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Investigating the challenges faced by female students in STEM courses: case study of a traditional South African University

Abstract

The paper investigated the challenges faced by female students enrolled in the Science, Technology, Engineering and Mathematics (STEM) field of study. The social cognitive theory (SCCT) was employed to examine the role played by the environment, goals, behaviour, and self-efficacy factors of female students studying towards Engineering and Information Technology degrees at a traditional South African university. The study examined the interdependencies between these four factors and their role in female students' success in STEM courses at the university. The finding revealed that female students possess the self-efficacy required to excel in their studies, despite overt or covert hostilities and other challenges they face during their study. The data analysis indicate that female students need the support of their families in achieving their goals. The fear of disappointing parents or family members if they fail to obtain their qualifications seem to be a key motivation to female students in STEM courses. It is recommended that all stakeholders be positively involved in ensuring that female students in the STEM fields get the needed support. Such support, in tandem with their self-efficacy, outcome expectations and goal setting, will ensure that they overcome obstacles and are adequately equipped to realise their dream of achieving qualifications in this critical segment of the economy.

Keywords: *Social Cognitive Career Theory, female students in STEM, university education, outcome expectancy*

1. Introduction

The Science, Technology, Engineering and Mathematics (STEM) field is acknowledged as one of the key drivers of sustainable development worldwide. STEM is crucial in promoting global competitiveness and innovative capacity. Unfortunately, despite attempts to bridge the gender gap, women remain underrepresented in STEM careers (Ceci & Williams, 2011; Fernández Valdez *et al*., 2022). An untapped opportunity to increase STEM employment in developing countries such as South Africa exists. Skilled human capital is one of the significant resources for global development; therefore, more attention should be given to

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this phenomenon (Jabbah & Imran, 2013). The challenges faced by women in STEM careers and in the academic field are well documented in literature (Kanny, Sax & Riggers-Piehl, 2014; Avolio, Chávez & Vilchez-Román, 2020). Personal resilience, goal setting and an affirming environment have been found to assist female students in achieving their academic goals despite the hurdles they need to overcome. Although UNESCO (2007) states that the development of the modern world is hinged on equal opportunity and access to science for both genders, the metaphor of the glass ceiling is a real threat to women in STEM careers worldwide (Smith, Caputi & Crittenden, 2012). Glass ceiling in this context is described as a blockage in the progression of competent and proficient women in organisations due to gender bias or racism (Aranha, Aquinas & Saldanha, 2019).

Researchers have argued that the factors influencing the challenges faced by women are myriad (Kanny *et al.,* 2014). With the aid of the social cognitive career theory (SCCT), this paper examines the role played by the environment, goals, behaviour, and self-efficacy factors of female students studying Engineering and Information Technology degrees at a traditional South African university in achieving their learning outcomes. Quantitative data was analysed statistically, and the results are presented, followed by recommendations on how to alleviate the students' challenges. The paper is structured as follows; a review of relevant, extant literature is conducted, followed by a discussion of the method and research design. Findings from the empirical data is thereafter presented, followed by the conclusion and recommendations for further studies.

2. Methodology

The SCCT, originally by Bandura (1999), and further extended by Lent, Brown, and Hackett (2000) was employed to investigate the influence exerted by the student's self-efficacy, personal goal setting, environment, and behaviour on women's performance in STEM courses at a traditional South African university. An investigation of how the four elements of the SCCT influence learning outcomes for women in Engineering and Information Technology, and how this could be applied in a way that encourages more women to venture into the STEM fields was conducted. A quantitative questionnaire instrument was designed to investigate the research problem. The paper investigates the impact of personal attributes, the environmental context and female students' behaviour on their academic performance in the STEM fields. Lent *et al.* (2000) translated Bandura's social cognition theory into the three concepts of self-efficacy, outcome expectations and personal goal setting. They posit that the three concepts are key in understanding how students achieve desired academic outcomes. For this study, we added the environmental factor, as discussed by Bandura (1999) as it is considered a vital element for the study's context. An ethical clearance certificate (reference no: FSETFREC01-10-21MNC) was obtained from the University research committee before data was collected from the students. Data is available on request from the corresponding author.

3. Literature review

The dependence of all sectors of the economy on technology has lent credence to the urgent call for an improvement in STEM courses, as well as an improvement in women's rate of participation across the broad spectrum of academic pursuit (Moss-Racusin *et al.,* 2012). According to He *et al.* (2020), the academic opportunities available to a student at higher education/tertiary level are hugely dependent on the choice of subjects chosen at high school level. Research shows that socialised gender norms, cultural values and the impersonal

nature of the sciences are some of the factors that discourage female students from pursuing careers in the STEM fields (Blackburn, 2017).

Studies also suggest that women find the STEM environment intimidating, competitive and lacking in empathy; hence the tendency for more women to show interest in the social sciences where they are of direct service to people (Norgbey, 2017; Guy & Boards, 2019). The personal traits of conformance, nurturing and family commitment are some of the reasons advanced for the paucity of women in the STEM fields (Cech & Blair-Loy, 2019). Additional issues such as the lack of female role models, hostility from male colleagues, gender-based exclusionary behaviour in the classroom, and the difficulty of linking theory to practice were also identified (Blackburn, 2017).

Myriad studies have confirmed the existence of a glass ceiling based on numerous constructs such as individual barriers, cultural barriers and social barriers (Smith *et al.,* 2012). Some of the hindrances are the organisational culture, prejudices, biases and the attitude of male colleagues (Aranha *et al.,* 2019; Rottinghaus, Falk & Park, 2018). Research suggests that females in the STEM fields still require support and affirmation (Ceci, Williams & Barnett, 2009; Blackburn, 2017). Women in science are paid less than their male colleagues, get promoted less often and win fewer grants (Nimmesgern, 2016). Women with STEM degrees are less likely to work in a STEM occupation than men and are more likely to go to the healthcare or education fields (Ceci *et al.,* 2009). As the complex, continually evolving occupational landscape in STEM fields dictates the futuristic career paths, research shows that women are still underrepresented in this sphere globally (Blackburn, 2017).

