"I Didn't Understand Why it had to be a Woman" Realities of Ghanaian Women in Engineering

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Abstract

Purpose: This study examines the lived realities of Ghanaian women in engineering (GWIE) within the broader context of persistent gender disparities in science, technology, engineering, and mathematics (STEM).

Research Methodology: This study adopts a qualitative design grounded in a phenomenological perspective and guided by social constructivism to capture participants lived experiences. A maximum variation sampling technique was employed to select 20 female engineers to ensure diversity across disciplines and career stages. Data were generated through in-depth interviews and observations and subsequently analyzed using thematic analysis to identify recurring patterns and meanings.

Results: The findings revealed that many GWIE experienced unplanned career shifts, often undertaken without consultation. Their educational and professional pathways are marked by versatility and adaptability, reflecting the need to adjust to constrained opportunities in the job market. Participants operate in work environments characterized by entrenched gender biases and infrastructural inadequacies, which limit their professional growth. Nevertheless, GWIE demonstrate strong intrinsic motivation, driven by their passion for engineering and commitment to contributing meaningfully to society.

Conclusions: The study concludes that the professional experiences are shaped by a complex interplay of individual resilience, family support, and systemic gendered constraints within engineering institutions. While personal motivation sustains women's engagement in the field, institutional practices continue to reproduce inequities that hinder their career advancement.

Limitations: The reliance on self-reported experiences may be influenced by subjective interpretations

Contributions: This study contributes to the limited empirical literature on women in engineering in Ghana by providing context-specific insights into their experiences.

Keywords: *Career Advancement, Engineering, Gender, STEM, Workplace Bias, Women in Engineering*

1. Introduction

In recent years, there has been a worldwide increase in the number of women pursuing careers in science, technology, engineering, and mathematics (STEM) (Abrigo et al., 2024; Bans-Akutey, 2025a; Macaso & Dagohoy, 2022) in fields that have traditionally been dominated by men (Banchefsky & Park, 2018; Bans-Akutey, 2025a; Chikwe, Kuteesa, & Ediae, 2024; Dhiman, 2023; S. G. Smith & Sinkford, 2022). However, despite these advances, the underrepresentation of women in STEM, particularly in engineering, remains a significant challenge both globally and within specific regions

(Bataineh, Qablan, Belbase, Takriti, & Tairab, 2022; Kayan-Fadlelmula, Sellami, Abdelkader, & Umer, 2022; Kim et al., 2024; Zhan, Shen, Xu, Niu, & You, 2022). The global landscape continues to reflect this disparity, with women often comprising only a small fraction of the engineering workforce.

Even in countries where strides have been made to close the gender gap, the presence of women in engineering roles is still disproportionately low, as many engineering firms report a minimal percentage of women in their technical teams (Hickey & Cui, 2024; Jung & Kim, 2020; Ly-Le, 2022; Murciano-Goroff, 2022; Nalle & Muljaningsih, 2024; Roy, 2022). Despite improvements in education and policy initiatives aimed at increasing female representation in STEM, the industry continues to grapple with the notion that engineering is a male-dominated field. Those who are able to stay within the engineering field are unable to attain leadership roles within the discipline. This calls for a probe into how the minimal percentage of women within technical teams cope within their chosen fields of engineering.

Historically, STEM fields have been dominated by men, with women often relegated to supportive or nontechnical roles. This gender disparity has been influenced by societal norms, educational biases, and limited access to opportunities for women (Bans-Akutey, 2025b; Kanny, Sax, & Riggers-Piehl, 2014; Simbolon, 2025). According to UNESCO (2017), women constitute only approximately 28% of the global engineering workforce, highlighting the deep-seated gender gap in the field. The global trend of underrepresentation is not uniform, with variations across regions and countries. In some developed countries, there have been significant improvements in female representation in STEM, driven by targeted policies and educational reforms (Febrianty, Sentanu, Martini, & Divianto, 2025).

In Scandinavian countries, where development is far advanced, the representation of women in engineering is higher compared to other regions with less development, due to working policies on progressive gender equality and societal support for women in engineering (Lo Andersson & Landström, 2023; Nordvall, 2023; Silander, Drange, Pietilä, & Reizel, 2022; N. Smith, Chowdhury, & Costello, 2023). However, in other parts of the world, especially in developing countries, female participation in engineering remains strikingly low. This reflects the broader socioeconomic and cultural challenges globally. In Ghana, traditional gender roles, limited access to quality education, and societal expectations significantly hinder women's entry into higher education institutions and account for their underrepresentation in higher positions.

In examining the underrepresentation of female engineers in the Ghanaian labor market, scholars have pointed to the influence of societal perceptions of the female reproductive role (Bans-Akutey, 2025b). These perceptions are reflected in state policies, particularly in the provision of maternity leave, which disproportionately assigns childcare responsibilities to women (Aziz, 2023; Feld et al., 2023; S. G. Smith & Sinkford, 2022). This policy gap not only reinforces traditional gender roles but also limits women's participation in male-dominated professions, further perpetuating gender disparities in Ghana's labor market. Consequently, for the few women who are able to start careers in engineering, most do not remain within the confines of the discipline throughout their entire work life (Adikaram & Razik, 2023; Epstein, 2022; Sharma, 2022).

