students' experiences in US higher education.," *J. Divers. High. Educ.*, vol. 12, no. 1, p. 52, 2019.
- [41] M. G. Constantine, G. M. Anderson, L. A. Berkel, L. D. Caldwell, and S. O. Utsey, "Examining the Cultural Adjustment Experiences of African International College Students: A Qualitative Analysis.," *J. Couns. Psychol.*, vol. 52, no. 1, pp. 57–66, Jan. 2005, doi: 10.1037/0022-0167.52.1.57.
- [42] Marjorie C. Shavers and James L. Moore Iii, "The Double-Edged Sword: Coping and Resiliency Strategies of African American Women Enrolled in Doctoral Programs at Predominately White Institutions," *Front. J. Women Stud.*, vol. 35, no. 3, p. 15, 2014, doi: 10.5250/fronjwomestud.35.3.0015.
- [43] D. Dutta, "Sustaining the Pipeline: Experiences of International Female Engineers in U.S. Graduate Programs," *J. Eng. Educ.*, vol. 104, no. 3, pp. 326–344, 2015, doi: 10.1002/jee.20077.
- [44] D. Dutta, "Negotiations of cultural identities by Indian women engineering students in US engineering programmes," *J. Intercult. Commun. Res.*, vol. 45, no. 3, pp. 177–195, May 2016, doi: 10.1080/17475759.2016.1165727.
- [45] J. Woods, "Un(Bundling) the Black Experience at PWIs: Using Assets-based Frameworks to Explore the Lived Experiences of Black Sub-Sharan African-born Graduate Students in STEM," *J. Comp. Int. High. Educ.*, vol. 13, no. 5S, pp. 118-, 2022, doi: 10.32674/jcihe.v13i5.4249.
- [46] E. O. McGee, D. M. Griffith, and S. L. Houston, "'I Know I Have to Work Twice as Hard and Hope that Makes Me Good Enough': Exploring the Stress and Strain of Black Doctoral Students in Engineering and Computing," *Teach. Coll. Rec. Voice Scholarsh. Educ.*, vol. 121, no. 4, pp. 1–38, Apr. 2019, doi: 10.1177/016146811912100407.
- [47] J.-L. Mondisa, "THE ROLE OF SOCIAL CAPITAL IN AFRICAN AMERICAN STEM MENTORING RELATIONSHIPS," *J. Women Minor. Sci. Eng.*, vol. 26, no. 2, pp. 125–153, 2020, doi: 10.1615/JWomenMinorScienEng.2020022267.
- [48] P. Bourdieu, "THE FORMS OF CAPITAL," *Richardson J Handb. Theory Res. Sociol. Educ. 1986 Westport CT Greenwood Pp 241–58*, pp. 241–258, 1986.
- [49] R. S. Burt, "The Contingent Value of Social Capital," *Adm. Sci. Q.*, vol. 42, no. 2, pp. 339–365, 1997, doi: 10.2307/2393923.
- [50] N. Lin, "Building a Network Theory of Social Capital'," 1999.
- [51] J. S. Coleman, "Social Capital in the Creation of Human Capital," *Am. J. Sociol.*, vol. 94, pp. S95–S120, Jan. 1988, doi: 10.1086/228943.
- [52] R. D. Putnam, "Social Capital and Public Affairs," *Bull. Am. Acad. Arts Sci.*, vol. 47, no. 8, pp. 5–19, 1994, doi: 10.2307/3824796.
- [53] A. A. Akamobi, "Social Networking and Access to Jobs in Sub-Saharan Africa: An Inquiry into the 'Ima Mmadu' Theorem," 2021.
- [54] E. Volpe, M. Polmear, D. R. Simmons, and D. Weisenfeld, "Exploring the Role of Social Capital in Civil Engineering Students' Leadership Development," *J. Civ. Eng. Educ.*, vol. 149, no. 3, p. 04023002, Jul. 2023, doi: 10.1061/JCEECD.EIENG-1870.
- [55] J.-L. Mondisa, "THE ROLE OF SOCIAL CAPITAL IN AFRICAN AMERICAN STEM MENTORING RELATIONSHIPS," *J. Women Minor. Sci. Eng.*, vol. 26, no. 2, pp. 125–153, 2020, doi: 10.1615/JWomenMinorScienEng.2020022267.
- [56] T. U. Ganiron, "Social Capital and Career Success of Civil Engineers towards Designing Career Paths," *Procedia - Soc. Behav. Sci.*, vol. 102, pp. 611–621, Nov. 2013, doi: 10.1016/j.sbspro.2013.10.778.