There is a gender imbalance ratio in the sciences. Statistics for universities show that male students dominate in most popular majors in STEM-related courses (Gupta, 2017). Enrolment for male students account for more than 80% student population in STEM, while females tend to cluster around majors in the social sciences, such as art, education, psychology, and sociology (He *et al.,* 2020). Although women have made impressive accomplishments in tertiary education over the past decade, participation and enrolment in STEM subjects have been lagging compared to the high numbers of males (He *et al.,* 2020). Gender and gender identity are built because of social interactions and affected by an individual's social environment, including other people's behaviours and attitudes in a social context; hence the perception, attitude and disposition of others towards women in the STEM fields can significantly impact their ability to perform optimally in the field.

3.1 The influence of societal norms on women's underrepresentation in sub-Saharan Africa

Parental, institutional, and societal factors were found to be key contributors to gender inequality in sub-Saharan African countries. Parents' perceptions of their children's academic abilities affect the level of confidence the children develop in their own abilities. The home environment also influences a child's perception of the field (Blackburn, 2017). The culturally inclined stereotype that females are less talented in Mathematics for instance than males also play a role. Parents tend to overemphasise their sons' abilities and underate their daughters' abilities in Mathematics (Gomez *et al*., 2020). Such parentals' influence on their children's career choices is important and should be considered since they give advice, emotional support, and financial provision to their children with mothers especially playing a critical role in their daughters' career choices (Norgbey, 2017).

Additionally, due to women's virtues being linked to labels such as "wise mothers and good wives" as prejudiced by Confucian philosophy, most parents prefer to invest more in the education of male children. It is projected that they are likely to get a 'return' on their investment, unlike a girl who belong to in-laws in the future (He *et al.,* 2020). There are many biases within STEM; among the intellectual and physical hindrances are gender and race, labelled as having distinct advantages and privileges (Farinde & Lewis, 2012).

In another vein, the global development divide is widening, thus hindering global competitiveness and economic advancement (Norgbey, 2017). There is a limited number of women who enrol for STEM programmes as compared to a high number of females in humanities and social science specialisations. Globally, insubstantial progress has been made in addressing the gender gap and inequality as the United Nations Educational, Scientific and Cultural Organization records indicate that only 28% of research and development employees are women (Ceci *et al.,* 2009). Science is a critical determinant in innovation, and a country cannot afford to lose any individual who can contribute vastly with skills and talent because of their gender (Cech & Blair-Loy, 2019).

Work environment

Despite women making up half of the world's population, they are underrepresented in the STEM workforce (Kanny *et al.,* 2014). Individual, institutional and policy-related factors are the main contributors to the underrepresentation of women in science. Science, Technology & Innovation initiatives have been introduced in sub-Saharan African countries' policies to encourage women to participate more actively in science. However, these are often not applied (Ceci *et al.,* 2009).

Additionally, the gender gap has widened due to the absence of gender-friendly policy frameworks that can prevent women from abandoning the science profession (Guy & Boards, 2019).). The lack of solid gender-sensitive promotion policies allowing women to advance their careers results in most women discouraged from pursuing long-term careers in STEM (Ceci et al., 2009) and pursuing other professions. Research shows that women are not disposed towards vocalising the discrimination and unfairness they experience because they are less cognisant of it, are unwilling to put their careers at risk or being labelled as problematic (Nimmesgern, 2016).

Traditional gender roles have added to the socialisation of African girls, as women have been portrayed as being driven by emotions and irrational yet cooperative, dependable, and loyal followers (Blackburn, 2017). Males, on the other hand, are considered the most suited for the science fields as they are deemed competitive, logical, analytical people and producers (Farinde & Lewis, 2012). Additionally, lack of professional mentors and networks, and societal expectations, like choosing between raising a family and developing their career, are some of the factors that demotivate many women from pursuing future in STEM careers (Cech & Blair-Loy, 2019).

Patriarchy and culture negatively affect the STEM curriculum and teaching and learning styles and reinforce the gender gap in higher education and STEM programmes (Norgbey, 2017; Matete, 2022). Suggested strategies to combat gender inequality are gender mainstreaming, gender affirmative action, capabilities-based policies and practices, and awareness. Several other contributing factors were also identified in literature including: influence of teachers, influence of the labour market, parent's influence and, peers' influence (He et al., 2020).

A sparse number of female researchers are unexpectedly recorded in high-income countries. In Germany, France and the Netherlands, the ratio of one in four researchers is recorded in favour of men (Ceci *et al.,* 2009; Moss-Racusin *et al.,* 2012). An even lower number is found in Japan (15%) and the Republic of Korea (18%) (Ceci *et al.,* 2009). Africa faces the greatest challenge in the underrepresentation of scientists; specifically, recruiting and retaining local talent is a significant challenge. The lack of resources and adequate STEM skills can be insufficient for trainee scientists to interact and compete with peers worldwide (Okeke *et al.,* 2017). To meaningfully contribute to global development in STEM fields, gender inequality must be resolved in African universities as well as in the global community at large (Norgbey, 2017). The exclusion of Africa in global participation due to the shortage of leading scientists contributes to an even greater gap in the underrepresentation of women in STEM (Okeke *et al.,* 2017).

Educational context

The shortages of trained STEM professionals may prospectively lead to a decline in the innovation potential of a society (Ngila *et at.,* 2017). Empirical studies have demonstrated that countries tend to develop faster if there is a high proportion of science and engineering (STEM) graduates than countries with a high percentage of graduates in other disciplines outside (Tacsir, Grazzi & Castillo, 2014). The move between high school and tertiary education has been identified as the crucial transition point where most students leave the science and technology field (Shober, 2014) to other disciplines. The next section discusses the SCCT, which forms the theoretical underpinning of the study.