A study by Fouad, Chang, Wan, and Singh (2017) revealed that women in engineering are less likely to be promoted compared to their male counterparts, despite having similar qualifications and experience. This bias is often rooted in stereotypes that question women's technical abilities and leadership potential, further entrenching the gender gap in the field of engineering. Moreover, the work culture in many engineering firms is often described as male-dominated and unwelcoming to women (Berglind & Tarkian, 2025; Chew, Atay, & Bayraktaroglu, 2020; Flykt, 2025; Hamrita, Hall, Fling, & Mendoza, 2023; Roksana, 2018). This culture is characterized by long hours, a lack of work-life balance, and limited support for women who may need to balance their professional responsibilities with family obligations. These factors contribute to the attrition of women from engineering careers, as many opt to leave the profession in search of more supportive and flexible work environments.

Studies have shown that girls are less likely to pursue STEM subjects in school, a trend that continues into higher education (De las Cuevas, García-Arenas, & Rico, 2022; Tandrayen-Ragoobur &

Gokulsing, 2022; Tereshchenko, Happonen, & Hasheela-Mufeti, 2023; Zvavahera, 2026). This is often due to societal perceptions that STEM subjects, particularly engineering, are more suited to males. Additionally, the lack of female role models and mentors in STEM fields discourages many young women from pursuing careers in engineering (Nweje, Amaka, & Makai, 2025; Warsito, Siregar, Gumilar, & Rosli, 2023). Even when women enter engineering programs, they often face a host of challenges that contribute to higher dropout rates than their male peers. These challenges include a lack of peer support, gender discrimination, and curricula that do not adequately address the needs and experiences of female students (Erdol & Gözütok, 2017). Therefore, it is implied that the "entry and remaining" of women in engineering-related domains is not as straightforward as it is for their male counterparts globally.

It is worth noting that despite the challenges and under-representativeness, some women have been able to thrive and remain within the discipline of engineering. For the few women represented in the discipline, it is not known from the literature how they have been able to cope despite the numerous challenges. This study aims to fill this theoretical gap. It is important to study GWIE's lived experiences to understand how the few women who remain in the engineering field cope with work and family. In Ghana, studying the lived experiences of such women is crucial for identifying the drivers of gender equality in the engineering field and fostering inclusive workplaces in disciplines that are considered male-dominated. This study explores how GWIE perceive the continual gender dynamics within their professional environments.

2. Literature Review and Hypothesis Development

This study is anchored in the Social Role Theory, originally articulated by Eagly (1997), which provides a useful framework for understanding the persistent barriers that women in engineering face. Social Role Theory posits that gendered expectations and stereotypes are socially constructed and maintained through cultural norms and institutional practices. In many societies, women are often ascribed roles that emphasize nurturing, cooperation, and support, whereas men are associated with roles such as assertiveness, leadership, and technical competence. These role expectations shape educational and career pathways by encouraging men to pursue science, technology, engineering, and mathematics (STEM) fields while implicitly discouraging women from pursuing them.

Applied to the Ghanaian engineering context, Social Role Theory helps explain why women engineers continue to encounter structural and cultural obstacles despite deliberate initiatives to increase women's participation in STEM. The theory suggests that women who enter engineering are navigating against entrenched gender norms that view engineering as a "male domain." This manifests in several ways, such as reduced mentorship opportunities, limited inclusion in male-dominated professional networks, implicit bias during recruitment and promotion, and societal pressures that prioritize women's domestic roles over professional advancement. Consequently, female engineers are perceived as deviating from expected social roles, leading to both subtle and overt forms of discrimination.

The use of Social Role Theory in this study situates the lived experiences of Ghanaian women engineers within a broader framework of gendered expectations and systemic inequality. This demonstrates how cultural scripts and institutional practices interact to create barriers that go beyond individual ambition or capability. This theoretical perspective enriches the exploration of women's realities in engineering by linking personal experiences to the wider social and cultural environment in which they are embedded. A study by Omari et al. (2024), conducted at a major Ghanaian university, highlights how negative social networks and stereotypes act as barriers to women's participation and retention in engineering education. Using focus group discussions with undergraduate engineering students, the research found that misleading information from family, peers, and community networks, such as the notion that engineering will negatively affect women's physical appearance or is inappropriate for women, undermines women's motivation and sense of belonging in engineering programmes.

These barriers are rooted in sociocultural expectations and gender schema influences, reinforcing engineering as a male-dominated field for women. Empirical work in the wider sub-Saharan African context by Maccaro, Oronti, Zito, Piaggio, and Pecchia (2024) similarly highlights the cultural,

structural, and institutional barriers affecting women's full participation in engineering and related fields. It focused on women in biomedical, science, and technology fields in sub-Saharan Africa and found that cultural attitudes and social norms significantly shape women's opportunities in these fields. This is particularly true in specialized areas such as biomedical engineering and medical device maintenance, which influence educational choices and career sustainability. While these studies provide valuable insights, they often focus on specific institutional settings without studying how various aspects of the lives of women in engineering work together to shape their career paths.

3. Methodology

This study was conducted from a phenomenological perspective. Phenomenology prioritizes subjective experiences and the meanings that individuals attach to their interactions with the world (Freeman & Muhammad, 2023). Phenomenology was therefore best suited for this study because it allowed for a deeper understanding of the essence of individual experiences, providing a rich, detailed account of the professional lives of GWIE and the personal meanings they attach to their roles in the engineering field. The study was also guided by social constructivism, which explores how individuals and groups construct their perceptions of reality through interactions and social contexts. According to social constructivism, our understanding of the world is shaped through social processes and interactions rather than existing as an objective reality (Ahmad & Wilkins, 2025). Therefore, this study employed a qualitative research approach, which allowed for an in-depth exploration of the multifaceted experiences of GWIE.

