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GENDERED EXPERIENCES OF GHANAIAN FEMALE ACADEMICS AND SCIENTISTS

Fred K. Boateng
University of Ghana, Legon,
Ghan.

Abstract

Although women's roles in development are vital, they are generally marginalized in all spheres of society's development including Science, Technology, Engineering, and Mathematics (STEM). This article explored the experiences of women in STEM domains in Ghana's tertiary education and research institutions. Thirty participants (students, faculty, and research scientists) were selected through purposive/criterion sampling. Their experiences were elicited using semi-structured interviews. The interview data were thematically analysed using initial coding, axial, and selective coding under grounded theory. The findings confirmed that the Ghanaian society is still deeply patriarchal. On the STEM trajectories of the participants, gender discrimination was manifested in comments, structures, and practices. In the face of the gender discrimination experienced, the support system of the female faculty interviewed, enabled them to succeed in their professional and educational endeavours.

Key Words: Women, gender, discrimination, science, Ghana.

Introduction

Women universally grapple with inequalities in society as they struggle to assert their identity in a male dominated society (Galor & Weil, 1996; UNDP, 2007; Wollstonecraft, 1975). Inequalities in societies do not emanate from the "fact that different people do different things but from the fact that different tasks are valued differently and carry with them different amounts of prestige and power" (Hubbard, 1989:120). These normative injustices make women susceptible to higher risks and discriminatory practices (Mensah-Kutin, 2010). They are largely kept from participation in education, politics and decision-making at various levels and other

critical activities that are considered to be the sole preserve of men (Bem, 1993; Hill & King, 1993; Morimoto, Zajicek, Hunt, & Lisnic, 2013; UNDP, 2007). These realities contradict the fact that their roles are very essential (Adeyemo, 1990; Gutek & Larwood, 1987; Hall, 1987; UNDP, 2007; USAID, 1982).

Gender relations in Ghana are moulded by deep, complex, and complicated patriarchy (Baden, Green, Otoo-Oyortey, & Peasgood, 1994; UNDP, 2007). This is against the background of extant legal frameworks and constitutional safeguards to end various gender discrimination practices in Ghana. The Ghanaian Constitution, among other mandates, enshrines equality in the protection and promotion of all basic human rights and freedom, premises the implementation of policies and programmes aimed at redressing social, economic and educational imbalances through legislative enactments. The Constitution also prohibits the holding of persons in slavery or servitude. Some legislative or legal instruments dealing with gender bias are the Criminal Code Amendment Law (1998), the Human Trafficking Act (2005), the National Land Policy (1999), National Gender and Children's Policy (2004), and the Education Strategic Reduction Plan (2003-2015). Despite these laws, many gender inequalities are still prevalent in Ghana (UNDP, 2007).

Several studies point to the persistence of gender inequalities and inequities in Ghana and its prevalence in the tertiary education sector (Addae-Mensah, 2000; Ardayfio-Shandorf, 1995; Atuahene & Owusu-Ansah, 2013; Bunyi, 2003; Girdwood, 1998; Manuh, Budu, & Gariba, 2007; Prah, 2004). Some of the factors prompting the high rate of gender disparities in Ghana's education system are socio-cultural considerations, gendered social practices within households, financial difficulties associated with women, education, lack of role models for girls in schools, hostile school environments such as sexual harassments from male students and inadequate institutional facilities (Atuahene & Owusu-Ansah, 2013; Daddieh, 2003; Morley, Leach, & Lugg, 2009; UNDP, 2007).

Science and technology (S&T) are considered to be the panacea to underdevelopment (UNESCO, 2007) and are recognized by all governments, including those in Africa as the drivers of development (Juma, 2005; Mensah-Kutin, 2010). S&T can help in poverty reduction by promoting economic development which in turn reduces the gender gap. The human resources of women are however

seldom tapped to enhance socio-economic and technological development (UNESCO, 2007). The marginalization of women encompasses the Science, Technology, Engineering, and Mathematics (STEM) fields. Women in prospective and existing STEM academic/research careers have faced a myriad of barriers and hindrances in their careers (Ginther & Kahn, 2006; National Academy of Sciences, 2007) including higher education careers. Every level of the academic pipeline-graduate education, hiring, tenure/promotion, and leadership is characterized by systematic, historical and widespread inequities (National Academies Report, 2006). Women in STEM grapple with persistent discrimination in the academic workplace. Institutions also fall short in the hiring, retention, and promotion of women faculty (Morimoto et al., 2013).