4. Theoretical background

The social cognitive career theory

Bandura (1999) states that three factors, including the person, the environment, and behaviour, are intertwined in the process of learning, and the positive development of all the factors is more likely to ensure a successful outcome in the achievement of academic goals. Lent *et al.* (two thousand) further extended Bandura's theory by translating the aforementioned three factors into self-efficacy, outcome expectations and personal goal setting. For this paper, **self-efficacy** is described as the personal beliefs of female undergraduates about their ability to perform well in their chosen field of study. Although Bandura (1999) states four primary sources of learning experiences as responsible for self-efficacy beliefs, research has confirmed that personal performance accomplishments are the strongest motivation for raising self-efficacy beliefs. **Outcome expectations** are students' personal beliefs about the consequences of their performance (or non-performance) of certain actions regarding their studies. Self-efficacy speaks to the intrinsic '*can I'* quality, while outcome expectations speak to the concept of what outcomes can result in the performance of certain actions in female undergraduates. Outcome expectation beliefs are based on extrinsic reinforcements such as expected rewards for performance and self-directed consequences hinged on the sense of personal achievement students may feel at accomplishing a perceived challenging task. The two are intricately linked as it may be argued that the same primary sources apply to influence both self-efficacy beliefs and outcome expectation beliefs. The third concept is goals, which is described as a student's determination to engage in specific behaviour to achieve a particular future outcome. **Personal goal setting** is the main element that influences the students' behaviour without external reinforcement (Yusoff, Mahfar & Saud, 2019). Four sources of

information are considered to influence goal attainment namely: Performance attainment, shared experiences, verbal persuasion, and coping mechanisms.

The fourth factor investigated is the influence of students' studying **environment** on their performance and successful completion of their courses. The paper focuses on self-efficacy as an important investigator of how women in STEM courses at the university overcome social and personal hurdles and achieve their education goals despite negative institutional, peer or environmental factors.

Online quantitative questionnaires were distributed to seventy female undergraduates in B. Tech Information Technology (IT) and Engineering courses. The respondents' year of study ranged from first to third year (advanced diploma). The representative population was selected based on the research problem under investigation. Additionally, all students had just completed a year in their respective courses and could relate to the roles played by SCCT attributes in the performance of their academic achievements for at least one year. The number of registered female students was estimated to be about 1693 across two campuses in the 2021 academic year. However, we only collected data from students in IT and Engineering across two sites, with an estimated number of six hundred students in the category, a heterogeneous purposive sampling method was employed to select the study's respondents. This method was considered as most appropriate as it is believed that selecting participants with diverse characteristics will ensure maximum variability within the primary data.

The data was collected via an online survey hosted on Google Forms. The response rate for the questionnaire was 71 % of the distributed questionnaire population, which is an acceptable ratio for research of this nature. The results were exported from an Excel format into the SPSS package for analysis.

5. Data analysis and interpretation of the findings

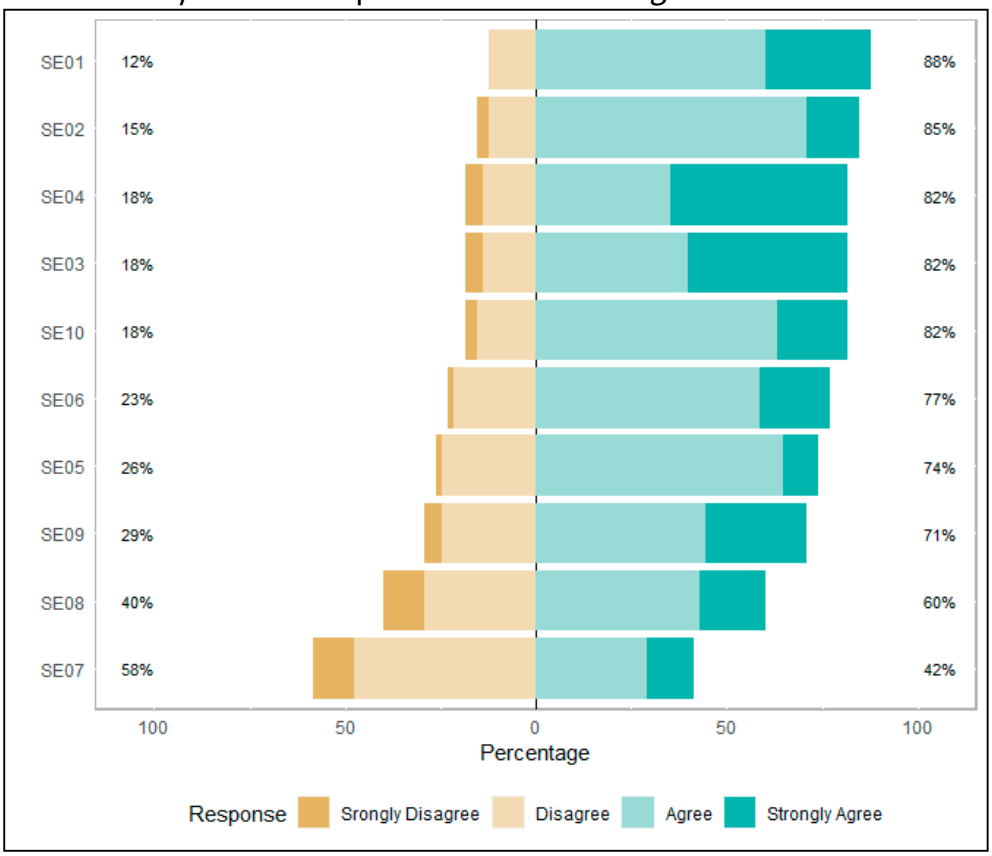

Figure 1: Likert scale plot for self-efficacy

where
SE01 = It is easy for me to stick to my aims and accomplish my goals
SE02 = I am confident that I could deal efficiently with unexpected events
SE03 = I have a good understanding of my own emotions
SE04 = I am strong enough to overcome life's struggles
SE05 = I am sensitive to the opinion of my peers, lecturers and family
SE06 = I usually take rational decisions and keep my emotions in check
SE07 = I feel weak and helpless most of the time
SE08 = I have never considered the possibility of failing in life
SE09 = I can remain calm when facing difficulties because I can rely on my coping abilities
SE10 = When I am confronted with a problem, I can usually find several solutions