The study population comprised Ghanaian women engineers currently pursuing engineering careers in the field. The population was not limited to any specific engineering disciplines. Consequently, the inclusion criteria required that participants be employed as engineers in an engineering firm. The maximum variation sampling technique was employed to select 20 participants for the study. Maximum variation is rooted in the principles of purposive sampling, where participants are intentionally selected based on their relevance to the research question (Ahmad & Wilkins, 2025). Diverse participants were selected to ensure that the research captured the widest possible range of experiences. The goal was not to generalize the findings to the entire population but to understand the breadth of the experiences of Ghanaian female engineers.

The criteria for maximum variation encompassed age, years of experience, educational background, engineering discipline, type of employment, geographical location within Ghana, and organizational hierarchy. This allowed for an in-depth exploration of individual experiences while ensuring diverse representation across various criteria of maximum variation sampling. The sample size of 20 was guided by the principle of saturation, which refers to the point at which no new insights emerge from the data being collected (Ahmad & Wilkins, 2025). This ensured that the gathered data were comprehensive and captured the full spectrum of the experiences of Ghanaian women in engineering. Data were collected through non-participant observation and online semi-structured interviews. The Zoom conferencing app was used for the interviews owing to the diverse geographical locations of the participants and time constraints.

The study participants provided informed consent prior to data collection and were assured of confidentiality and anonymity. The interviews were recorded to ensure that all details were accurately transcribed. The recordings were securely stored on Google Drive and were only accessible to the researcher. The link to the stored recorded interview was shared with the concerned participants as requested. Participation in the study was entirely voluntary, and participants had the right to decline to answer any question(s) or to end the interview at any time without any consequences. For the non-participant observation, the observer blended into the environment without actively participating in the activities. Observation was conducted for 2 hours per day for one week, scheduled at different times of the day to capture a variety of activities and interactions.

Nvivo was used to develop first- and second-cycle codes from transcribed interviews and field notes, from which themes and categories emerged. Inductive thematic analysis was employed for data analysis, and the themes were strongly linked to the data. With inductive thematic analysis, themes

emerge naturally from the data without being fit into a pre-existing coding frame or the researcher's theoretical preconceptions. The emerging themes and subthemes are presented graphically in Figure 1 and color-coded. The main themes are coded in black background and white font, while the sub-themes are coded in blue background and white font.

4. Results and Discussions

The results of this study revealed multidimensional perspectives on the experiences of women in engineering. The study exposed key themes that focused on the career development of Ghanaian women in engineering, how they navigate education and training, issues related to their work environment, their sources of motivation, the influence of family on what they do, and other gender-related issues. Figure 1 illustrates the various key themes that emerged from the study and their respective subthemes following   the   analysis.
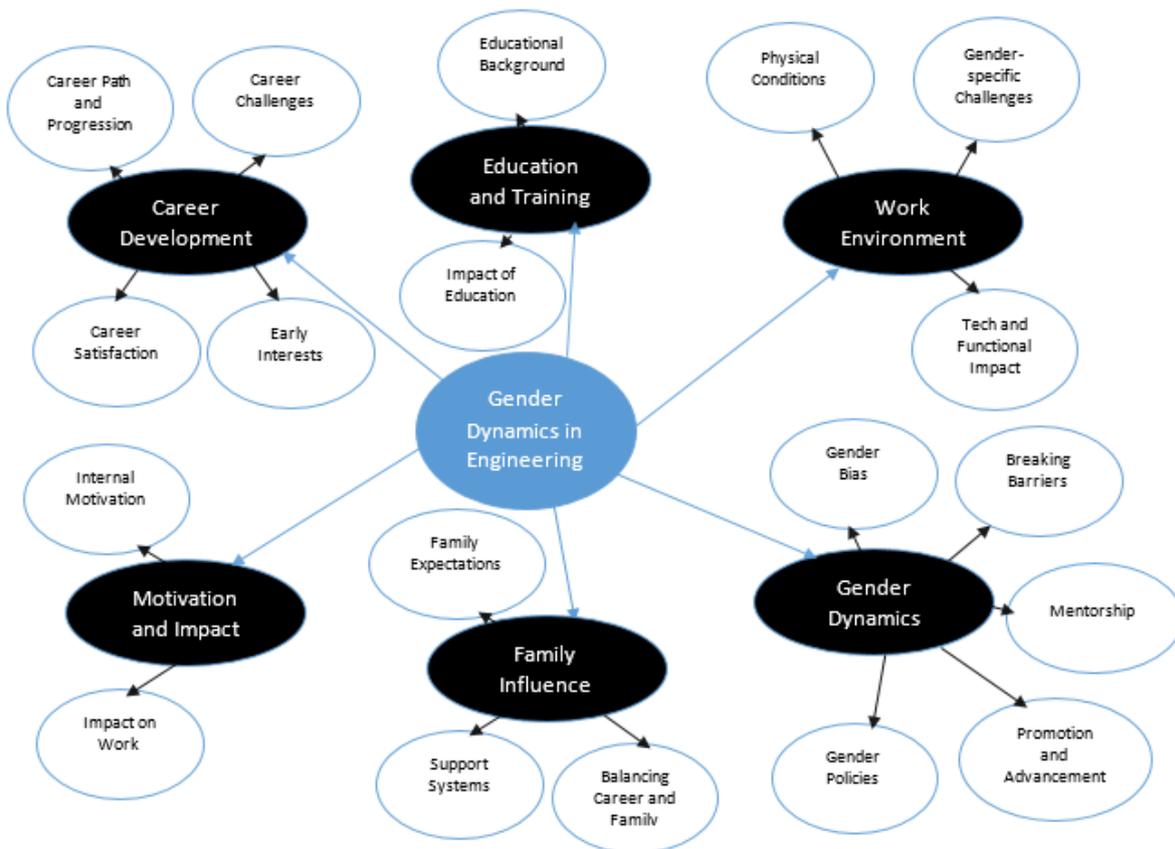

