Career aspirations and influencing factors among male and female students studying Science Technology Engineering and Mathematics (STEM) subjects in Ghana

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Abstract

This paper examines the career aspirations of male and female students studying Science Technology Engineering and Mathematics (STEM) subjects at the tertiary level in Ghana and the motivating factors for these aspirations. The study objectives were addressed using data gathered from a survey, in-depth interviews, and focus group discussions. Chi-square test and binary logistic regression were used in analysing the quantitative data, while the qualitative data were analysed using thematic content analysis. The results show that there is no significant difference in the career aspirations of male and female students. However, we established that there are differences in the factors that influence career choices of male and female students. While economic consideration was a significant factor for males' interest in pursuing a career in STEM, females were influenced by external motivation factors such as encouragement and motivation from role models. The authors recommend both formal and informal science-related mentorship programmes and internships as measures that could encourage females to actualise their career aspirations in STEM since it is an essential way of empowering them and building their capacities for national development.

Keywords: Gender, career choices, empowerment, Science Technology Engineering and Mathematics (STEM), Ghana

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Introduction

Historically, females have been disadvantaged relative to males concerning access to formal education, particularly, in the sciences (Andam et al., 2015; Noonan, 2017). While some scholars have argued that physiological factors contribute to fewer females' interest in science-oriented disciplines (see Schiebinger, 2014), others have argued that socio-cultural norms create a more positive attitude toward science for males than females (see Breakwell & Beardsel, 1992). Further, males have made more progress in STEM careers than females, with some scholars attributing females' slow progress in STEM careers to socio-cultural factors. Some factors identified as being responsible for this include family work-life balance conflict, conflicts between being an acceptable woman and being a good scientist (Mann & DiPrete, 2013; Legewie & DiPrete, 2014), and the slow pace of policy efforts to increase females' interest in science and reduce barriers to career opportunities in STEM.

Over the years, women's underrepresentation in STEM careers has gained both policy and research attention globally (see Hill et al. 2010; Boateng and Gaulee, 2019; Coffie et al. 2020). There have been several policies and programmes at both the global and national levels to encourage young females to offer science-oriented programmes at the tertiary level and increase their opportunities in pursuing a STEM career. The rationale behind some of these policies is to ensure that there is gender equity in capacity building in STEM to facilitate the socio-economic advancement of countries with wide gender gaps in science education and training (UNESCO, 2020). Indeed, there have been suggestions that if more females and males are allowed to pursue careers in STEM, it will increase the human resource capacity in STEM occupational fields and make countries more competitive economically (Smith, 2014; Hango, 2015).

In Ghana, strides have been made to improve upon female uptake in science-related courses at both secondary and tertiary levels of education. The goal is to bridge the gender gap in science education and ensure equal opportunities in STEM occupations for both males and females. The Ghana Tertiary Education Statistics published by the National Accreditation Board shows a gradual improvement in enrolment figures for females in science programmes (see Table 1). This is in line with UNESCO's (2021) report that female enrolment in STEM programmes globally has increased from about 19% in 1995 to 35% in 2015.

Table 1: Trend in enrolment into Science Programmes in Ghanaian Public Universities

Sex	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019
Male	37,526 (72.6%)	37,708 (69.3%)	43,534 (68.3%)	43,312 (67.5%)	42,309 (67.0%)	44,417 (67.0%)
Female	14,158 (27.4%)	16,284 (30.2%)	20,175 (31.7%)	20,826 (32.5%)	21,419 (33.0%)	21,854 (33.0%)
Total	51,684 (100%)	53,992 (100%)	63,709 (100%)	64,138 (100%)	63,138 (100%)	66,271 (100%)

Source: National Accreditation Board

The improvement in female enrolment in the sciences has been attributed to educational policies of governments, including the institutionalisation of science clinics for girls. Nevertheless, the critical question is whether these policy efforts and females' interest in studying science at the secondary and tertiary educational levels have translated into a concrete desire to pursue careers in STEM. According to Heilbronner (2011), several factors influence career choices in STEM beyond cognitive abilities and passion. Literature available on research in this area, especially from the global north, have illuminated our understanding of the reasons and motivations for pursuing STEM programmes among students at the tertiary level and subsequent motivation for opting for a STEM career (see Cui et al., 2019; Hoferichter & Raufelder, 2019).

While studies in Ghana have examined pedagogical issues particularly, at the secondary level and females participation in STEM (see, for instance, Azure, 2015; Nyavor, 2017; Quansah, 2019; Coffie et al., 2020), there has been limited understanding of the gender differences in career aspiration of students studying STEM courses at the tertiary level and the factors influencing these career options. This study thus, seeks to examine these by addressing the following research questions:

(1) Are the career aspirations of females studying STEM courses at the tertiary level different from their male colleagues?