The Likert scale plot for self-efficacy shows that female students in STEM fields are ambivalent with respect to their self-efficacy and how this affects their ability to perform well in their chosen field of study (Figure 1). The results are considered positive as research has shown that students with strong self-efficacy beliefs are more likely to persevere, overcome adverse situations, and achieve their goals (Bandura, 2001; Sabouripour *et al.,* 2021). Approximately 88 % of female students in the study's STEM fields claimed to have the ability to stick to their

aims and accomplish their goals (SE01), while 84 % could deal efficiently with unexpected events (SE02). However, more than half (58 %) of the respondents claimed to feel weak and helpless most of the time (SE07). Additionally, 74 % of the students affirmed that they care about the opinions of their peers, lecturers, and family members (SE05). This seems to suggest that female students believe in their abilities to succeed but are also affected by the opinion of the stakeholders in their lives. It, therefore, makes sense that the students desire the support of their peers, lecturers and family members as they pursue the goal of obtaining qualifications in the STEM fields. The density plot for self-efficacy (Figure 2) reveals that the probability of agreement with the opinions SE01, SE03, SE04 and SE07 is high among advanced diploma and third-year students. It is moderate in SE02, SE05, SE06, SE09 and SE10. The advanced diploma students do not agree so much with the opinion in SE09.