Figure 1. Presentation of key themes and sub-themes

4.1 Career Development of GWIE

The career development of the participants was marked by both noteworthy progress and challenges. While participants demonstrated significant strides in various chosen engineering fields, their career paths mostly began with unexpected shifts and diverse aspirations as they took to the engineering journey.

4.1.1 Career Path and Progression

The participants' journeys mostly began with unexpected or unplanned shifts in their career paths. These shifts often occur when colleagues or supervisors identify certain qualities or competencies, leading to the offer of roles that are mostly different from their original career intentions. GWIE find themselves moving into administrative roles or other non-technical specialized areas within the engineering sector. This shift, mostly unanticipated, tends to present several opportunities for career advancement, although not technical. Women in these positions often set new goals for their future, leveraging their administrative or newly assigned roles to advance their careers. The ability to adapt to these unplanned

shifts and leverage identified qualities into career advancement opportunities ensures that they stay within the engineering discipline even if they do not perform technical functions. For instance, one participant explained:

> *"I spent a little over a year with the ECG and moved to the VRA. So with VRA, I was a maintenance engineer with VRA. Therefore, I performed maintenance for close to eight years before moving into planning. Moving to planning, not like I requested to, but I was asked to go to planning.... In the last two years, I was again transferred to HR. I did not ask to be taken to the HR department. I was asked to go to HR Talent Management and Training, so I became the manager responsible for learning, development, and talent management. Surprisingly, I love what I do here. I think that when it comes to people development, I love it. Perhaps, owing to my training, I am versatile. I do not complain much. Therefore, when I was asked to leave, I did not ask any questions. Nobody engaged me as to whether I would go or what I was going to do. I was just asked to go. I believe my superiors saw some qualities in me that they think would be best utilized at the HR department, I don't know."* (P12, Electrical Engineer)

4.1.2 Career Challenges

The study found that participants often face significant challenges that impede their career development. Notably, there is a lack of consultation and support for their career progression. Participants reported feeling confused about their career paths, particularly in the early stages of their professional lives. This confusion is worsened by the lack of a clear career plan, which leaves students uncertain about the steps needed to achieve their professional goals. Additionally, adapting to technical demands and the workplace environment is daunting. These challenges are often compounded by the broader reproductive societal expectations placed on women, which add pressure and limit their ability to focus on their careers. The absence of adequate mentorship and guidance leaves most participants feeling isolated and unsure about effectively navigating their career trajectories.

4.1.3 Career Satisfaction

Despite these challenges, the participants reported a high level of career satisfaction. This satisfaction is often linked to a sense of achievement and recognition in the field. Awards and other forms of recognition play a significant role in boosting morale and validating contributions to the engineering sector. Such recognition enhances job satisfaction and reinforces commitment to work. For many, the ability to overcome challenges and achieve recognition serves as a powerful motivator that drives them to continue striving for success in their chosen fields. The sense of fulfilment that comes from knowing that their work is valued and impactful contributes to their overall career satisfaction, even in the face of ongoing challenges.

4.1.4 Early Interests and Ambitions

The early interests and ambitions of these women played a critical role in shaping their career paths. These early ambitions often lay the foundation for future career paths and play a crucial role in their overall professional journeys. For instance, one participant stated:

> *"I happened to share an office with I mean P&C guys, so P&C is Protection and Control and I got interested in that aspect of our work so I was more like working with them than the communications which I was employed for"* (P8, Telecommunications Engineer).

4.2 Education and Training

This study found that education and training played a critical role in shaping the participants' careers. Their educational journeys are mostly influenced by a range of factors, from the courses they choose to study to the guidance they receive along the way. This theme explored the participants' educational backgrounds and the impact of their education on their careers.

4.2.1 Educational Background

This study showed that the participants' educational background was often characterized by versatile training. They receive a broad-based education that allows them to explore various fields before settling

on engineering as a career. Most participants entered the engineering domain because of their exceptional performance in school. In most cases, this occurred without any input from their parents to pursue engineering. For other participants, owing to their intelligence in the science disciplines, their parents expect and encourage them to pursue medicine. For the final group, the journey into engineering began with the choice of elective courses to study or even the dislike for a teacher based on a comment made by the teacher. The long-term effect of this dislike for a teacher was the pursuit of a career in engineering that was not initially planned.

> "*My father was thinking about medicine. I attended Holy Child* [a Senior High School in the Central Region of Ghana]. *When I got to Holy Child, my dad thought I was doing Biology, but I did not fit in the biology class. In my first biology class, the teacher yelled at me, and I menstruated immediately. It was not yet my time, but that's how you know that 'yell' really showed the biology in me. That was when I decided that I would choose elective mathematics. My dad actually thought I was doing Biology until it was time for me to write my SSCE*" (P7, Electrical Engineer).