(2) Are there different factors influencing the career aspirations of males and females?

We begin the discussion with some theoretical arguments on gender and career aspirations of students in STEM and the factors influencing these aspirations. We then present the methodology adopted for the study, then the results and discussion of key findings. The final section draws some conclusions.

Theoretical Perspectives on Gender, Career Choices and STEM

STEM occupational subfields can be grouped into four broad areas: science technicians and associated professionals, science and engineering professionals, health professionals, and information communication technology professionals (Du &Wong, 2019). In recent times, there are arguments that other disciplines such as Geography should be considered a STEM discipline since some of its sub-themes are science-based (see Caldis & Kleeman, 2019). While these occupational subfields in STEM are broad, and categorisation varies from country to country, career interest in these areas has increased over the years because of the rapid technological changes and the increasing need to address the myriad of society's challenges through scientific innovation and inventions (Kelly & Knowles, 2016; Shaw et al., 2019).

Consequently, more females have been encouraged to pursue STEM programmes and chart a career path in STEM, as it is also one way of empowering women (UNESCO, 2020). Thus, opportunities to study and work in STEM have increased, with females being beneficiaries of most of these opportunities (Langen & Dekkers, 2016). The literature, however, highlights several theoretical arguments on factors that could influence career aspirations from a gender perspective, and these have been discussed in the next section.

Gender norms, practices and socialisation

Boateng and Gaulee (2019) argue that career choices in STEM are imbued within norms and practices at the home, school, and societal levels. A critical gender norm and practice that could influence one's ability to pursue science is the influence of parents or guardians. Parental guidance and parents' background, such as parents' occupation, perception, and socio-economic status, all play a pivotal role in the choices that children and young adults make in the course of their life journey (Buunk et al., 2009; Tey et al., 2020). According to Nawabi et al. (2019), parental expectations often shape children's self-identity and career choices. Gender stereotypes and norms held by parents are more likely to influence females' career choices in STEM fields (Tey et al., 2020). Further, it has also been explained that females' failure to rise to the highest level in STEM has been the loss of confidence in, for instance, their mathematics and science abilities due to early experiences and socialisation that promote sexist stereotypes about females' lack of ability in STEM subjects (Eagly et al., 2000; Ong et al., 2011). Scholars such as Diekman and Eagly (2008) view the problem relating to the gender gap in STEM education as a reflection of a problem that begins at childhood and worsens as females' progress in age.

It is also argued that STEM education is often associated with qualities such as subjectivity, remoteness, and detachment and is seen to be congruent with the natural qualities of males (Lent et al., 1994; Valla &

Ceci, 2014). Females' attributes, which are perceived to include coyness and subjectivity, are at variance with qualities required to pursue a career in STEM. Deikman et al. (2010) also note that women have been involved in caretaking and nurturing in traditional settings, leaving much of men's leadership and agentic roles. Even though women are taking more agentic roles, their traditional roles have often made them more tender-minded and maintain high communion levels. In effect, Deikman et al. (2010) suggest that fewer females are likely to pursue careers in STEM because of the belief that many of the careers in the field do not directly deal with the care for people, especially careers in the basic and applied sciences. Another important argument for the low representation of females in STEM careers is inadequate female role models in STEM-related careers (Botella et al., 2019). While overt gender discrimination has been largely eliminated, other barriers that mitigate against women's interest in pursuing a STEM career remain widespread. These include the paucity of successful female role models and mentors that reinforce women's lack of belongingness in STEM fields (Botella et al., 2019).

Gender and pre-tertiary school experience in STEM

Simpson (2001) and Crisp et al. (2009) have argued that the experiences gained during pre-tertiary education can positively influence females' desire to pursue STEM education at tertiary or higher levels of their education. Good training in mathematics and a favourable learning environment helps in developing a positive academic aptitude for science-related disciplines (Crisp et al., 2009). Bonous-Hammath (2000), also argues that females who do remarkably well in STEM-related fields during their pre-tertiary levels have stronger desires to pursue STEM programmes to the highest levels of their education. Crisp et al. (2009) further note that what early exposure and interest in STEM do is that it builds the confidence of females at an early stage and makes them feel that they can compete and excel to the highest level.

Gender and Self-efficacy

Self-efficacy aligns with Bandura's social cognitive theory, which states that individual efficacy plays an influential role in people's motivation and persistence to achieve their goals (Pajares, 2005). Self-efficacy is one of the critical factors used to explain people's desire or interest in pursuing a career in STEM. It refers to the confidence people have in their abilities to do something. In this context, it refers to the confidence that both male and female students have in their abilities to excel in STEM-related subjects and pursue a career in STEM (Pajares 2005; Buday et al., 2012). Pajares (1996) argues that those who can accomplish a task because of their abilities and confidence are more likely to attempt and even do well to complete. Self-efficacy is developed over a period and is contingent on many factors. These factors include special abilities one is born with and the learning environment during the developmental or early and later stages in their educational journey (Heilbronner, 2011). The learning environment includes a positive relationship with advisors, mentors, interest in STEM classes, the quality of teaching and learning, and the support given to a child at home and school (Heilbronner, 2011; Tey et al., 2020). Nugent et al. (2015) argue that self-efficacy is vital in career choice in STEM because females believe that their capabilities will enable them to excel to the highest level in a STEM career.