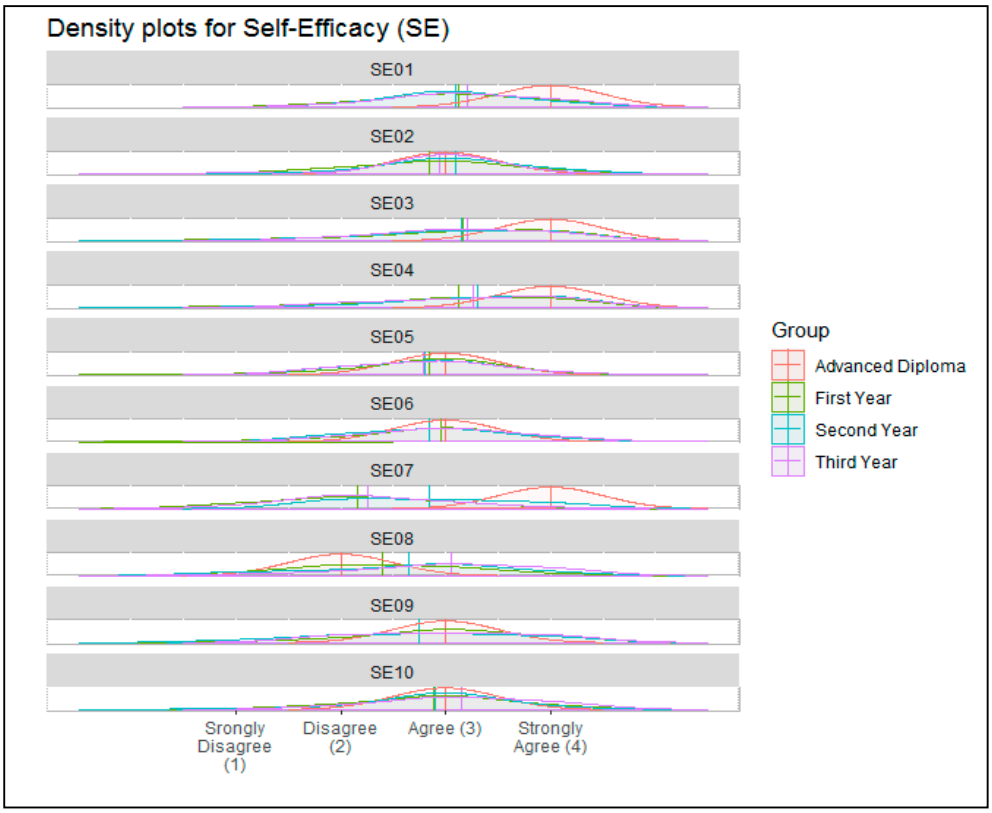

Figure 2: Density plots for self-efficacy by level

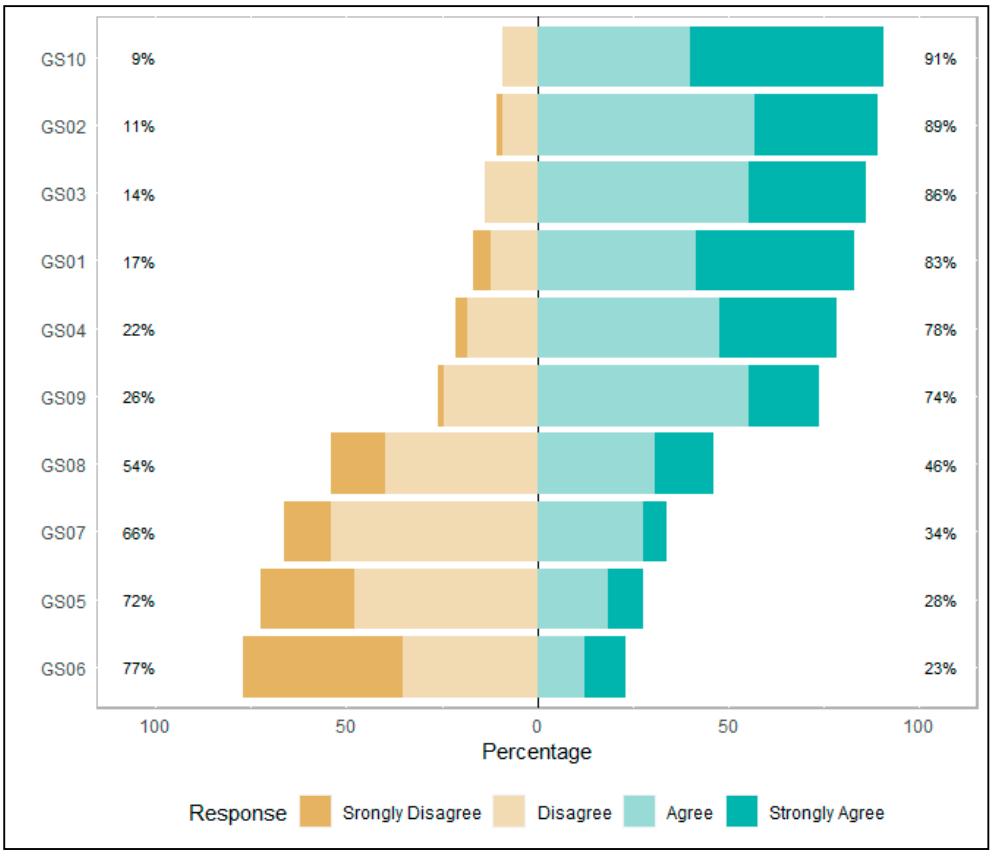

Figure 3: Likert scale plot for personal goal setting

where
GS01 = I have always been interested in the science field
GS02 = I have definite plans for my post-school career path
GS03 = I can handle the pressures that come with my chosen career field
GS04 = I feel anxious about passing my courses
GS05 = I am not confident of my ability to do well in my chosen field of study
GS06 = I sometimes feel like I am wasting my time in my area of study
GS07 = The major concepts in my field are difficult for me to understand
GS08 = My role models have always been in the science field
GS09 = I feel like I am an average student most of the time
GS10 = Many of the adults I admire have strong academic skills

This section sought to investigate the impact of personal goal setting on female students in STEM disciplines. As displayed in Figure 3, results obtained revealed that a keen admiration for people with strong academic skills and personal interest were the most crucial factors for these sampled students (GS10 and GS01). Despite this interest, the confidence level of the students regarding their ability to excel in their chosen field of study is incredibly low (GS05, GS06 and GS07). The findings imply that students have a keen interest in the STEM field but encounter difficulties grasping the concepts. Interestingly, 86 % of the students expressed

confidence that they can manage the pressure that comes with the field of study. It is, therefore, asserted that most of the students will excel in their courses with the proper support as they have the right attitude and can withstand the pressure of the field of study. If faculty members, male peers and tutors offer support to female students, they are likely to excel and remain in STEM careers after graduation. The density plot for the levels of education reveals the probability of agreement with the opinions GS10, GS02, GS03 and GS01 high among advanced diploma and third-year students as shown in Figure 4. There is strong disagreement with GS05 and GS06 among most respondents, suggesting that most students believe there is value in studying towards these STEM degrees.