4.2.2 Impact of Education on Career

The impact of education on the participants' careers was profound but not always positive. Many participants entered the field without a clear understanding of the various engineering disciplines, leading to unfamiliarity and uncertainty. This lack of knowledge in the various engineering disciplines limits their final choices and decisions in the field. Moreover, the negative impact of teachers who do not fully support or encourage young women's interest in engineering leads to a lack of confidence and a sense of isolation when they finally enter the engineering workforce. Despite these challenges, the evolution of career guidance has begun to make a positive difference. Schools are increasingly recognizing the importance of providing students with comprehensive information about engineering careers and other STEM fields. This evolution in career guidance is helping bridge the knowledge gap and better prepare young women for the demands of an engineering career. One participant explained:

> "*….my grades were good. I mean, I had really good grades. Therefore, I applied for engineering, and at the time, I only knew of electrical, civil, and mechanical engineering. And this is not to belittle any other discipline but if your grades are really good your first choice will be electrical and then you go to civil then you consider mechanical and the others until I got to KNUST and realized that oh there were geological, then I didn't understand what they were doing, metallurgical engineering, you know all those ones. There was agricultural engineering, I didn't know yeah, I didn't know until I got to campus and I realized that oh there are others, but of course I loved me, I don't know whether I loved my electrical or I didn't love my electrical. I mean, we seem to love it, but as to why, it's not like I had a plan of what I was going to do. However, things have changed. When you are in school, you receive career guidance. Therefore, you sort of think about what you really want to do. And, you know, but our time, we just wanted to finish school and get yourself a job*" (P6, Electrical Engineer)

4.3 Work Environment

The current study showed that the work environment for almost all participants presented a complex blend of physical, gender-specific, and technological perspectives. While the engineering field has made significant strides in technological advancement and role integration, the work environment still reflects deeply ingrained gender biases and infrastructural inadequacies in the workplace.

4.3.1 Physical Work Conditions

The study found that physical work conditions for most participants often posed significant challenges, particularly in terms of location, commuting, and the availability of appropriate personal protective equipment (PPE). Some participants explained that the location of their work sites impacted their daily routines, with long commutes adding to the stress of an already demanding job: The availability and comfort of personal protective equipment (PPE) is another critical issue. PPEs is typically designed for men, making PPEs uncomfortable for women, who often have to choose between protection and comfort. However, this discomfort hinders performance and poses safety risks. In addition, the lack of

designated changing rooms and shared washroom facilities is another concern. In many workplaces, women have to share washrooms with men or use facilities not designed for their needs, leading to unhygienic conditions that affect their health and well-being. These inadequacies prove a significant gap in workplace infrastructure that fails to accommodate the needs of female engineers, forcing them to adapt to environments that were not originally designed with them in mind. A participant explained:

> "*So, PPEs are never meant to be comfortable. They are intended to protect you. Okay. As you begin, I mean, you just have to know that PPEs are not comfortable; they are there for your protection. Now you have women's boots and overalls, which are stylish and look good. But at the time, it was the men's one that we used to wear. It was not comfortable for me. I remember my male colleagues complaining that it was not comfortable for them. But any time you complain, our supervisor will tell us, PPEs are not for our comfort. Okay. It is not your bathroom slippers or church shoes. It is what it is. It is a personal protective equipment. And so, yeah, I mean, once you know that it's for your protection, you do not really look at whether it's comfortable, it's not comfortable, it's stylish, it's not stylish. You must use it. In terms of washrooms and changing rooms, I was fortunate to have an office where I could change. We did not have a designated changing room for women or men. However, men could easily change at the workshop. But the women couldn't, unless maybe you have an office where you are there alone or where you can lock and change*" (P9, Telecommunications Engineer)

4.3.2 Gender-Specific Challenges

In addition to general physical challenges, participants faced gender-specific obstacles stemming from the historical design of engineering workplaces. Many plants and work environments were initially built with only men in mind, meaning that essential facilities for women, such as washrooms and changing rooms, were not included in the design. As a result, for privacy, women often have to ask men to leave shared spaces, creating awkward and uncomfortable situations. These gender-specific challenges are not just physical but also cultural, as most participants often found themselves adapting to conditions that did not consider their needs. The need to constantly negotiate their space in a male-dominated environment can be draining and often reinforces feelings of isolation and exclusion among women. These reflect broader gender biases in the workplace and expose the ongoing struggle for gender equality in the engineering field.

> "*But do not forget that most of our plants were built way back, and it was all men. Therefore, the plants were built for men. Before, they did not see women, so there was no need to have separate women's and men's washrooms. There was one washroom. When I was there, there was one washroom that we all used, which we complained about. The visitors' restroom has men and women because that one is for visitors. However, the number of workers was one. Sometimes you go, and they may have peed on it, but I mean, it is what it is. They are not coming to build another washroom now. The plant was designed, but the newer plants that were built had accommodations for men and women because women have started coming in. Therefore, we do not complain too much. We make do with what we have*" (P 15, Electrical Engineer)

4.3.3 Technological and Functional Impact

This study showed that the challenges posed by the physical and gender-specific aspects of the work environment, technological evolution, and functional roles in engineering have seen significant advancements. The integration of new technologies has transformed the engineering field, resulting in a reduction in the physical demands of the job. However, the impact of these technological advancements on women's experiences in engineering has been mixed. While technology has helped level the playing field in some respects, the functional and role similarity between men and women in engineering does not always translate into equal treatment. Women still find that their experiences are shaped by the same gender biases that affect other aspects of their work environment. For instance, even with technological advancements, women are assigned roles or tasks based on stereotypical gender expectations rather than on skills or interests. According to one participant:

"Now people do not use fixed lines anymore; everything is mobile, so the old system is no longer there. If the women had started working in those days and in today's time, I do not think it would have changed their role in any way because the system has changed, and it suits us more. The current system suits women's work because everything is somehow digitized. We work with the PC" (P17, Telecommunication Engineer)

4.4 Motivation and Impact
This study shows that the motivation and impact of participants reflect a deep-rooted commitment to both personal and societal goals. Despite the numerous challenges they face in a traditionally male-dominated field, these women are driven by an intrinsic passion for their work and a desire to make a meaningful impact on their communities and broader society.

4.4.1 Internal Motivation
The participants' internal motivation is primarily fuelled by their love for their work and passion for teaching and learning. Many participants were driven by an innate desire to persist in their chosen field, even when faced with significant obstacles. Their passion for teaching, in particular, plays a crucial role in their professional journeys. This passion often extends beyond formal education, as they find themselves mentoring younger colleagues, sharing knowledge, and contributing to the growth of the engineering community. Additionally, the participants demonstrated a determined balance in managing their careers alongside personal responsibilities. The ability to juggle work and family life while maintaining high levels of performance speaks to their resilience and commitment. This balance is not just about managing time but also about maintaining a sense of purpose and direction in both personal and professional lives. Their persistence is not merely about survival in a challenging field but also about thriving and making a lasting impact.

"I tried a number of times to get other organizations like a telecom field, but luck was not on my side. If not for childbirth and family, which is taking up much of my time now, I would have been very, very dissatisfied because I see myself as underutilized and am less motivated in the field. The challenges are fewer for me, and this is because of where I find myself. I know it's not like that everywhere." (P7, Telecommunication Engineer)

4.4.2 Impact on Work and Society
The impact of the participants is evident in both their immediate work environments and in broader society. These women derive immense satisfaction from the tangible impact their work has on their community. Whether through cost-saving innovations, efficiency improvements, or contributing to the sustainability of engineering projects, their work often goes beyond personal achievements to address broader societal needs. Positive feedback from colleagues, supervisors, and the community further fuels motivation and reinforces the importance of their contributions. These women are impact-driven, meaning that their efforts are consistently geared toward making a difference in their communities. This continual effort is reflected in their dedication to ensuring that their work not only meets professional standards but also serves the greater good.

Their impact is not only measured in technical achievements but also in the cultural shifts they help foster within the engineering field. In their own unique ways, they try to break gender barriers and challenge stereotypes, thus paving the way for future generations of women engineers and inspiring others to pursue STEM careers. This legacy of impact is perhaps one of the most significant contributions these women make, as they help reshape the narrative around women's roles in engineering and society at large.

4.5 Family Influence
The study showed that family influence plays a pivotal role in the career trajectories of the participants. From parental expectations to the challenges of balancing career and family responsibilities, the support, or lack thereof, from family can significantly impact a woman's ability to succeed in a traditionally male-dominated field. Subsequent sections examine how family dynamics, support systems, and the balance between professional and personal lives shape the experiences of women.

4.5.1 Parental and Family Expectations

This study found that parental and family expectations often set the stage for the career paths of most participants in this study. In almost all cases, parents held high expectations for their daughters, hoping they would excel in their chosen professions. However, these expectations are mostly based on misconceptions about the engineering field, leading to unrealistic pressure. For instance, some parents do not fully understand the demands and challenges associated with engineering careers.

They expect their daughters to perform well without fully appreciating the need for specialized skills, dedication, and sometimes, financial sacrifices. Financial constraints play a significant role in shaping the educational and career choices of women. In some families, the financial burden of pursuing higher education in engineering was a significant hurdle. Parental support, whether through financial means or encouragement, is crucial for overcoming these obstacles. However, when this support is lacking, participants struggle to meet both their families' expectations and the financial demands of their education and career progression. In such cases, government policies that cater to the financial needs of struggling students tend to be very beneficial.

4.5.2 Support Systems

The findings of this study show that the presence of support systems within the family greatly influenced the success of almost all participants. Family support often comes in various forms, including emotional backing, financial assistance, and stable home environments. Mutual understanding between couples is essential, as it allows for the creation of a home that encourages and sustains participants' career ambitions. When families understand the challenges and demands of a wife with an engineering career, they provide the necessary support, whether it means helping with household chores or offering moral support during difficult times. Participants who can rely on their families are often better equipped to handle work stress, knowing that they have a strong foundation to fall back on. This support was particularly crucial for participants who were the first in their families to pursue a career in engineering, as they faced additional pressure to succeed.

> "*Yes, yes, yes, yes, yes, he* [her husband] *understands. He is in Akosombo, so now what I do, Monday to Friday, I am in Accra. On weekends, I go to Akosombo, which is stressful because driving up and down is stressful. Once you get to Akosombo, even though I have a house help, you still have to be seen cooking. African women, our husbands expect us to cook. So, you still have to cook, you have to supervise cleaning of the home if you are not cleaning yourself but for me my bedroom is a no-go area for my house help so I have to do my own cleaning you know.*"
> (P17, Telecommunication Engineer)

4.5.3 Balancing Career and Family

This study showed that balancing career and family responsibilities is one of the most significant challenges faced by participants. The demands of the engineering profession often clash with the traditional roles expected of women in the family, such as caregiving and household management. Women in engineering must navigate these dual roles, often with little room for error, particularly young mothers. The advantage of having older children who can take on more responsibilities at home can ease this burden for mature mothers, but the challenge remains significant.