Gender and Individual-level factors

Demographic factors influence the decision to undertake STEM programmes at both secondary and tertiary levels and pursue a STEM career. Demographic variables, which are noted to have a significant influence on career aspiration in STEM, include race and sex. For instance, some studies have shown that people from minority groups have fewer opportunities in pursuing careers in STEM (see Crisp et al., 2009). Others have shown that males are more likely to pursue careers in STEM when compared to females (see Senadza, 2012). Studies which give credence to the influential role of the individual-level or demographic factors argue that cognitive abilities tend to translate into a positive attitude towards STEM subjects (see Lent et al., 1994; Valla & Ceci, 2014). These cognitive abilities are linked to good foundations provided at early stages and parental support and expectations. In all of these, socio-cultural and stereotypical attitudes are demotivating factors for females (Hill et al., 2010; Tey et al., 2020).

Whether a person will pursue a career in STEM to the highest level or not also depends on their interest in STEM (Pajares, 2005; UNESCO, 2020). According to Pajares (2005), interest drives a person to work hard and excel, envision a career prospect in STEM, and take the necessary step to reach one's goal. Langdon et al. (2013) mention that STEM jobs involve a lot of research, experimentation, and application of knowledge leading to innovation. These require critical skill sets, which may be gained through an interest in the subject and desire to learn. Often people have differences in a career path in STEM due to differences in interest (Pajares, 2005; Langdon et al., 2013). Studies have shown that males are more likely to express interest in pursuing engineering courses than females (WGBH, 2009; UNESCO, 2020). It is noted that there have been occasions where women have excelled in maths than their male counterparts but have gone ahead to pursue careers not related to STEM (WGBH, 2009). Pajares (2005) also argues that differences in self-confidence, which develops at the early stages of schooling, is also a factor that could increase people's interest in STEM subjects.

Gender and STEM education in Ghana

Science, Technology, and Innovation (STI) have become key to many countries' socio-economic transformation. This point is acknowledged in the various policy documents in Ghana, such as the Growth and Poverty Reduction Strategy II (GPRS II) and the Medium-Term Development Plan (UNCTAD, 2011). Thus, some efforts have been made over the years to increase female enrolment in STEM in Ghana. In 1987, the Ghana Education Service (GES) instituted the Science, Technology, and Mathematics Education (STME) clinic, which was aimed at offering training opportunities for teachers (Sutherland-Addy, 2002). STME sought to organise special programmes for students on innovations in science and technology. The Girls' Education Unit (GEU) of the Ministry of Education was also established in 1997 to work toward non-discriminatory enrolment in education and the general reduction of gender disparities in the education sector. Additionally, affirmative action policies have been instituted by tertiary institutions to increase female enrolment in STEM (National Gender Policy, 2015).

There are public-private partnership efforts to encourage more females into STEM-related fields through mentorship programmes in recent times. For instance, through the Millennium Challenge Corporation and the Government of Ghana, the Millennium Development Authority has instituted the Ghana Power Sector Internship and Mentoring Programme to increase women's participation in Ghana's power sector (MiDA, 2019).

Despite the varied policy initiatives made over the years to promote STEM education and increase career opportunities for females in Ghana, there are still gender gaps in STEM disciplines and careers. Nyavor (2017) notes that it will be challenging to have a large threshold of females pursuing STEM programmes at the tertiary level in Ghana due to existing gaps at the secondary level. These gaps have been associated with both socio-cultural factors and policy issues, with socio-cultural factors being the dominant ones that impede female participation in STEM in Ghana (see Boateng & Gaulee, 2019; Nyavor, 2017). For instance, the notion that girls cannot or are not expected to study science-related disciplines is still strong in most societies in Ghana. Some families still prefer girls to pursue humanities and clinical science courses than to go into engineering and physical science, which are considered male fields of study (UNESCO, 2017). Additionally, other factors include gendered social practices in households, lack of role models for girls in schools, inadequate awareness and education about the relevance of STEM in the country's socio-economic development, and the problem of gender insensitive teaching methodologies and unfriendly teaching and learning environment (Boateng, 2017; Boateng & Gaulee, 2019).

There are also policy issues that constraints female progress in STEM educational programmes and careers. For instance, UNCTAD (2011) highlights low public investment and expenditure in science education and inadequate funding for the girls' education units to train and build staff capacity. In furtherance, there has been a limited inter-sectorial collaboration among various government ministries and agencies whose role is critical for promoting science education and female enrolment in science-related fields.