Universally, there are clear disparities across all levels of education with fewer enrolments of girls in S&T subjects (UNESCO, 2007). In Africa and Ghana specifically, enrolments in S&T are symptomatic of gender imbalances (Bunyi, 2003). The enrolment ratio of S&T to Humanities in public universities in the 2006/2007 academic year was 38 percent for STEM and 62 percent for Humanities (Somuah, 2008). The statistical information of female academic staff of Ghana's premier university, the University of Ghana, in 2008 illuminates these gender disparities among faculty members (Tettey, 2010). The composition of female academic staff as compared to male academic staff was 24 percent and 76 percent respectively. The proportions of female academic staff at various ranks of Lecturer, Senior Lecturer, and Professor were 25 percent, 24 percent, and 17 percent respectively. The trends in female academic staff qualifications in the same year were for Masters and Doctorates, 29 percent and 20 percent respectively.

A number of studies have focused on gender discrimination in Ghana's education system, including its higher education system (Ardayfio-Schandorf, 1995; Atuahene & Owusu-Ansah, 2013; Britwum, Prah, & Oduro, 2014; Daddieh, 2003; Manuh et al., 2007; Shabaya & Konadu-Agyeman, 2010; Tsikata, 2001). Nevertheless, issues about gender in Science, Technology, Engineering, and Mathematics (STEM) in Ghanaian tertiary education institutions are scantily discussed. As a consequence, the objective of this study was to inquire in-depth and detail into the experiences of female graduate students, faculty, and scientists in Ghanaian academic and

professional STEM institutions based on their experiences. It was also crucial to augment the innovative capacities of women in STEM careers through gender research to inform gender-friendly S&T policies. The research questions that guided the study were:

1. What gender discrimination do women in STEM fields in Ghana experience in their educational and professional lives?
2. How do women in STEM experience gender biases or discrimination relating to their STEM experiences?
3. How do women in STEM succeed in their STEM educational and professional endeavors in spite of the gender discrimination they face?

From August to October, 2014, the experiences of thirty STEM female scientists and academics in three universities and a research institution were elicited through semi-structured interviews. The interviews were done using an interview protocol as a guide. The findings of the study emerged from thematically analyzed data.

Universities as Catalysts of Gender Inequalities

Universities have the responsibility to provide leadership in gender equity (Manuh et al., 2007). Unfortunately, they are also replete with gender contradictions, because their power and bureaucratic set up stifle efforts at attaining gender equity (Acker, 2000; Morimoto et al., 2013) Bird (2011) confirmed that universities are bureaucratic agencies that enhance gender inequalities. They have distinctive gendered bureaucracies characterized with "formalized institutional-level policies and procedures" and are simultaneously "decentralized and staffed by relatively independent faculty members" (Bird, 2011, p. 205, cited in Morimoto et al., 2013). As performance standards and evaluative criteria are department-based and department-determined respectively, the tendency for individual faculty members to be following university and departmental formal guidelines as against informal norms is ambiguous (Bird, 2011, cited in Morimoto et al., 2013).

Gender disparity arises as women in academia do not have mentors and networks to assist them navigate through the inconsistencies and ambiguities (aforementioned). As such, men subjectively formulate and utilize standards and expectations based on their own experiences without any regard to the barriers and challenges women in academia face (Etzkowitz, Kemelgor, & Uzzi,

2000; Morimoto et al., 2013). It appeared that research into gender issues has not addressed the manner in which the ambiguities and inconsistencies that contribute to gender disparities in educational institutions affect women in academia in general and those in academic STEM fields in particular.

Acker (1990) proffers the abolition of the bureaucratic set-up but Britton (2000) advocates more clarity and formalization of bureaucratic structures as well as addressing structures and processes of power and increasing the recruitment of female STEM workers (Britton, 2000, Morimoto, et al., 2013). Such clarity should incorporate work and family role conflict and as such the assessment of the productivity of female scientists should be different from that of the males (Ward & Wolf-Wendel, 2004). An area of inquiry in the study was the power structures of departments, universities, and workplaces as a whole and, the manner STEM females navigate through such structures.