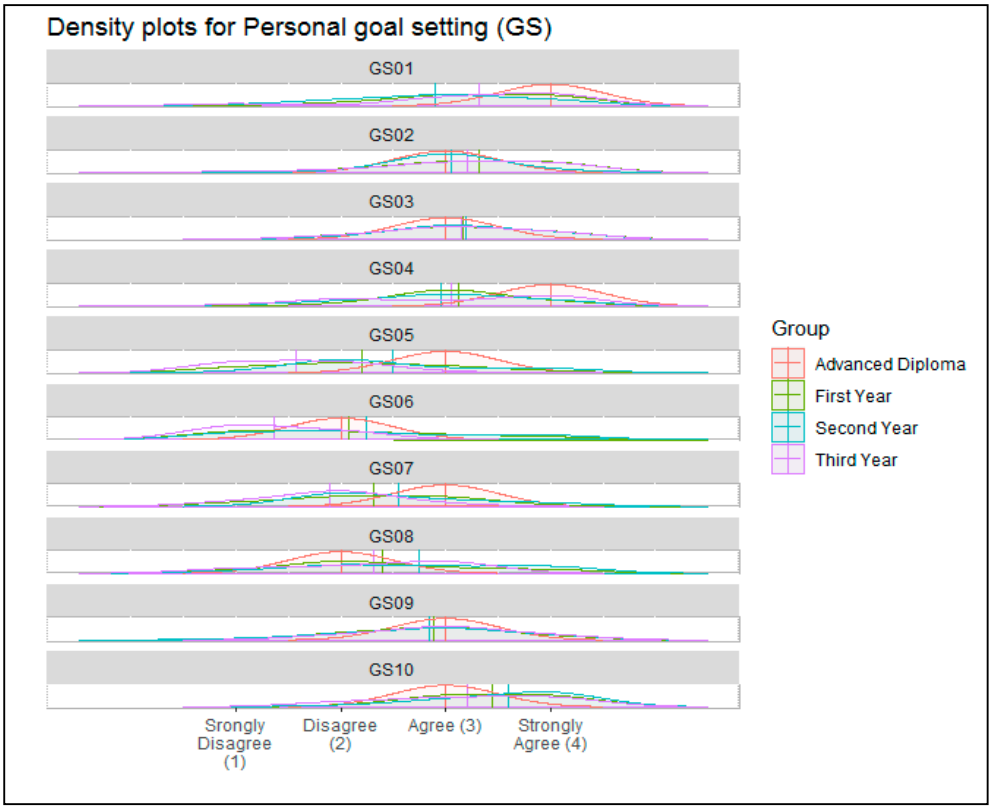

Figure 4: Density plot for personal goal setting by level

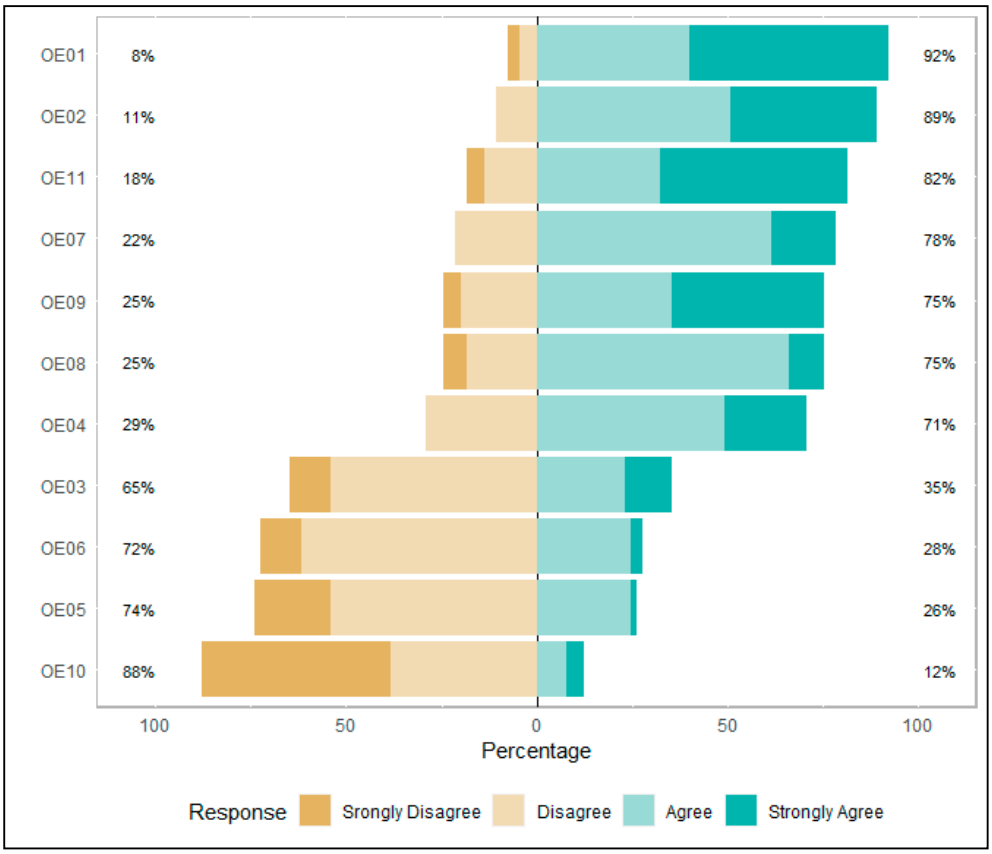

Figure 5: Likert scale plot for outcome expectations

where
OE01 = My career field is an important part of who I am
OE02 = This career field has a great deal of personal meaning to me
OE03 = I do not feel "emotionally attached" to this career field
OE04 = I have created a plan for my development in this career field
OE05 = I do not have a strategy for achieving my goals in this career field
OE06 = I do not identify specific career goals for my development in this career field
OE07 = The costs associated with my career field sometimes seem too great
OE08 = Given the problems I encounter in the career field; I sometimes wonder if I will get anything out of it
OE09 = The science career field is highly recognised in our society,
OE10 = I chose my current course due to my parents' recommendation
OE11 = In the future, I plan to mentor others in my field

As shown In Figure 5, female students regard their study area as important to them, with 89% stating that the career field held a personal meaning for them (OE02). This is considered an affirmation of the result in personal efficacy where students contend that they have the resilience and determination required to obtaining these qualifications. Respondents who chose the career path due to pressure from their parents (OE10) were in the minority (12 %),

reinforcing the belief that most students are studying in their career path due to strong personal goal setting and not compulsion from parents. Therefore, it could be extrapolated that female students have a strong attachment to their career fields and should be offered the necessary support to complement their determination to succeed. The density plot shown in Figure 6 for outcome expectations reveals that the probability of strong agreement on OE01, OE02 and OE11 is greatest among advanced diploma, third and second-year students. This trend may be because these students have more experience of the challenges encountered in their fields while first-year students are still primarily engaged in foundational courses.