Despite the marginalisation and underrepresentation of females in STEM-related fields, Boateng (2017) shows that some women have risen through the ranks of their STEM-related careers regardless of gender disparities in the various disciplines. Strong networks that females built along their career paths also contributed to their successes in their fields of interest (Heilbronner, 2011; Boateng, 2017). Our study builds on these earlier studies and examines the gender differences in the career aspirations of males and females studying STEM courses at the tertiary level and the motivating factors. The subsequent sections outline the research methodology and the discussion of key findings.

Study methodology

Research design

This paper is part of a pilot study that sought to investigate the underlying factors that influence career choices for males and females in science disciplines at the University of Ghana and their interrelationship with social and gender norms in Ghana. A mixed-methods research strategy was adopted for this study, and the purpose was to provide an in-depth understanding of the quantitative results and allow for data triangulation (Creswell & Plano, 2006). The specific mixed-methods design used was sequential explanatory mixed-methods design, which involved collecting the quantitative data, and then a follow-up with the qualitative data.

Data collection

An online-based questionnaire survey was employed. This was deemed appropriate due to the ease of reaching the target population, the cost-effectiveness of the method, tracking of responses in due time, and assessment of the pattern of responses. Five STEM departments in the University of Ghana were involved in the survey: engineering, mathematics, statistics and actuarial science, biological sciences, and computer science. Permission was sought from the heads of the aforementioned Departments before the survey exercise was carried out. The target population were students from the second to fourth year, undertaking courses in the above mentioned departments with an expected sample size of 400. However, a sample of 252 comprising students at all levels responded to the survey, representing a response rate of 63%. Out of this number, 54% were males, and 46% were females. Furthermore, 82% were between 20–25 years, with 18% below 20 years. On the survey instrument, there was a statement explaining the aim of the study, background information about the study, and assurance of confidentiality of the survey respondents.

Qualitative data were gathered from in-depth interviews and focus group discussions (FGDs). In all, 20 in-depth interviews were conducted (through WhatsApp phone calls) with students conveniently sampled from the pool of respondents from the online survey. Ten of the informants were males, and the other 10 were females. The in-depth interviews provided deeper insights into motivations for studying and pursuing STEM courses and careers, respectively. In addition, three FGDs were held in-person: male, female, and one mixed group. These discussions were particularly useful as they also provided a more nuanced understanding of the differences in motivations among males and females.

Study variables

In terms of the quantitative data analysis, nine (9) independent variables were used. These included age, which parent (s) or guardians the respondent lived with, the STEM programme being pursued, father's educational background, mother's educational background, and three composite variables, including self-efficacy and career prospect, external motivation, and non-interest in other humanities disciplines. Regarding coding the independent variables, age had two categories (1=below 20, 0=20-25), who respondents lived with had five categories (1=both parents, 2=father only, 3=mother only 4=relative guardian, 5=live by myself/I have my own family). STEM programmes being offered had four categories (1=engineering, 2=biological science, 3=mathematics, 4=other), father and mother educational level variables had four categories (1=none, 2=basic, 3=secondary, 4=tertiary).

Factor analysis was used to generate the composite variables (i.e., factors) for the three composite variables. The total number of items included in the factor analysis was eleven, as shown in Table 2. Varimax rotation was used, and a three-factor solution was arrived at. The three factors were named as follows: self-efficacy and career options, external motivation, and non-interest in other disciplines. The first factor accounted for a percentage variance of 22.7%, the second factor accounted for 19.6%, and the third accounted for 12.8%. Overall, the three factors accounted for 55.09% of the total variance. The dependent variable was whether respondents' future occupation will be within the field of STEM or will be a STEM-related occupation.

Table 2: Factor analysis of items influencing career aspirations in STEM

Items	Factor 1	Factor 2	Factor 3
I had a good foundation in science at the basic/secondary level	0.698	0.054	0.041
I want to pursue a career in a math and science-related field	0.770	0.007	0.128
The economic benefits in pursuing science is more compared to other programmes/ I want to earn more money	0.538	0.250	-0.056
I have the passion/challenge myself for pursuing a science programme	0.852	-0.105	-0.002
I had no option than to do this course	-0.274	0.368	0.232
I had people/ parents/ role models who encouraged me to pursue this programme	0.279	0.614	-0.088
Because there are few women pursuing careers in science and engineering	-0.052	0.812	-0.052
My parents are into science, and I want to follow their footsteps	-0.411	0.482	0.305
I am not very good in humanities and the arts	-0.035	0.139	0.854
I do not have interest in humanities and the arts	0.121	-0.038	0.871
To prove that everyone is capable of doing science to the highest level	0.232	0.555	0.306