The perception and support of a husband makes a significant difference in how most participants manage their careers along with their family obligations. A husband's active involvement in family responsibilities alleviates some of the pressures, so women can focus more on their professional growth. Family responsibilities, however, are not solely about balancing tasks but also about the emotional labor involved in maintaining family relationships while advancing in a demanding career. For almost all the participants, the ability to juggle these responsibilities was a testament to their resilience and determination to succeed.

> "*If you have a supportive husband, it also helps. A husband who will step in, you know, when you can't be there and your husband is there taking care of the kids, taking care of the home, it helps.*"
> (P12, Electrical Engineer)

4.6 Gender Dynamics in the Workplace

The theme of gender dynamics encompassed gender bias and discrimination, efforts to break gender barriers, mentorship opportunities, challenges in promotion and career advancement, and the implementation of workplace gender policies. Each factor played a critical role in shaping the participants' professional lives.

4.6.1 Gender Bias and Discrimination

Almost all participants faced various forms of gender bias and discrimination, which manifested subtly as unconscious bias or more overtly as perceived discrimination and gender exclusion. Unconscious bias occurs when individuals, often without realizing it, hold prejudiced views that affect their behaviour and decisions. In the workplace, participants were overlooked for challenging projects or technical leadership roles due to preconceived notions about their capabilities. Perceived discrimination is an explicit recognition by participants that they are being treated unfairly because of their gender, leading to feelings of exclusion and frustration. Moreover, pregnancy-based reassignment and gendered task allocation are common issues, where women are either reassigned to less demanding roles or given tasks deemed "suitable" for their gender or pregnancy status. These reassignments limit opportunities for professional growth and advancement.

> *"Sometimes you have to handle contract documents, and I learnt a lot of things, project management, contract administration, budgeting, you know. I learned all those things when I was a planning engineer, but I did not understand why it had to be a woman. I guess unconsciously, because I was a woman, that is why they asked me to go to the office. And you cannot take this from the men, I mean if they have to decide on something soft, they would rather push a woman there instead of asking a man to go. They do not even ask you or talk to you about whether you want to go or not. The just have to let you go."* (P8, Electrical Engineer)

> *"There was a project that I was handling. I handled the pre-engineering work. Pre-engineering has to do with the procurement aspect, procuring a consultant, procuring a contractor, securing funding, writing all those plenty, plenty writings, and somehow, the women are able to write better. So those pre-contract engineering works, I handled that and I was thinking I would be the project engineer when the project starts for the implementation of the project. However, I was not given that job, and the excuse was that I am a woman. They did not tell me directly, but I heard from the grapevine that my superiors were conversing somewhere and said I was a woman and would get pregnant, so they would not allow me on the project. I felt this was, but of course, this is somebody telling me, so it was not like it was an official thing or the person told me in person. So, it tells you that there are some decisions that will be made unconsciously, because you are a woman, it goes against you. For instance, when I go to HR, I sometimes ask myself. Fine, even if there is a problem to be solved, why did not they ask any of the male engineers on the field to go to HR? Why does it have to be me? Do you understand? Perhaps they have seen that I am flexible, and because I like learning, I do not have to be an expert in anything. Just give me the job, and I will do my research and get it done. Perhaps that was the quality they saw in me, but I sometimes question why it had to be me. It could have been anyone. Sometimes I question why let's say if there is a position for a plant manager, why won't they consider me to be the plant manager."* (P14, Electrical Engineer)

4.6.2 Breaking Gender Barriers

The study found that participants are actively working to break through gender barriers in the workplace, although achieving this is still in progress. Most participants had to tolerate inappropriate comments or "*dirty talks*," which contributed to an intimidating work environment. They had to endure these experiences, which contributed to feelings of isolation and resentment, as they felt alienated from their male colleagues. Almost all participants challenged these norms and created a more inclusive workplace. This requires not only personal resilience but also collective efforts to change the culture within engineering companies. A participant explained:

"I tell my ladies that, for instance, if you do not like dirty talk, you cannot work in the plant. People will make comments about your back, about your front, about your dress, so if you are uncomfortable, you have a challenge, but this thing starts from school. I don't know your experience but when we were in school if maybe you have to go and stand in front of a blackboard to draw something or to write something people and you are endowed at the back you know the "eeish" that will come, you know, people will be jeering and making noise. Therefore, it starts from there. You cannot say that because of that you will not go for lectures, no, or because of that you will not volunteer to answer a question. In the same vein, when you come to the field and are working with men, sometimes they make comments without realizing that this is the workplace, and these are comments that they used to make or make when they are with their own gang, but they fail to understand that a woman has come in and the conversations have to change. We have to know the boundaries, no more "dirty talks" and stuff like that, but the women too have to understand that it's not everything that you react to and it's not everything that you take to heart. Sometimes you just have to ignore some of the comments and just keep pushing." (P2, Electrical Engineer)

4.6.3 *Mentorship and Support Networks*
Most participants in this study explained how crucial mentorship and support networks were for their career development. While male mentorship is beneficial and available to participants, it sometimes comes with its own set of challenges, as women feel that their mentors do not fully understand their unique challenges. Nevertheless, goal-oriented mentoring, where mentors can relate to mentees on a common level and focus on helping women achieve specific career objectives, has proven to be incredibly effective. P2 puts it this way:

> *"I saw Eva Lokko on TV. I saw Professor Awurama Addy on TV. They were somehow mentors because I wanted to be like them and I knew they were science people, okay, so if I'm choosing a career then I should be science-biased before I'd be like them."*

Informal mentoring and networking play important roles, as they provide women with opportunities to learn from other experts and build relationships that can support their career advancement. The importance of networks cannot be overstated, as these connections often provide the resources and support necessary for success in a male-dominated industry.