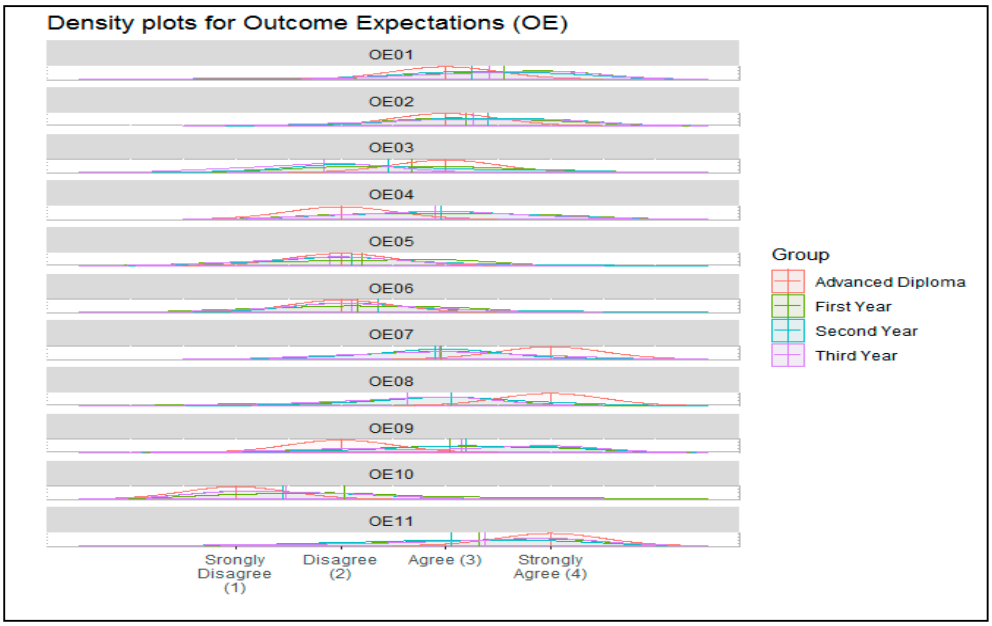

Figure 6: Density plot for outcome expectation by level

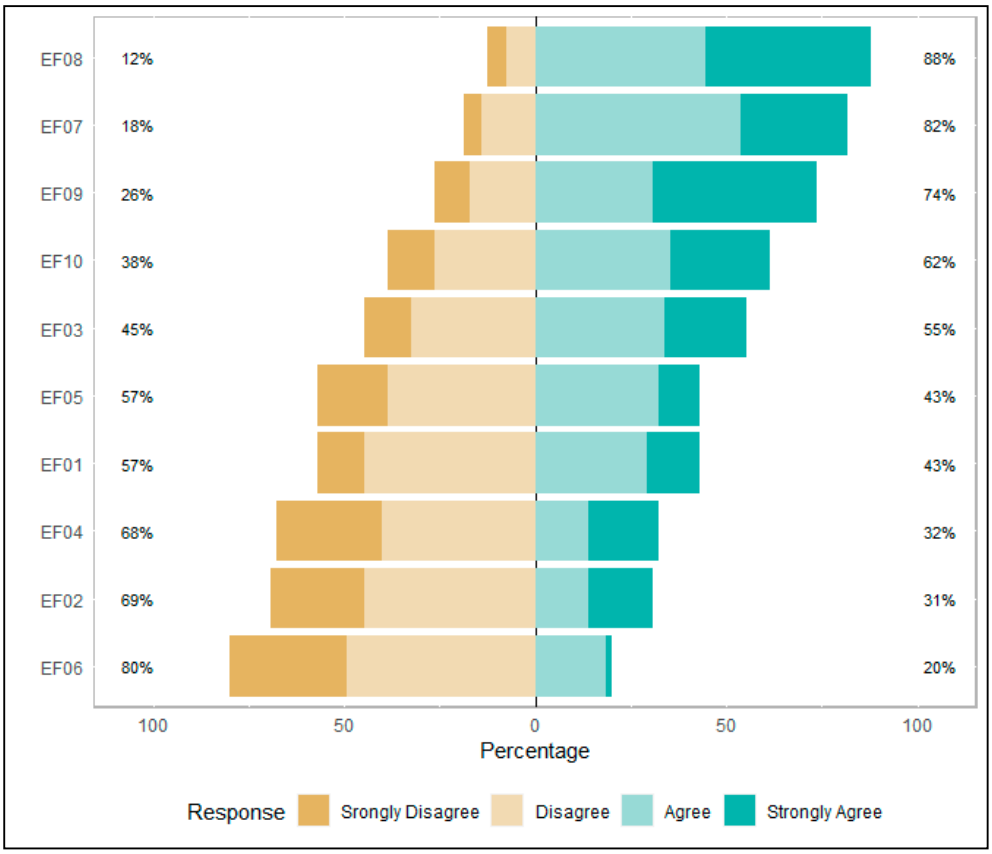

Figure 7: Likert scale plot for environmental factors

where
EF01 = There is no strong support for me as a female student in a male-dominated field
EF02 = I feel a sense of hostility from my male colleagues when in a group setting
EF03 = I am sometimes hesitant to seek help with difficult topics as I feel it proves that I am incompetent
EF04 = I often consider changing from my course to a less difficult/technical course
EF05 = Most of my female peers/course mates are not sure if they will succeed in their studies
EF06 = I sometimes get degrading remarks from my lecturers when trying to seek help with difficult topics
EF07 = I believe there are invisible obstacles on my way to success as a female science major
EF08 = My parents/family are very supportive of my career goals
EF09 = I am worried that I may fail and disappoint my family
EF10 = There are female faculty members available to assist me if I need help

The Likert scale plot for environmental factors shows a variation/disjunction in the results as displayed in Figure 7. 88% of the respondents stated that their family members are supportive of their study (EF08), which concurs with 74 % of students who are afraid of failing their courses and disappointing their families (EF09). Eight-two per cent of respondents strongly

agreed that there are invisible obstacles on their path to success in their chosen courses (EF07), while only 18 % disagreed with the statement. It is believed that there is need for a qualitative study to understand further what these students perceive as "invisible" obstacles and how they could be addressed and alleviated. Contrary to the literature reviewed, only 31 % of respondents strongly agreed with their peers, while 20 % agreed that they get degrading remarks from their lecturers when they sought help with difficult topics (EF06). The results also show that 55% of respondents hesitate to ask for help when facing challenges as they are afraid of being seen as incompetent (EF03). The results thus show environmental factors in a positive light as students are likely to revert to their self-efficacy beliefs when there are challenges, as they would not want to disappoint their support system. The density plot on environmental factors as indicated in Figure 8 reveals that advanced diploma students, third- and second-year students have a higher probability of strongly agreeing with the statements.

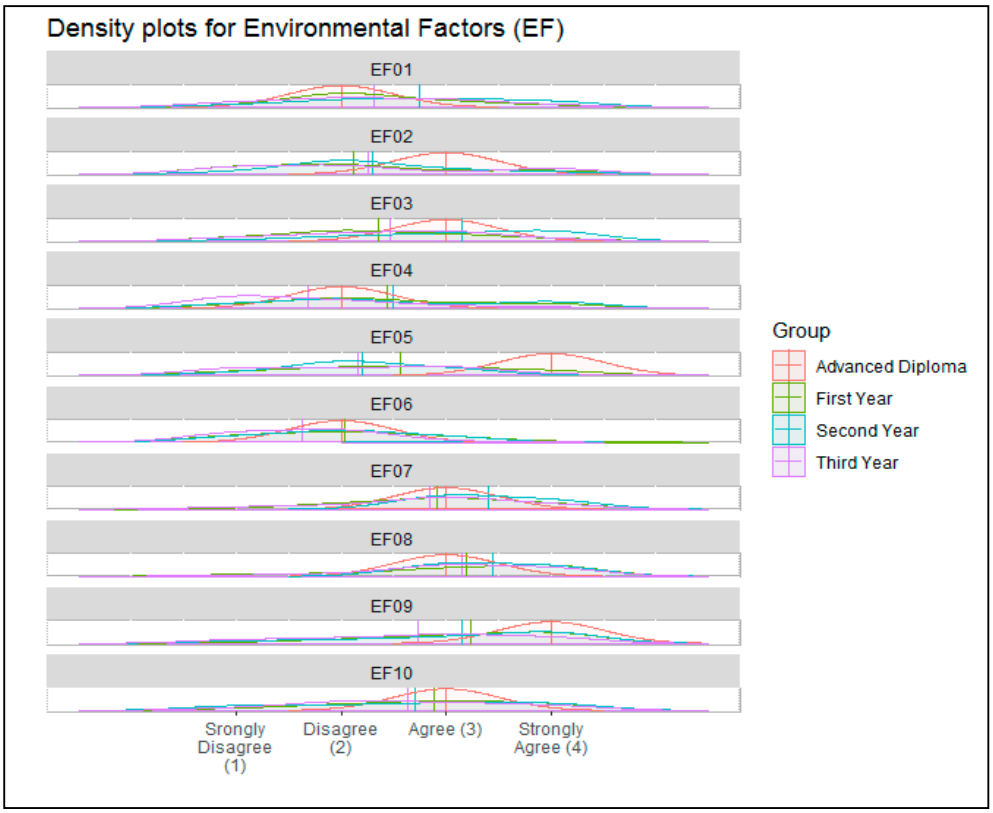

Figure 8: Density plot for environmental factors by level

Bold items in Table 1 signify the most significant factors in the survey.