Data analysis

The analysis section of the paper was segmented into two. The first section involves a chi-square test to assess whether there is a significant difference between the sex of respondents and aspiration to pursue a career in STEM. A contingency table was generated using SPSS version 22.0 and followed with a chi-square test. The second section assesses the effect of the independent variables on career aspiration in STEM. This relationship was tested using binary logistic regression. Binary logistic regression was appropriate in this context because the dependent variable was dichotomous. The odds-ratio was used for the interpretation of the results. For categorical independent variables, an odds-ratio greater than one indicates a higher likelihood of pursuing a STEM-related career for the reference category. For continuous variables, a unit increase in the variable leads to a corresponding increase in the likelihood of pursuing a STEM-related career. Before presenting the binary logistic regression results, descriptive statistics of the categorical variables were presented, showing the frequency and percentages.

All interviews conducted were recorded after consent was sought from the informants. The recorded interviews were played back, manually transcribed, and analysed based on the themes that emerged from the transcripts. The themes identified were in connection with the objectives of the study. The themes included career aspirations, motives for career choices, anticipated challenges, constraints, and opportunities. Statements or quotes were categorised under the themes and discussed the results and the survey data.

Results and discussion

Career aspirations for males and females: Are they different?

This section presents the result that addresses whether there are differences in career aspirations in STEM for male and female students at the tertiary level. As shown in Table 3, the result indicates that both male and female students currently offering STEM programmes at the University of Ghana aspire to pursue a career in STEM after getting their undergraduate degrees. In essence, there was no statistically significant difference between male and female students regarding career choice in STEM. This result is evidenced by the large proportion of respondents who desire to pursue a career in STEM (221 students). Disaggregation of data based on the sex of respondents' shows that 92% of females aspire to pursue a STEM-related career, while for males, it was 87%.

Table 3: Career aspiration by sex

Sex of respondent	Is your future occupation related to a field in STEM		Total
	Yes	No	
Male	116 (86.6)	18 (13.4)	134 (100.0)
Female	105 (92.1)	9 (7.9)	114 (100.0)
Total	221 (89.1)	27 (10.9)	248 (100.0)
	X^2= 1.947 df=1 p-value=0.163		

Source: Field data, 2020

The finding from the chi-square test indicates that females' willingness to pursue a career in STEM, after obtaining their undergraduate degrees, was high, and this was attributed to a personal interest in STEM, the desire to challenge the status quo and motivate other younger females (Pajares, 2005; UNESCO, 2020). For instance, a third-year female biomedical engineering student explained her choice of a STEM-related career as follows:

> *…I have a passion for science courses, and I'm particularly interested in mathematics and practical courses. Therefore, I want to pursue and choose a profession in that area. Most importantly, I come from a part of Ghana that many girls hardly do science. Girls usually choose general arts and business in school, and so I want to become a role model for the younger females in my area… to let them know that science programmes are not just for males but can also be done by females. (21-year-old third-year female biomedical engineering student).*

Indeed, many of the females interviewed expressed similar motivations for choosing science-related courses and expressed the desire to pursue a career in this area. Essentially, this demystifies previously held views that females have less interest in STEM or may be unfit because they do not possess qualities that serve as an inhibiting factor in pursuing a career in STEM (see, for instance, Schiebinger 2014; Boateng & Gaulee, 2019).

This result must also be situated within the larger context of progress made within the Ghanaian educational sector regarding STEM. As indicated, science and mathematics clinics have continuously been a forum that has provided the needed training for science teachers and boosted the interests of females in STEM subjects at the secondary levels. Again, the reservation of spaces for females in science programmes at tertiary levels has played a significant role and has enabled more females to undertake science programmes interested in charting a career path in STEM (Boateng, 2017; UNESCO, 2017).

In addition to the above findings, which show that both males and females desire to pursue a career path in STEM, the respondents also highlighted specific career areas they want to pursue. A gender analysis, as shown in Table 4, indicates that 16% of males compared to about 7% of females, want to go into an engineering-related field. In comparison, 16.2% of females (mostly biological science students) as compared to 15.6% of males wanted to pursue a career in Medicine and health-related field. The revelation above is not surprising as a similar study in the Science-based University in Ghana (Kwame Nkrumah University of Science and Technology) showed that females make up only 13.71% of engineering students enrolled in the University from 2003-2018 (Appiah-Castel et al., 2020). Indeed, their study revealed that there are more females in health sciences than in pure and applied sciences and engineering, pointing to females' reservations for studying such courses and pursuing careers in that field.

These findings point to the fact that careers in healthcare services continue to be of much interest to females and are well in synch with the proposal of Deikman et al. (2010) that females preferred a career that aligns with their traditional caretaking and nurturing roles such as in the area of medicine and health-related profession.