- [57] L. Zhang and J. Cheng, "Effect of Knowledge Leadership on Knowledge Sharing in Engineering Project Design Teams: The Role of Social Capital," *Proj. Manag. J.*, vol. 46, no. 5, pp. 111–124, Oct. 2015, doi: 10.1002/pmj.21525.
- [58] J. P. Martin, S. K. Stefl, L. W. Cain, and A. L. Pfirman, "Understanding first-generation undergraduate engineering students' entry and persistence through social capital theory," *Int. J. STEM Educ.*, vol. 7, no. 1, p. 37, Aug. 2020, doi: 10.1186/s40594-020-00237-0.
- [59] J. P. Martin, "The invisible hand of social capital: Narratives of first generation college students in engineering," *Int. J. Eng. Educ.*, vol. 31, no. 5, pp. 1170–1181, 2015.
- [60] J. P. Martin, D. R. Simmons, and S. L. Yu, "The Role of Social Capital in the Experiences of Hispanic Women Engineering Majors," *J. Eng. Educ.*, vol. 102, no. 2, pp. 227–243, Apr. 2013, doi: 10.1002/jee.20010.
- [61] J. P. Martin, M. K. Miller, and D. R. Simmons, "Exploring the Theoretical Social Capital "Deficit" of First Generation College Students: Implications for Engineering Education".
- [62] S. Wall, "An Autoethnography on Learning About Autoethnography," *Int. J. Qual. Methods*, vol. 5, no. 2, pp. 146–160, Jun. 2006, doi: 10.1177/160940690600500205.
- [63] S. Wall, "Easier Said than Done: Writing an Autoethnography," *Int. J. Qual. Methods*, vol. 7, no. 1, pp. 38–53, Mar. 2008, doi: 10.1177/160940690800700103.
- [64] H. Chang, *Autoethnography as Method*. Routledge, 2016.
- [65] T. E. A. Ellis Stacy Holman Jones, Carolyn, Ed., *Handbook of Autoethnography*, 2nd ed. New York: Routledge, 2021. doi: 10.4324/9780429431760.
- [66] C. Ellis, T. E. Adams, and A. P. Bochner, "Autoethnografie: Ein ÜberblickAutoethnography: An Overview," *Hist. Soc. Res.*, vol. 36, p. 273290, 2011, doi: 10.12759/HSR.36.2011.4.273-290.
- [67] N. K. Denzin, "Constructing New Critical Inquiry Through Performance Autoethnography," *Int. Rev. Qual. Res.*, vol. 11, no. 1, pp. 51–56, 2018.
- [68] X. Xu, S. Wei, and Y. Cao, "Moving beyond the 'international' label: A call for the inclusion of the (in)visible international engineering students," *J. Eng. Educ. Wash. DC*, vol. 112, no. 2, pp. 253–257, 2023, doi: 10.1002/jee.20513.
- [69] S. E. Crozier and C. M. Cassell, "Methodological considerations in the use of audio diaries in work psychology: Adding to the qualitative toolkit," *J. Occup. Organ. Psychol.*, vol. 89, no. 2, pp. 396–419, Jun. 2016, doi: 10.1111/joop.12132.
- [70] M. Birks, Y. Chapman, and K. Francis, "Memoing in qualitative research: Probing data and processes," *J. Res. Nurs.*, vol. 13, no. 1, pp. 68–75, Jan. 2008, doi: 10.1177/1744987107081254.
- [71] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
- [72] H. Chang, "Autoethnography in Health Research: Growing Pains?," *Qual. Health Res.*, vol. 26, no. 4, pp. 443–451, Mar. 2016, doi: 10.1177/1049732315627432.
- [73] J. W. Creswell and D. L. Miller, "Determining Validity in Qualitative Inquiry," *Theory Pract.*, vol. 39, no. 3, pp. 124–130, Aug. 2000, doi: 10.1207/s15430421tip3903_2.
- [74] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qual. Res. Psychol.*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
- [75] G. Nkotagu, "Internet Fraud: Information for Teachers and Students," *J. Int. Stud.*, vol. 1, Nov. 2011, doi: 10.32674/jis.v1i2.557.
- [76] T. J. Yosso *, "Whose culture has capital? A critical race theory discussion of community cultural wealth," *Race Ethn. Educ.*, vol. 8, no. 1, pp. 69–91, Mar. 2005, doi: 10.1080/1361332052000341006.
- [77] L. Habib, M. Johannesen, and L. Øgrim, "Experiences and Challenges of International Students in Technology-Rich Learning Environments," *J. Educ. Technol. Soc.*, vol. 17, no. 2, pp. 196–206, 2014.