The STEM Classroom Environment

The classroom environment plays a role in college students' persistence and success (Kinzie, Gonyea, Shoup, & Kuh, 2008). It is therefore not surprising that the ambience in the STEM classroom leads to STEM girls dropping out (Seymour & Hewitt, 1997). According to a survey findings of Murray, Meinholdt and Bergmann (1999), three factors account for the perceived hostility towards women on science and engineering programmes dominated campuses in the United States, a nation known for its excellence in science and technological fields. These are course and curriculum structure, faculty beliefs and behaviour toward women, male students' beliefs and behaviour towards their female counterparts, to some extent, and female faculty and students' experiences with their male students.

As a product of the curriculum, the "weed-out" pedagogy that many STEM faculty members adopt sends signals to many female students who do not identify with the pedagogy that they are not part of the domain. Faculty members in general cover as much material as possible, assign excessive homework, give difficult examinations, and adopt severe grading policies (Murray et al., 1999).

A lot of female STEM students' complaints about disorganization of faculty are associated with drop-outs in STEM programmes (Etzkowitz, Kemelgor, Neuschatz, Uzzi, & Alonzo,

1994). Murray et al., (1999) found that interests of many female students in STEM are largely ignored by male faculty even though many of these faculty members are compelled to seek help from their male counterparts. This is because many male faculty members do not know how to relate academically to the few female students as they fear their outreach may be misinterpreted as sexual harassment.

Many female faculty members operate in chilly STEM classroom environments with lack of support from their male students (Allen & Niss, 1990; Etzkowitz et al., 1994; Murray et al., 1999). When some women excel in Science and Mathematics classes, some of their resentful male colleagues take credit for their success and often accuse them of flirting with their teaching assistants or professors (Murray et al., 1999). These accusations are not corroborated denoting, the patriarchal belief that women cannot be successful in male dominated endeavors. Many male students make suggestive sexual remarks about their female teachers and mates, call them, sarcastic names, and often socially ignore them, citing them as unattractive (Murray et al., 1999). Therefore, an inquiry into the experiences of STEM women relative to their classroom settings in Ghanaian universities was a focus of this study.

Research Design

This study sought to inquire into the gender experiences of women in STEM fields in Ghanaian tertiary educational institutions in a quest to create a theory concerning their gender experiences of STEM women in Ghana. The framework of any methodological section is composed of ontology, epistemology, methodology, and method (Crotty, 2008). Ontologically, the study was based on constructionism which denotes that participants internally construct their perceptions of the world (Patton, 2002; Creswell, 2008). The study's epistemological lens was interpretivism, holding the belief that meanings in human behaviour can be understood and known subjectively because there are multiple realities (Crotty, 2008). The findings of the study emerged from themes generated from participant data through coding.

Participants, research sites and sampling methods

Thirty participants were interviewed between August and September of 2014 in Ghana. The research sites were the University of Education, Winneba (UEW), the University of Cape Coast (UCC), the

Kwame Nkrumah University of Science and Technology (KNUST), and the Center for Scientific and Industrial Research (CSIR). Based on institutional differentiation, the first two sites are predominantly non-STEM institutions, KNUST is a STEM institution, and CSIR is Ghana's science and technological research body. Geographically, the sites were fairly spread across the country.

Two sampling methods were utilized. The foremost, purposive/criterion sampling, which focuses on the selection of participants based on certain characteristics (Patton, 1990), which in the context of the study were discipline, gender, and position or status of participants, was adopted. Formal letters addressed to the Deans of various STEM departments asking them to allow me interview their female academics and scientists were sent. I also utilized snowball sampling in the study. This is the kind of sampling used when the participant pool developed is based on the suggestions of major participant figures who would provide valuable perspectives (Flick, 2009). This method was necessitated by a faculty strike in Ghana which transpired for half of the data collection period. Participants interviewed on the first day of each research site led me to their influential colleagues. I was able to get close to two-thirds of the sample through the snowball sampling. There were 7 participants sampled out of a population of 13,3 out of 6, 9 out of 20, and 11 out of 22 participants recruited from UCC, UEW, CSIR, and KNUST respectively.