Table 4: Choice of future career in STEM

Categorisation of future STEM careers	Males		Females	
	#	%	#	%
Engineering related field	22	16.3	8	6.8
Medicine and health related field	21	15.6	19	16.2
ICT	4	3.0	2	1.7
Academia/Applied Science	28	20.7	23	19.7
Business and entrepreneurship	11	8.1	1	0.9
Industry	5	3.7	10	8.5
Politics and public sector	-	-	2	1.7
Not yet decided on specific area	44	32.6	52	44.4
Total	135	100.0	117	100.0

Source: Field data, 2020

Pursuing a career in academia is also another area that both males and females desire. This implies furthering their studies in a STEM-related programme, which many had personal commitment in achieving. Interestingly, some were undecided about the STEM career they would want to pursue, with more females

(44.4%) expressing that uncertainty as compared to males (32.6%). Even though the respondents desired to pursue a career in STEM, qualitative interviews with some of the respondents revealed that factors especially the uncertainties within the labour market coupled with the real chance of getting a job in the field after school, appeared to be more of major concern thus contributing to the undecidedness. Others have also held the view that some of the careers in STEM required further training at the postgraduate level, which will mean additional financial resources, which both male and female respondents interviewed confessed may be a challenge. Therefore, it is not surprising that some students, particularly males, opted to move into business or entrepreneurship after school, with more females also opting to move into industry. In effect, they would settle in 'for *any job that comes their way immediately'* as hushed by one female mathematics student.

However, this situation may push them into a non-STEM field, a challenge that must be looked at critically to retain females in STEM-related fields. The factors contributing to the uncertainties in pursuing a career in a STEM-related field as expressed by both males and females were summed up by a final year female engineering student as follows:

> *…. my immediate goal after school is to look for a job and work for a while before continuing my education. You know, it is not easy to get a job these days, there's so much competition …..I know some who did engineering and have ended up as teachers, accountants and bankers, all because they couldn't find a job in their field of study and could not also do further studies because of financial challenges. Most of our parents do not have that kind of money so we have to work. For me, I am not sure my parents can support me to further my education now so I have to work and save so I can continue to pursue my dream of becoming an engineer. (22 year old female agricultural engineering student.)*

The above quote clearly shows that challenges within the broader economy such as the increasing unemployment in the labour market and parents' inability to provide support due to financial challenges could lead to non-STEM field careers even though they desire to pursue STEM careers. Nevertheless, many were quick to express their wish to work in science-related fields and industries in multi-national companies and institutions like Nestle, Cadbury and Ghana Standards Authority, whilst furthering their education. This demonstrates their desire to pursue STEM-related careers, and the next section will discuss factors contributing to this.

Factors influencing career aspirations in STEM

Descriptive statistics

This section presents results on the factors that influence the career aspirations of students studying STEM courses. A binary logistic regression was conducted, and the analytical sample for the model was 175. This sample was arrived at after processing the data for the model, which includes the removal of missing data for the variables. Overall, the analytical sample results indicate that about 81% of respondents were between 20-25 years (see Table 5). The majority of respondents stayed with both parents (62%), with a sizeable proportion also staying with their mothers (20%). In addition, more than half of respondents of the analytical sample were currently pursuing biological science (57%), followed by engineering (27%). In terms of parents' educational level, the sample showed that the majority of parents of the respondents had basic and secondary level education.

Table 5: Case-processing summary of categorical variables

Variables	Categories	Frequency/mean	Percentage/SD
Sex of respondents	Male	92	53
	Female	83	47
Age	Below 20	33	19
	20-25	142	81
Who do you live with	Both parents	109	62
	Father only	9	5
	Mother only	35	20
	Relative guardian	16	9
	I live by myself/I have my own family	6	3
Which STEM programme are you currently offering	Engineering	47	27
	Biological Science	99	57
	Mathematics	20	11
	Other	9	5
Father's educational level	None	16	9.1
	Basic	75	42.9
	Secondary	68	38.9
	Tertiary	16	9.1
Mother's educational level	None	4	2.2
	Basic	47	26.9
	Secondary	74	42.3
	Tertiary	45	25.7
Self-efficacy and career prospects	Continuous	0E-7	1.0
External motivation	Continuous	0E-7	1.0
Interest in pursuing Science	Continuous	0E-7	1.0
Analytical sample		175	100.0

Source: Field data, 2020

Binary logistic regression

Table 6 shows the effect of the independent variables on students' decision to pursue a career in STEM in the future. The results showed that the sex of a student has no significant effect on their decision to pursue a career in STEM, a result similar to the earlier chi-square result. This result suggests that being a male or female does not significantly influence the decision to pursue a career in STEM, but rather, such a decision is based on other factors.