- [78] J. Kaya, "Inside the International Student World: Challenges, Opportunities, and Imagined Communities," *J. Int. Stud.*, vol. 10, no. 1, pp. 124–144, Feb. 2020, doi: 10.32674/jis.v10i1.1031.

- [79] S. Sovic, "Coping with stress: the perspective of international students," *Art Des. Commun. High. Educ.*, vol. 6, no. 3, pp. 145–158, May 2008, doi: 10.1386/adch.6.3.145_1.
- [80] E. O. McGee, P. K. Botchway, D. E. Naphan-Kingery, A. J. Brockman, S. Houston II, and D. T. White, "Racism camouflaged as impostorism and the impact on Black STEM doctoral students," *Race Ethn. Educ.*, vol. 25, no. 4, pp. 487–507, Jun. 2022, doi: 10.1080/13613324.2021.1924137.
- [81] B. J. Petet, L. Montgomery, and J. C. Weekes, "Predictors of Imposter Phenomenon among Talented Ethnic Minority Undergraduate Students," *J. Negro Educ.*, vol. 84, no. 2, pp. 175–186, 2015, doi: 10.7709/jnegroeducation.84.2.0175.
- [82] W. Barnes and M. C. Loui, "The adjustment experience of first-year international undergraduate students in engineering," in *2012 Frontiers in Education Conference Proceedings*, Seattle, WA, USA: IEEE, Oct. 2012, pp. 1–6. doi: 10.1109/FIE.2012.6462245.
- [83] B. A. Burt, A. Knight, and J. Roberson, "Racializing Experiences of Foreign-Born and Ethnically Diverse Black Male Engineering Graduate Students: Implications for Student Affairs Practice, Policy, and Research," *J. Int. Stud.*, vol. 7, no. 4, pp. 925–943, Oct. 2017, doi: 10.32674/jis.v7i4.182.
- [84] D. Chakraverty, "The Impostor Phenomenon Among Black Doctoral and Postdoctoral Scholars in STEM," *Int. J. Dr. Stud.*, vol. 15, pp. 433–460, 2020, doi: 10.28945/4613.
- [85] D. Chakraverty, "PhD student experiences with the impostor phenomenon in STEM," *Int. J. Dr. Stud.*, vol. 15, p. 159, 2020.
- [86] E. O. McGee, P. K. Botchway, D. E. Naphan-Kingery, A. J. Brockman, S. Houston, and D. T. White, "Racism camouflaged as impostorism and the impact on Black STEM doctoral students," *Race Ethn. Educ.*, vol. 25, no. 4, pp. 487–507, 2022, doi: 10.1080/13613324.2021.1924137.
- [87] E. Litzler, S. E. Lange, and S. Brainard, "Climate For Graduate Students In Science And Engineering Departments," presented at the 2005 Annual Conference, Jun. 2005, p. 10.308.1-10.308.16. Accessed: Dec. 06, 2023. [Online]. Available: <https://peer.asee.org/climate-for-graduate-students-in-science-and-engineering-departments>
- [88] C. Rodríguez, M. Ed, C. R. Chavez, M. Ed, C. Klauber, and M. Ed, "International Graduate Student Challenges and Support," *Int. Res. Rev. J. Phi Beta Delta Honor Soc. Int. Sch.*, vol. Volume 8, Number 2, Spring 2019, spring 2019.
- [89] H. Wu, E. Garza, and N. Guzman, "International Student's Challenge and Adjustment to College," *Educ. Res. Int.*, vol. 2015, p. e202753, Feb. 2015, doi: 10.1155/2015/202753.
- [90] J. J. Lee, "Engaging International Students," *J. Quaye R Harper Eds Stud. Engagem. High. Educ. Theor. Perspect. Pract. Approaches Diverse Popul. Pp 105-120 Routledge N. Y. NY*, pp. 105–120, 2015.
- [91] C. A. George Mwangi, N. Changamire, and J. Mosselson, "An intersectional understanding of African international graduate students' experiences in US higher education.," *J. Divers. High. Educ.*, vol. 12, no. 1, p. 52, 2019.
- [92] D. J. Houston, "Buses, Trains, and Automobiles: Facing the Challenges of Urban Transportation," *Public Perform. Manag. Rev.*, vol. 25, no. 2, pp. 251–255, 2001, doi: 10.2307/3381104.
- [93] H. Y. Kim, "International graduate students' difficulties: Graduate classes as a community of practices," *Teach. High. Educ.*, vol. 16, no. 3, pp. 281–292, 2011, doi: 10.1080/13562517.2010.524922.