4.6.4 *Promotion and Career Advancement*
The results showed that promotion and career advancement remain areas where gender dynamics are particularly pronounced. Almost all participants are often overlooked for promotion, with political influence and favouritism towards men playing significant roles in such decisions. The phenomenon of "*men supporting men*" creates a cycle in which women are consistently passed over in favour of their male counterparts, regardless of their qualifications or performance. Additionally, the lack of female solidarity in some workplaces further worsens this issue, as women feel they are competing against each other rather than supporting each other. High standards for women, often higher than those for men, also contribute to the difficulty women face in advancing their careers, as they are expected to prove themselves to a greater extent than their male counterparts.

4.6.5 *Workplace Gender Policies*
Participants revealed that some workplaces have implemented gender policies aimed at promoting equality. A well-structured gender action plan creates a more inclusive environment by outlining specific roles for women and ensuring that they have the support they need to succeed. These policies also promote workplace equality by setting clear expectations for behaviour and holding individuals accountable for their discriminatory actions. Equality in the workplace must go beyond creating policies; it requires a commitment to fostering a culture where women are valued and given equal access and opportunities.

4.7 Implications

The findings from this study, through Social Role Theory, not only explain the persistence of barriers for Ghanaian women in engineering but also point to the kinds of interventions that could dismantle them. Since these barriers are rooted in gendered social expectations, effective policies must go beyond numerical increases in women's enrolment in STEM programs and instead challenge the social roles that sustain inequity. At the educational level, universities and technical institutes must integrate gender-sensitive curricula and mentorship schemes that normalize women's presence in engineering. Early exposure programs, including career guidance in secondary schools, can shift perceptions by presenting female engineers as role models. Furthermore, institutional policies should mandate bias awareness training for faculty to counteract subtle stereotypes that influence teaching, assessment, and academic opportunities.

In engineering firms, workplace policies must explicitly target the dismantling of gendered expectations. This could include structured mentorship and sponsorship programs to connect female engineers with senior professionals, transparent promotion and recruitment processes to mitigate implicit bias, and flexible work arrangements to address the disproportionate burden of family responsibilities. When firms institutionalize diversity and inclusion metrics, they are better equipped to sustain environments in which female engineers thrive rather than merely survive.

At the level of national STEM policies, gender equity must be approached as a structural transformation. Government-led initiatives could include funding for women-focused engineering scholarships, incentives for companies that demonstrate measurable progress in gender diversity, and public awareness campaigns aimed at shifting social perceptions of engineering as a "male-only" profession. Additionally, policies that address the "double shift" of professional and domestic responsibilities, such as affordable childcare support, can help reduce the conflict between the cultural expectation of women as caregivers and their professional aspirations. Taken together, these interventions align with the insights of Social Role Theory by directly confronting the cultural and institutional remedies that limit women's participation in engineering. Without such systemic changes, efforts to increase numbers alone will continue to leave Ghanaian women engineers navigating the same entrenched barriers identified in this study.

5. Conclusions

5.1 Conclusion

This study offers an in-depth understanding of the gender dynamics that shape the experiences of Ghanaian women in engineering (GWIE). Despite global and national efforts to promote gender diversity in STEM, the findings indicate that GWIE continue to contend with entrenched structural and cultural barriers, including unconscious bias, gender discrimination, gendered task allocation, and limited access to leadership and career advancement opportunities. The underrepresentation of women in decision-making and technical leadership roles underscores the persistence of systemic inequality within engineering workplaces. Nevertheless, the study highlights the resilience and determination of GWIE, who draw on mentorship, support networks, and a strong commitment to challenging gender norms to navigate and remain in a traditionally male-dominated profession. These findings affirm that while individual agency is critical, institutional transformation is central to achieving sustainable gender equity in engineering.

5.2 Research Limitations

The study is limited by its qualitative design and the scope of the sample, which may not fully capture the diversity of the experiences of all women engineers in Ghana. As the findings were based on participants' self-reported experiences, they may have been influenced by personal perceptions and contextual factors. Consequently, the results should be interpreted as context-specific rather than broadly generalizable across all engineering contexts.

5.3 Suggestions and Direction for Future Studies

Based on these findings, it is recommended that engineering organizations go beyond the formal adoption of gender policies to ensure their effective implementation and rigorous enforcement. Clear

and transparent mechanisms should be established to address unconscious bias, discriminatory practices, gendered task allocation, and inequities in promotion processes in academia. Targeted interventions aimed at increasing the representation of women in technical and leadership roles are essential. In addition, continuous workplace sensitization through training and awareness programs on gender bias and discrimination should be institutionalized for both men and women. Such measures are critical for fostering inclusive engineering environments that value diversity and support the long-term professional advancement of women in engineering.

Author Contribution
ABA contributed to all this manuscript.

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