Table 1: Participants and their Disciplines

Participant	Discipline
KB	Materials Engineering
JB	Materials Engineering
ML	Mechanical Engineering
LA	Agronomy
PH	Soil Science
CR	Soil Science
DM	Agricultural Economics
PT	Forestry/Natural Resources
BR	Entomology/Wildlife
MB	Entomology/Wildlife
LS	Entomology/Wildlife
RM	Biology

RK	Biology
PB	Biotechnology
YD	Microbiology
PL	Microbiology
BF	Physiology
YO	Optometry
DI	Nursing
ND	Medical Laboratory Technology
WH	Medical Laboratory Technology
CV	Clinical Psychology
HU	Chemistry Education
IJ	Biology Education
SV	Science Education
NT	Analytical Chemistry
TM	Polymer Chemistry
BE	Planning
YM	Physics
DY	Mathematics

Participants were made up of graduate students, faculty members, and research scientists. Postgraduate students were selected for interviews because of their vast educational experiences.

Data Collection

Semi-structured interviews are flexible interviews in which the researcher in advance prepares a set of general questions, from which follow-up questions are asked, to produce fluid conversations (Rubin & Rubin, 2012). An interview protocol (See Appendix) was used to guide the researcher in the interviews. The protocol contained leading questions which when posed, elicited information and acted as the basis for follow-up questions and prompts to be posed further. The interviews were done face-to-face in various office locations mostly with an audio recorder. About half of the participants knew beforehand (including those who made me reschedule interview dates) that they would be interviewed. This was because I had emailed them informing them about the research. The other half was interviewed once I went to their offices and informed them about the study. Twenty-seven participants, constituting 90 percent, were interviewed with an audio recorder. The remaining 10 percent however requested not to be audio-recorded owing to the sensitivity and uneaseness they

had for job security and legal reasons. I utilized short-hand notes-taking to capture the essential interview data for participants necessary for data analysis. The interview sessions were characterized by rapport between the participants and researcher in serene and quiet ambiences. The interviews lasted between 45 minutes and 60 minutes.

Data Analysis

Themes were generated from the data by the identification of patterned meanings pointing to the gender experiences of STEM females in Ghanaian tertiary education institutions congruous to the research questions. The themes were analyzed and connected through three coding phases. The open coding stage word by word and line by line analyses were done to disaggregate the data into concepts and categories which were further dissembled later (Strauss & Corbin, 1990).The axial coding process involved connecting categories to subcategories, while relating them to the central phenomenon (Charmaz, 2006; Strauss & Corbin, 1990, 1998). The coding process of connecting categories and sealing them with a set of discursive narrative is selective coding (Strauss & Corbin, 1990).

The Female STEM Experience

Gender discrimination was pervasive in the trajectories of the women in STEM whether it was school/university, workplace or home, gender discrimination of institutional, cultural, and/or educational bearing manifested in their STEM trajectories. The theory included support that was present in the journeys of the participants.

The three stages of the STEM experiential journeys were Interest Creation and Development (pre-higher education), Higher Education Participation, and Career Dynamics were found to be characterized with gender discrimination and support. The participants began with an interest in STEM before accessing higher education. In the universities, they had academic relationships influenced by their backgrounds especially determined by the type of high school (girls' or co-educational) they attended. They experienced change and/or continuity depending on the type of family/parental background and academic relationship they had in STEM. The career dynamics stage was quite similar to the higher education participation stage except that it had in addition the contextual realities of work.

Gender Discrimination

Gender discrimination or bias was expressed in subtle, sarcastic or explicit comments and embedded in cultural, institutional, curricular practices, institutional, and classroom structures. Participants, throughout their STEM educational and/or professional journeys, experienced varying degrees or magnitudes of gender discrimination. The responses to the discrimination or bias they experienced based on their gender were different, nuanced or similar.

Gender Discrimination Exhibited in Cultural Practices/Notions

Pertaining to gender relative to STEM fields, sexual stereotyping (emanating from culture) between disciplines determines the choice of females in enrolling in other fields and shunning others (Jacobs, 1986, 1995). This situation is a corollary of gender tagging of disciplines by society and explains why when women "cross the borders" to undertake science programmes, they are met with hostilities. This is because they have apparently broken cultural norms or expectations pertaining to the enrolment into science programmes. At the centre of the belief is the idea that science is intricate and very arduous to be undertaken by females:

> *I even got people scaring me, like, science is difficult so why do you want to...friends and neighborhood people...saying science is difficult and I'm a woman and what am I going to do in science? And basically, it's difficult and even guys don't want to do science and I am a lady, that kind of stuff. Even when I had my undergrad degree, I was told by my friends that they wouldn't associate themselves to me because I was more educated than them. One of them treated me with contempt, insulting me and all that.*

The cultural notion heralding the inferiority of women to men extends and cascades into the educational realm and STEM disciplines for that matter. The Ghanaian society with its socio-cultural and associated religious, ethnic, geographical, and economic ramifications generally endorses gender roles to which both males and females are supposed to conform. According to such norms, women are supposed to preeminently undertake domestic roles (managing the home). Even when they add on career roles to their domestic duties, the latter are not to be compromised. Serving children and especially the husband is

a cardinal domestic responsibility. Males are generally not supposed to undertake housekeeping duties (Erinosho, 1994).