Moreover, whom a student lives with (i.e., parents, mother only, or father only) also did not significantly affect the choice of a future STEM career. However, it can be observed from Table 6 that respondents whose mothers have a minimum of secondary education were 2.394 times more likely to pursue a career in STEM. This result suggests that educated mothers (at least up to secondary level) play an influential role in choosing STEM-related careers for the respondents. As noted earlier, parents and mothers in particular, play a key role in the upbringing of their children through their stereotypical attitude towards females pursuing science courses and careers (Buunk et al., 2009; Tey et al., 2020). Nevertheless, they could also play an important role for females' achievement in STEM disciplines, including math test scores and college aspirations (see Cui et al., 2019; Hoferichter & Raufelder, 2019). When mothers are educated, it contributes significantly to the cognitive development of the child as they have much appreciation of the value of education and therefore are likely to invest in their wards' education to the highest level

(Hoferichter & Raufelder, 2019). The central role of mothers came out clearly in the interviews, especially with female informants. For instance, a female student expressed the central role that her mother plays in her quest for pursuing a science-related discipline as follows:

> *… My mother is a teacher and has been instrumental in my life in my pursuit of science. Right from childhood when I expressed interest in doing science, she has assisted and supported me. I can say she has been my main motivator. I want to pursue medicine and she has encouraged me to study hard to achieve my dreams. (20-year-old female biological science student).*

This clearly shows that mothers could play a significant role to support their children's education. For females in particular, mothers could be a central force in achieving their STEM disciplines (Cui et al., 2019). The results also show that those who did engineering were 1.475 times more likely to pursue a career in STEM when compared with those doing other programmes. The qualitative data further provided insight into this finding. It was noted that engineering students perceived their programme to be a more specialised field and, therefore, a specific career focus. The interviews further showed that personal interest and the perceived better opportunities within the engineering field pushed them to pursue a career path in that area. Interviews with male engineering students in particular showed that, apart from personal interest, they were motivated to pursue a career in engineering because of the economic opportunities in that field. In effect, the economic prospects as an engineer was the main motivation for their interest in pursuing a career in STEM, as echoed by this male student:

> *... I really like mathematics and engineering…and back in high school our teachers also urged us to take these subjects seriously because of the opportunities in this area and that one will earn more money. That is why I am currently doing engineering. I want to be an engineer and I know I will make a lot of money in this field…. (22year-old third year male computer engineering student).*

This, however, was not the case for female engineering students who revealed that their main motivation was more about self-interest (Pajares, 2005; Buday et al., 2012). The female students thus, do not lose sight of the fact that they are taking up the challenge to venture into a field where there are few women, as well as the desire to follow in the footsteps of females who are already making great strides in the engineering profession.

The results further show that self-efficacy and career prospects had a significant relationship with career aspiration in STEM. Interpreting further, a unit increase in self-efficacy and career prospects led to a 1.450 likelihood of pursuing a career in STEM. In furtherance, a unit increase in external motivation also leads to a 1.518 likelihood of pursuing a career in a STEM-related profession. Results on the role of self-efficacy and career options corroborate previous studies that have shown that self-efficacy does influence students to pursue a career in STEM (see Buday et al., 2012; Nugent et al., 2015). In this study, items within this construct (i.e., self-efficacy and career option) included a good foundation at the basic levels, the belief that one can succeed if one has the passion and interest in pursuing STEM, and having the strong urge to pursue a career in STEM (Eagly et al., 2000; Heilbronner, 2011).

Table 6: Binary logistic regression of career aspiration in STEM

Independent variables	Exp (B)	Beta	SE
Gender			
Male	0.789	-0.237	0.164
Age			
Below 20	0.768	-0.264	0.144
Who do you live with			
Both parents	0.770	-0.261	0.360
Father only	0.023	-1.613	0.138
Mother only	0.891	-0.116	0.149
Relative guardian	0.281	-1.269	0.133.
STEM programme offering			
Engineering	1.475*	0.389	0.179
Biological Science	1.279	0.237	0.116
Mathematics	0.232	-1.459	0.150
Father's educational level			
None	0.023	-1.095	0.188
Basic	0.762	-0.272	0.092
Secondary	0.904	-0.101	0.125
Mother's educational level			
None	2.299	0.855	0.212
Basic	1.317	1.220	0.134
Secondary	2.384*	1.666	0.082
Self-efficacy and career prospects	1.450***	0.799	0.234
External motivation	1.518**	0.666	0.280
Interest in pursuing Science	1.013	0.691	0.277
Pseudo R^2 (C&S)		0.367	

Note: Exp (B) is exponentiated beta (or odds-ratio), SE is standard error, *$p < 0.05$ **$p < 0.01$ ***$p < 0.001$