Table 1: Major determinants in the factors

Item	Opinion/response	SD	D	A	SA	% Agree	% Disagree
1	SE01	8	0	39	18	**88**	12
2	SE02	2	8	46	9	**85**	15
3	SE03	3	9	26	27	**82**	18
4	SE04	3	9	23	30	**82**	18
5	SE05	1	16	42	6	74	26
6	SE06	1	14	38	12	77	23
7	SE07	7	31	19	8	42	58
8	SE08	7	19	28	11	60	40
9	SE09	3	16	29	17	71	29
10	SE10	2	10	41	12	**82**	18
11	GS01	3	8	27	27	**83**	17
12	GS02	1	6	37	21	**89**	11
13	GS03	0	9	36	20	**86**	14
14	GS04	2	12	31	20	78	22
15	GS05	16	31	12	6	28	72
16	GS06	27	23	8	7	23	77
17	GS07	8	35	18	4	34	66
18	GS08	9	26	20	10	46	54
19	GS09	1	16	36	12	74	26
20	GS10	0	6	26	33	**91**	9
21	OE01	2	3	26	34	**92**	8
22	OE02	0	7	33	25	**89**	11
23	OE03	7	35	15	8	35	65
24	OE04	0	19	32	14	71	29
25	OE05	13	35	16	1	26	74
26	OE06	7	40	16	2	28	72
27	OE07	0	14	40	11	78	22
28	OE08	4	12	43	6	75	25
29	OE09	3	13	23	26	75	25
30	OE10	32	25	5	3	12	88
31	OE11	3	9	21	32	**82**	18
32	EF01	8	29	19	9	43	57
33	EF02	16	29	9	11	31	69
34	EF03	8	21	22	14	55	45
35	EF04	18	26	9	12	32	68
36	EF05	12	25	21	7	43	57
37	EF06	20	32	12	1	20	80
38	EF07	3	9	35	18	**82**	18
39	EF08	3	5	29	28	**88**	12
40	EF09	6	11	20	28	74	26
41	EF10	8	17	23	17	62	38

The test of two means was conducted to for the significance of the difference of two means between the number of respondents in favour of the factors and those who were not:

$$T = \frac{\bar{d}}{s_d \sqrt{\frac{1}{n}}}$$

Where:

$\bar{d}$ is the mean difference, s_d is the sample standard deviation of the differences, and n is the sample size.

Hypothesis: There are significant differences in the percentages of those who gave positive and negative responses

$$H_0: \mu_1 = \mu_2 \quad \text{vs} \quad H_1: \mu_1 \neq \mu_2$$

The results obtained using STATA version 15 are presented in Table 2.

Table 2: Difference of two means test result

Variable	Obs.	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Agree	40	40.7	2.542006	16.07706	35.55831	45.84169
Disagree	40	24.3	2.542006	16.07706	19.15831	29.44169
Diff.	40	16.4	5.084012	32.15412	6.116615	26.68339
Mean(diff.) = mean (agree – disagree)					t = 3.2258	
Ho: mean(diff.) = 0				Degrees of freedom = 39		
Ha: mean(diff.) < 0			Ha: mean(diff.)! = 0		Ha: mean(diff.) > 0	
Pr(T < t) = 0.9987			Pr(|T| > |t|) = 0.0025		Pr(T > t) = 0.0013	

Since the p-value of 0.0001 is less than the significance level of 0.05, the null hypothesis is rejected. Therefore, the difference in the means is statistically significant.

6. Summary of findings

The data analysis revealed that the sampled female students in the STEM fields in the traditional University have the self-efficacy, personal goals, and outcome expectations that they need for them to succeed in their chosen fields of study, despite mitigating factors such as societal stereotyping, hostility from male colleagues and a lack of female role models. However, the analysis also reveals that female students do fear disappointing their families and significant others. Sometimes they hesitate to ask for help even when struggling as they do not want to appear incompetent or incapable. Additionally, about 82 % of them alluded to obstacles on their path to success, but the quantitative nature of the investigation precluded further probing as to the nature of these obstacles.

There is evidence that female students' self-efficacy beliefs are major determinant factors in their ability to succeed in their studies. The major determinants in goal setting and outcome expectations also affirm these as they allude to how important the STEM fields of study are to the students. The most significant environmental factors are the support and affirmation of parents and families, and there are unknown obstacles that female students believe are impeding their progress. Therefore, based on the results of this analysis, students at this university have the ability, self-efficacy, and goal setting factors to complete their studies successfully. However, we find that a crucial factor for the students is the support of their

significant others, and we recommend that students are assured and supported as they pursue their studies in a STEM field. It is also important that female students do not feel a sense of foreboding or limitation preventing them from asking for help whenever needed. Faculty, peers, and the university must do more to assure female students that the playing field for both male and female students is equal and that there are no obstacles on their paths due to their gender.

7. Conclusion

The paper investigated the interdependencies between self-efficacy, outcome expectations, goal setting and environmental factors and their role in female students becoming successful in STEM courses. The results reveal that female students are highly conscious of how important their area of study is to them and are usually focused on getting their degrees despite some challenges they face in their educational context. The study also revealed that students are anxious about the possibility of disappointing their families if they do not obtain their qualifications. We recommend that all stakeholders be positively involved in ensuring that female students in the STEM fields get the support they need. Such support, in tandem with their self-efficacy, outcome expectations and goal setting, will ensure that they overcome any hidden obstacles and are equipped to tackle environmental factors effectively.

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