The Ghanaian society implicitly places some limits to education on females. It generally places preference for males to females. In many rural areas in Ghana, females are generally dissuaded from going to school. Females with higher educational credentials like Master and Doctorate degrees, and even in some cases Bachelor degrees holders, are regarded as threats, spurned, and sometimes stigmatized. The rationale for the discrimination is that when they achieve such laurels, they may tend to compromise on the domestic roles the society sets for them for their careers. Fearing that they may be perceived as anti-social in a milieu where marriage and procreation are heralded, they are mostly susceptible to all forms of gender bias and discrimination (Tsikata, 2001).

A participant was confronted with the reality of gender tagging within her particular broad STEM disciplinary area. In a setting where a course like Mineral Engineering unlike Mechanical Engineering was perceived to be appropriate for females that chose Engineering, she was confronted with the societal perception that Engineering, and specifically Mechanical Engineering, are meant for males. This was because it was perceived that males were believed to be smarter than females in Engineering. Hence, the very few female Mechanical Engineering students, based on the participant's account, were underestimated. However, when they proved to be smart in the discipline, they were branded as witches:

> *Everybody I spoke to was pushing me towards mineral engineering. Because they felt mechanical was very hardcore, something for men, not for women...They didn't think that women would be that focused to be able to do it. And they also felt that we would be the last in the class every time because men well...they have an expectation of women and they expect that you fall in line with that expectation so anybody that does a little bit or falls a little bit outside that line they think you've done something really extraordinary. We were actually called witches by some of our colleagues and some elderly men and who you would talk to. It is said you have to be a witch to be able to read Mechanical Engineering.*

Classroom Structures as Sources of Gender Discrimination

Gender discrimination also emanated from the structural composition of students during their lectures. In the classrooms or lecture halls, it appeared that women get a tacit message that they do not belong to those classroom or lecture halls. The overwhelming male dominance in those environments affected them negatively. Some of them questioned their decision to undertake those disciplines because of the overwhelming number of men in the classes. For those participants who graduated from girls' schools, such classes were structurally different. They were in the same classrooms or lecture halls with many people with whom they were not accustomed to studying. In pre-requisite course classes, where they had students from related departments studying those pre-requisite courses and the class participation gap was wider, the effects on them exacerbated. A participant who majored in Mathematics narrated the manner the preponderant male presence in her classes impinged on her in her STEM journey:

> *In my class we had just seven ladies and there were seventy-seven guys. So the ratio was discouraging and we had joint lectures and with other Engineering and Science students and even that one was worse. So you go for lectures and it's like a male-dominated thing and that one in itself can discourage you...there were times when it did. Because you wonder, am I at the right place, am I doing the right thing?*

Gender Discrimination Manifested in Comments

Comments that people make are illustrative of the manner culture controls our remarks, observations, and speech. Culture influences the manner people think, perceive, act, and speak. In other words, there is a cultural linkage or association between culture and the utterances or comments people make. Deductively, in patriarchal contexts accustomed to relegate females to the peripheries, it is not uncommon for people to make discriminatory remarks when they observe that the former are violating socio-cultural norms governing them. Thus, women who pursue education to the advanced stages grapple with discriminatory comments in their university years (Daddieh, 2003).

One participant discussed how her male mates frequently questioned her and other female mates' decisions to undertake postgraduate studies. The men were surprised their female mates did

better than them in their studies. Implicitly, they thought that female postgraduate students did not have a place in graduate school and that undergraduate education should be their limit. The perpetrators in this regard, according to her, were men mostly from northern part of Ghana, highlighting a geo-cultural dimension to gender bias. Those areas appear to be deeply even more rooted in patriarchy where women seldom progress in the educational pipeline. Men are powerful forces in such societies who determine the destinies of the female in their societies in various spheres, including education. Such comments and utterances were more profound for Muslim students who had mates who were women in their graduate classes as the aforementioned participant:

> *I don't know but everywhere I go I can say that the ladies perform better than the guys. Even with the PhD it was serious. With the PhD, they were like: "what are you doing here?" I mean the guys in class, the Biochemistry; what are you doing here? You know, they are I don't know what to say, they're not Christians but Muslims from the north–they wouldn't allow their wives to study it; yeah they wouldn't allow their wives to come that far: "what are you doing here?"*

In the girls' schools, where some of the participants attended, they received support from their mates and teachers. In spite of that, they grappled with gender biases from people in their STEM classroom environment. However, they were not perturbed at all by any gender biased comments including sarcastic ones. One participant stated that she enjoyed support from her STEM mates and teachers but was met with gender stereotyping for being a Science student from non-STEM students (females) in her school as well as her sister. She was unfazed by the stereotyping by commenting that:

> *Those of us who did Science were very few and then we were encouraged by our teachers. The relationship among my mates was fine. Nobody would ridicule you because you did Science. Sometimes those not in the Sciences like the Arts students in my school would...would say – even my sister used to do that-sarcastically to the effect that you are always studying, like you are "anti–so" sort of. I didn't care though. It didn't push me at all.*

Curricular Practices as Sources of Gender Discrimination

Curricular practices also exacerbated gender gaps in the STEM areas. A participant recounted the manner a particular course in the curriculum objectified her and her female mates, making them objects of mockery to their male mates. The course (a STEM course) Beading, is linked to a cultural norm of women wearing beads around their waists, to evoke their sexual attraction in order to satiate their husbands. In a particular university, students in some STEM programmes were taught how to make waist beads. In the course of making those beads, the men teased or mocked the women by making sexually suggestive and performative comments. The women did not like the idea of that class being taught because they felt objectified. They felt degraded in the institution supposed to facilitate learning and advancement. Their gender was linked to the patriarchal notion that women are nothing but sex objects:

> *We did a course called Bead making. Most ladies didn't like that course because you know it had so much to do with women...you sort of feel some way...when that course is being taught...I think they are still doing that...and my class was male dominated. They were just laughing at us...and you know, making funny jokes...implying we are sex objects for male pleasures.*

There were other courses that implicitly or remotely heightened gender biases in the STEM journeys of the participants. Some of the activities in some of the classes required physical activities, which usually do not attract women. The problem was that such manual activities were old technologies that were in vogue many decades ago and are still being utilized in the STEM Departments. The participants spoke about those curricular practices in the universities that remotely affect the women in STEM. One participant stated a curricular practice affecting her interest and those of her female mates in their STEM field:

> *Casting is part of our courses...It's a course that should be studied but probably the content. I don't know how to say it...casting is manual but now I think there are other automated ways of casting...they haven't. They are still using the same approaches.*

Gender Discrimination Embedded in Institutional Practices

Universities through some of their practices, foster gender disparities. The universities, from their perspectives gave the participants the opportunity to utilize their expertise in the areas of teaching, research, and service. They relished the opportunity but indicated the disparities in the distribution of roles. As members of academia, they are supposed to teach for a certain number of hours per week. They also are expected to do high quality research intensively to yield outputs in terms of publishing papers in peer-reviewed journals as well as securing grants from external sources, and finally serve their Departments and communities.

Navigating these roles can be challenging in view of the fact that the Department, which evaluates the faculty based on these criteria, paradoxically tends to steer the latter not to suit the realities of motherhood and academia. Such navigation even becomes worse when the roles are not evenly distributed among the faculty and there are disparities in terms of gender. When the criteria are not focused on because of departmental overload, they are negatively evaluated. These practices do not take into consideration the domestic realities that women face in their lives. Women have to bear all these expectations and when those expectations especially those of the academy are not fairly set to consider their family or domestic roles, they are deeply disadvantaged. A respondent complained of being unfairly overburdened with a lot of service roles while her male colleagues were not given much service roles to perform. Such service roles were delegated to women irrespective of their reproductive conditions such as pregnancy:

> *I love teaching for the twenty hours given me, research is my favorite role, and I have no issue with service roles which I also love but I have a particular problem...Let's say we need somebody to arrange this and then maybe because I am a female, I am always given those other jobs compared to the males. Maybe there is a dinner or something and they will say you will be the chair; you will do this and those kinds of things. It affects my teaching and research...Sometimes you are pregnant and you are still being given a lot of things and you go like, "really"? They don't even care about my situation...They don't even delegate it to*

someone else to handle it. Not forgetting I have to take care of my home too.