- [94] N. M. Telbis, L. Helgeson, and C. Kingsbury, "International Students' Confidence and Academic Success," *J. Int. Stud.*, vol. 4, no. 4, pp. 330–341, Oct. 2014, doi: 10.32674/jis.v4i4.452.
- [95] C. Brathwaite, J. Vernon, and C. Ventura, "Analyzing the Group Effectiveness and Dynamics of a Heterogeneous International Research Group In Cartagena (Colombia): A Case Study," in *2019 ASEE Annual Conference & Exposition Proceedings*, Tampa, Florida: ASEE Conferences, Jun. 2019, p. 32093. doi: 10.18260/1-2--32093.
- [96] Burt, McKen, Burkhart, Hormell, and Knight, "Black Men in Engineering Graduate Education: Experiencing Racial Microaggressions within the Advisor–Advisee Relationship," *J. Negro Educ.*, vol. 88, no. 4, p. 493, 2020, doi: 10.7709/jnegroeducation.88.4.0493.

- [97] J. Posselt, "Normalizing Struggle: Dimensions of Faculty Support for Doctoral Students and Implications for Persistence and Well-Being," *J. High. Educ.*, vol. 89, no. 6, pp. 988–1013, Nov. 2018, doi: 10.1080/00221546.2018.1449080.
- [98] A. S. Ssemata, S. Gladding, C. C. John, and S. Kiguli, "Developing mentorship in a resource-limited context: a qualitative research study of the experiences and perceptions of the makerere university student and faculty mentorship programme," *BMC Med. Educ.*, vol. 17, no. 1, p. 123, Jul. 2017, doi: 10.1186/s12909-017-0962-8.
- [99] K. K. Koo, I. Baker, and J. Yoon, "The First Year Acculturation: A Longitudinal Study on Acculturative Stress and Adjustment among the First Year International College Students," *J. Int. Stud.*, vol. 11, no. 2, pp. 278–298, 2021, doi: 10.32674/jis.v11i2.1726.
- [100] M. L. Ridgeway, E. McGee, D. E. Naphan-Kingery, and A. J. Brockman, "Black Engineering and Computing Doctoral Students' Peer Interaction that Foster Racial Isolation," Apr. 2018. Accessed: Jan. 27, 2024. [Online]. Available: <https://www.semanticscholar.org/paper/Black-Engineering-and-Computing-Doctoral-Students%27-Ridgeway-McGee/9e67a8209a833d1aa20305bd567eef458549d190>
- [101] R. Stevens, D. Amos, A. Jocuns, and L. Garrison, "Engineering As Lifestyle And A Meritocracy Of Difficulty: Two Pervasive Beliefs Among Engineering Students And Their Possible Effects," in *2007 Annual Conference & Exposition Proceedings*, Honolulu, Hawaii: ASEE Conferences, Jun. 2007, p. 12.618.1-12.618.17. doi: 10.18260/1-2--2791.
- [102] C. G. P. Berdanier, C. Whitehair, A. Kirn, and D. Satterfield, "Analysis of social media forums to elicit narratives of graduate engineering student attrition," *J. Eng. Educ.*, vol. 109, no. 1, pp. 125–147, 2020, doi: 10.1002/jee.20299.
- [103] E. Lee, J. M. Bekki, A. R. Carberry, and N. N. Kellam, "Conceptualization and Situating of Sense of Belonging Among International Engineering Doctoral Students: In Light of the Previous Literature," presented at the 2021 CoNECD, in PaperID #28431. American Society for Engineering Education, Jan. 2021. Accessed: Dec. 02, 2023. [Online]. Available: <https://peer.asee.org/conceptualization-and-situating-of-sense-of-belonging-among-international-engineering-doctoral-students-in-light-of-the-previous-literature>
- [104] S. K. Gardner, "Fitting the Mold of Graduate School: A Qualitative Study of Socialization in Doctoral Education," *Innov. High. Educ.*, vol. 33, no. 2, pp. 125–138, Aug. 2008, doi: 10.1007/s10755-008-9068-x.
- [105] S. J. Bork and J.-L. Mondisa, "Engineering graduate students' mental health: A scoping literature review," *J. Eng. Educ.*, vol. 111, no. 3, pp. 665–702, 2022, doi: 10.1002/jee.20465.
- [106] S. R. Harper, "An anti-deficit achievement framework for research on students of color in STEM," *New Dir. Institutional Res.*, vol. 2010, no. 148, pp. 63–74, Dec. 2010, doi: 10.1002/ir.362.