The role of external motivation in influencing the desire to pursue a STEM career is also insightful. In this study, external motivation encapsulates issues such as support from parents and role models, challenging oneself because few women are in that area, and the desire to follow in the footsteps of people who are already into STEM professions. This was explicitly explained by most females interviewed. As noted earlier, their desire to pursue that career path was due to encouragement and motivation from role models such as teachers and parents (especially mothers). The role of government has also contributed to their strong desire in science and demystifying previously held views that STEM courses and careers are only for males, as noted by this female student:

> *…for me, I like and enjoy the field of science, and this passion started way back in junior high school when I had the opportunity to participate in science camps and talks organised for girls in our school. We had very good science teachers in our school who motivated us and took us on excursions to some industries to interact with female scientists and that really boosted my interest in science... (21 year old biological science female student).*

This shows the positive effects of the science clinics introduced by the government to increase female enrolment in STEM. It reiterates that eternal motivation from role models such as parents, teachers, and the government is critical, especially for females who desire to pursue a career in STEM. The lack of role models has been identified as a key disincentive for females and may intend to reduce aspiration in a STEM career (see Botella et al., 2019). Thus, if females, in particular, have people they can look up to as role models and programmes such as science clinics to support them, they are likely to pursue a career in STEM.

Conclusion and recommendations

This paper sought to examine the career aspirations of male and female students studying STEM courses and the influencing factors. The result shows that there is no significant difference in career aspirations between males and females and that they have almost the same career aspirations. While the literature highlights limited females' interest in science-oriented disciplines (Schiebinger, 2014), this study found a high enthusiasm among students, especially females who wanted to pursue STEM courses and careers. However, the study also revealed that pursuing a STEM career could be truncated by financial constraints, uncertainties in the job market, and the increasing unemployment in the job market.

Even though the findings of this study cannot be generalised, they seem to challenge the theoretical argument that gender stereotypes about females' lack of ability to pursue STEM subjects and careers, result from the socialisation process from home (Buunk et al., 2009; Tey et al., 2020). Instead, the findings revealed that the encouragement and motivation received from role models such as teachers, parents, particularly mothers, and the role of other stakeholders such as the government was a significant contributory factor to their desire to pursue STEM careers, especially for females. Females in particular, wanted to challenge themselves and change the status quo of fewer women in science-related fields. The factors point out that when females are motivated; it builds their confidence to study and chart a career path in that area. Indeed, self-efficacy and external motivation were significant factors contributing to their desire in pursuing science-related careers in line with some of the theoretical arguments (see Pajares, 2005; Buday et al., 2012).

Whilst individual capabilities and self-interest cannot be ruled out, for many females, the desire to make a difference was the motivating factor, while for males; it was the consideration of the economic prospects. Therefore, it is vital to continue to motivate females at an early stage in the educational level to stir up their interest in the sciences. Parents and other stakeholders should have continuous sensitisation programmes to change gender stereotypes toward females in the sciences. More science-related mentorship programmes for younger colleagues, particularly females, should be instituted by collaborating with educational institutions, government, and women's rights organisations. It is also important to go beyond mentorship programmes and advocate for policies such as scholarship schemes to provide quotas for females who want to further their studies in STEM fields and engineering in particular. This will provide greater ability for them to choose skills that they desired. It will also empower them to contribute to the transformation of their communities, enhance the economy and overall national development.

Finally, we recommend that there should be future research that would sample a larger number of students at different educational levels and institutions (i.e. secondary and tertiary) to ascertain the gender differences within the different STEM disciplines. It is also important to undertake a longitudinal study to track students studying STEM courses, particularly females, to ascertain whether these students actually end up in STEM fields. These are likely to generate more knowledge on the actual impact of science education and programmes on females interested in pursuing careers in STEM.

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Maintenance of rural water supply facilities in the Builsa North District of the Upper East Region of Ghana

Henry Achum Adeenze-Kangah

Abstract

In Ghana, the sustainability of rural water supply facilities has been a recurring national issue. Therefore, this study examined the maintenance structures, as they exist for the effective management of water supply facilities in the Builsa North District. The study was descriptive, non-interventional and applied the mixed method approach to collect data from 138 water users who were randomly selected from hand pump communities. The study found that the management architecture of the water supply systems of the district hinged on the District Water and Sanitation Teams (DWSTs), Water and Sanitation (WATSAN) committees, area mechanics and pumped spare-parts dealers. The significant constraints to pump maintenance were inadequate logistics, finance, and remuneration of DWST, poor financial mobilisation, financial embezzlement, and high attrition among WATSAN committee members. Additionally, poor transport support for area mechanics, bad access routes, and scarcity of spare parts were also significant constraints to the maintenance architecture. The study recommends government and donor/agency to provide requisite financial and logistical support to the DWSTs, WATSAN committees and area mechanics and provision of spare parts at affordable prices.

Keywords: Effective Maintenance, Rural Water Supply Facilities, (at least 6) note avoid long phrases

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