Support Surmounting Gender Discrimination

Although the research questions focused on gender discrimination in the experiences of the participants, the support that they gained from various quarters was incorporated in the study. This was done to give a perspective to the gender biases. There were various categorizations of gender discrimination experienced by the participants relative to the support that they benefited from.

The family was a major source of support to the participants. Parents, the foremost people from families, were bulwarks in the development of the participants' interests. There were some of them who had STEM backgrounds and that was a great impetus for their daughters who were in STEM programmes or had undertaken STEM courses/subjects unlike those who lacked parental STEM backgrounds. This phenomenon from participants with other relatives was similar.

Faith was another great source of support the participants benefited from. The idea that God had the ability to help them through the support system to surmount whichever impediments or challenges they had in their STEM journeys was very solid and strong among the participants. Their abilities to succeed in their STEM endeavours heavily relied on their performances. Although the aforementioned factors had an influence on their performances, their innate or inherent love for the STEM programmes or courses they undertook was vital to their success. Finally, institutional efforts or inputs from employers of the participants enhanced their progression in their STEM journeys. Institutional support came in the form of financial aid, collaboration, promotion, professional development opportunities, and so forth.

In order for some of the participants to succeed, they had to consolidate their support networks. In other words, their eclectic reliance on an array of supports from various sources or quarters was beneficial to them in their STEM journeys. A participant, like some others, incorporated a potpourri of networks to enhance her development in her journey. These networks were of spiritual, biological, and academic significance. Benefiting from these diverse networks mostly composing of males (teachers, heads of *Departments*, study mates), they regarded the "fatherly" roles of their role models as

having positive effects on their academic lives as females. They encouraged and supported them in the face of gender discrimination:

> *My social networks also helped. I mean apart from God, my father, lecturers, my pastor was strong. Actually they came into my life quite younger so he's no really – I want to say an academic person but then he believes in education. I call them fathers. I have academic fathers and my biological father and then my spiritual father. So these fathers were strong, even than the women in my life. So basically, those were the issues.*

The Milieu of the STEM Classroom Environment

The manifold experiences of female STEM students in Ghanaian schools/universities based on the study's findings are consistent with the nuanced classroom experiences women in STEM even to the same classroom stimuli relative to gender among others (Seymour, 1995; Seymour & Hewitt, 1997). Under similar conditions like the structural composition of the class overwhelmingly composed of males and/or subtle and explicit chauvinist/sexist comments mostly from their male colleagues, some of the girls/women as students and/or as faculty were adversely affected, others were adamant and resilient. The latter depended on the agency (Oyewumi, 2003), support and mentorship from their lecturers (Etzkowitz et al., 1994, 2000) among others were resourceful, or both factors. Some of the females had to think, behave and associate with the males, analogous to the unitary male model where females identify with power holders, i.e. men, in order to succeed (Etzkowitz et al., 1994). Nonetheless the experiences of those who were victims of gender bias attest to the point that STEM women find themselves in chilly classroom environments lacking support from their male counterparts, whether students or faculty. They are not given credit for their accomplishments which is given to the males and are wrongly accused of flirting with their tutors and professors (Seymour, 1995), consequently, they become victims of sexually suggestive remarks, and are spurned as unattractive because of their linkage to the STEM realms (Murray et al., 1999).

The Milieu of the STEM Workplace

Institutions like universities and their ilk are bastions for democratization and development (Mama, 1998) and thus, they have

the capacity to provide leadership on issues of gender equity (Manuh et al., 2007). Some women in STEM fields in the universities and other research institutions have fulfilling career experiences. Apart from their self-motivation and solid background in the STEM fields, they benefit from cooperation, collaboration, and respect from their work colleagues who are overwhelmingly male. Universities and Departments in which they work are seen to provide leadership in gender equity (Manuh et al., 2007). This may seem to be at variance with various literatures on stark gender imbalances in STEM fields (Etzkowitz et al., 1994, 2000; Harding, 1982). However, in consonant with the findings of the study, many women in STEM career fields find their institutional working atmospheres largely uneven and intimidating, including those in Ghana (Campion & Shrum, 2004) and its universities and research institutions (Lundgren & Prah, 2009; Mama, 2008; Manuh et al., 2007).

Summary of Findings

The study sought to explore the experiences of Ghanaian female academics and scientists. Throughout their educational and professional experiences, they experienced sorts of gender discrimination manifested in comments and embedded in structures and practices of their departments, universities, and workplaces. The subtle and explicit comments discriminating against their gender were made by some of their mates including the females, parents, and work colleagues. They were victims of cultural notions that portray STEM disciplines as the preserve of males, and as such were shunned by some of their male mates in school. They also felt intimidated in the classrooms by the numerical dominance of their male mates. The participants perceived a few prerequisite courses as objectifying them. Within their workplaces, some of their male colleagues and seniors belittled them and attempted to impede their professional development. Nonetheless, their families, colleagues, employers, faith and they themselves were instrumental in their successes.

Conclusion

Women's roles in development are vital but many of them experience marginalization in all spheres of society's development including Science, Technology, Engineering, and Mathematics (STEM) areas. This is against the background that the STEM fields are necessary for

socio-economic development. Although there are regulatory/legislative instruments implemented to check gender equality, gender discrimination is prevalent in Ghana. There are myriads of gender research studies about Ghana's education sector in general. However, gender issues in STEM areas are scantily discussed. The experiences of 30 women in STEM domains in Ghana's tertiary education and research institutions were explored. The perspectives of participants were elicited and analyzed through semi-structured interviews and grounded theory respectively. The findings illustrate that the Ghanaian society is still deeply patriarchal. On the STEM trajectories of the participants, gender discrimination was manifested in comments, structures, and practices. The magnitude of gender discrimination however nuanced depending on the level of support they had. Thus, the support system they had, provided a perspective to the gender discrimination meted out to them.

University stakeholders should assist the institutions in drawing up gender policy frameworks with the Science, Technology, and Innovation (STI) Policy, the national gender policy, and National Council for Tertiary Education (NCTE) norms as their rostrums in order for effective coordination to be achieved. Such frameworks should be standardized among universities and research institutions. Two mutually inclusive components of such frameworks encompassing all fields including STEM should be equity and accountability which are achievable by gender mainstreaming/affirmative action policies and gender auditing respectively.

In STEM institutions, there should be clarity in workplace policies on service and/or division of labour. Modalities for service roles, regarding committee membership for example, should be spelt out clearly. It should also be made clear who qualifies to sit on which committee, at which period, duration of service, and to whom allowances should be paid

The outcomes of the research present some recommendations for future research work.These include, prospective research in the experiences of women in non-STEM disciplinary areas, a comparison of the experiences of women in STEM and non STEM disciplinary areas, comparative studies between men and women in STEM and non-STEM areas, and international comparative studies including women in STEM disciplinary areas. Moreover the regulatory

institutions, their Departments, faculty, and especially government should make funds available and procure equipment and logistics to help make the STEM areas attractive to prospective and existing female STEM students and professionals.

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APPENDIX
INTERVIEW PROTOCOL
STUDENTS

1. To what disciplinary domain or major do you belong?
2. Why did you choose that major or program?
3. What do you think about the supports and/or obstacles you face(d) in undertaking your program?
4. Tell me about the networks you belong to or lack or need in your studies.
5. How do you experience conflicts between your study and family responsibilities? How do you negotiate through the conflicts?
6. Tell me about your relationship with your students, mates, and faculty in the classroom and/or laboratory.
7. What do you think about your male students, mates, and faculty?
8. How do you deal with all the challenges or problems you face in your studies?
9. What do you recommend to be changed in your classroom/lab/department/institution concerning your studies?
10. Do you have anything else to add?

Thank you.

FACULTY MEMBERS/RESEARCH SCIENTISTS

1. To which level of faculty or research scientist do you belong?
2. To what disciplinary domain or major do you belong?
3. Why did you undertake a faculty career in STEM?
4. What do you think about the supports and/or obstacles you face(d) in undertaking your career?
5. Tell me about the networks you belong to or lack or need in your academic or research career.

6. How do you experience conflicts between your study and family responsibilities? How do you negotiate through the conflicts?
7. Tell me about your relationship with your students, peers, and senior colleagues in the classroom and/or laboratory.
8. What do you think about your male students, peers, and senior colleagues?
9. What do you think about the impact about the impact of departmental processes and practices on your work? Explain your role in departmental decision-making. Tell me the difference (if any) between your roles and those of your male peers
10. How do you deal with all the challenges or problems you face in your career?
11. What do you recommend to be changed in your classroom/lab/department/institution concerning your career?
12. Do you have anything else to add?

Thank you.