The underrepresentation of women with STEM backgrounds in African TechCos

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ABSTRACT

The global phenomenon of digital transformation is expected to continue into the foreseeable future, forcing companies to ramp up their digital skills to avoid being disrupted by new entrants to the market. However, a digital skills crisis looms, particularly regarding women and girls in the workforce. There is a significant underrepresentation of women in Science, Technology, Engineering and Mathematics (STEM) fields, disciplines critical to meeting companies' needs in the Fourth Industrial Revolution. There has been a call for action from several governments and civil society to address the gender gap in STEM, which is seen as not just a social issue but an economic priority as well.

This research explored the barriers to entry and retention of women with STEM backgrounds in African TechCos. The study aimed to identify factors that motivate and enable women to enter STEM fields, particularly in the technology industry, as well as identify barriers to entry and retention for women in these sectors. The research was conducted through in-depth interviews with eight women with STEM backgrounds working in TechCos across several African countries. The findings of the study revealed that the primary motivators for women to enter and persist in STEM fields are societal perceptions and impressive financial prospects. The study discovered that the lack of visible, successful women in STEM that girls and young women can look up to during their school days reduces their willingness or eagerness to enter and stay in STEM careers. The study concludes that bridging the gender gap in STEM requires first addressing the root cause of the issue, i.e. the traditional parenting practices that do not expose girls to STEM-related activities from a young age. The study recommends the adoption of collaborative efforts by relevant stakeholders to implement transformational processes to address the low female representation in STEM.

KEYWORDS

STEM, TechCos, barriers, women

DECLARATION

I, **Mabedi Ruby Mufahothe**, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Mabedi Ruby Mufahothe Signature:

Signed at …Kent view……

On the ……**26th** ….day of ……**February**… 20**24**…..

DEDICATION

I dedicate this research report to a little girl from Siga and her mother. Mabedi, you did it, kudos my sista!

To my mother, I have finally kept my promise. I may have taken the scenic route but here we are, I hope you are proud.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Meaning
EXCO	Executive Committee
GSMA	Global Systems for Mobile Communications Association
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communications Technology
IS	Information Systems
IT	Information Technology
OTT	Over The Top
RO	Research Objective
SSA	Sub-Saharan Africa
SET	Science, Engineering and Technology
SCCT	Social Cognitive Career Theory
STEM	Science, Technology, Engineering and Mathematics
TECHCOs	Technology Companies
TELCOs	Telecommunications Company
WEF	World Economic Forum

CHAPTER 1. INTRODUCTION

1.1 Statement of purpose

This study aimed to explore the barriers to entry and retention of women with STEM backgrounds in African TechCos.

1.2 Background of the study

Technological disruption is the greatest driver of long-term force for change in the world. As a result, technology and the digital revolution are penetrating all aspects of organisations, as the fourth industrial revolution (4IR) continues to influence the drastic change in traditional processes, organisational forms, strategies, and jobs (Armstrong & Lee, 2021). Technological advancements are important in all spheres of society, be it academic, personal, or organisational domains. Therefore, the business sector desperately needs digital skills to meet these technological demands (Valdivia, 2019), STEM – Science, Technology, Engineering and Mathematics education combines elements of several disciplines, including technology, to empower students to transform the world through innovative and sustainable solutions, thus boosting technological advancements (Norris, 2022).

Although women such as Marie Curie, Ada Lovelace, Katherine Johnson, Tu Youyou and Maryam MirzaKhani have made invaluable contributions to the fields of STEM over the years, women and girls represented only 35 percent of STEM students in 2023 (Coto, 2023). Axian Telecom approximates that 90% of future jobs will require a basic understanding of information technology (IT). However, there is still a significant gender gap in the enrolment for STEM subjects, with fewer girls taking up the subjects and women underrepresented in STEM professions (Kamba, 2023). Some researchers attribute the low representation of girls and women in STEM to a global leaky pipeline (Marie-Nelly, 2021; Muhoro, 2023). The term leaky pipeline refers to the issue of women being susceptible to leaving their academic or professional careers, i.e. “leaking” out of

the system (Jakobs, 2022). Research data indicates that while more girls in Sub-Saharan Africa (SSA) enrol in secondary schools than their male peers, many drop out before completing their school programs, and those who finish are unable to enrol or excel in STEM-related professions (Marie-Nelly, 2021).

Tech-Driven-Telcos are described by TM Forum as telecommunications companies (telcos) that have recognised a need to transform from Telcos to TechCos (Patel & Smyth, 2021). Telcos are reported to be responding to an increasingly disruptive environment by maintaining their role as primary providers of telephony services and augmenting their service offerings with new products and services typically offered by OTT (over-the-top) players. This is an attempt by Telcos to utilise their existing networks and platforms to flight products and services to their clients, a role previously played predominantly by ICT (Information and Communications Technology) companies (Moitra, 2021). The word TechCos is thus derived from technology companies. In recent years, the largest telco groups in Africa (MTN, Vodafone and &e) announced their transition from Telcos to TechCos. For the purpose of this study, telcos are referred to as TechCos, a word deemed interchangeable with STEM fields, technology companies/industries and “tech”.

The technology sector is in desperate need of digital skills enabled by education and experience in STEM (Valdivia, 2019). An executive in a major TechCo was quoted emphasising that “it is no longer acceptable for commercial and business teams to not have a basic understanding of IT/architecture principles” (Patel & Smyth, 2021, p. 3). Although it is estimated that 230 million jobs in SSA will rely on digital skills in 2030, only 30% of women in the region receive STEM training. This means women will be limited from participating in key sectors of society (Porfido & Marks, 2020). Research data indicates that the technology sector has been dominated by male employees with limited participation from women over the years (Motaung, 2019). To illustrate this point, a 2017 PWC study found that only 3% of females surveyed in the UK chose technology as their first choice of career (PWC, 2017).

The gender gap remains significant, as evidenced by a GSMA survey that reported that women accounted for less than 40% of the global telecommunications workforce in 2015, with African statistics falling significantly lower than the global average. Of the African telcos studied, less than 10% of their leadership roles were held by women (Molina et al.,2015). In another report, the Independent Communications Authority of South Africa (ICASA) claimed a 32.9% decline in female employees across the South African telco sector between 2020 and 2021 (ICASA, 2022), adding to the already poor statistics for the African continent.

1.3 Research problem

"In the age of hyper-advanced technology and pioneering scientific breakthroughs, it's easy to imagine that the STEM industries have outgrown outdated stereotypes and gender bias. Yet, as we stand on the cusp of an era that promises unprecedented technological progress, a lingering question remains: why does the world of science, technology, engineering, and math still often resemble an exclusive 'club'?" (Christine Lewington, 2023, para.1). Science, technology and innovation have been identified as key drivers of Africa's future industrialisation efforts (Muhoro, 2023), and there is increasing concern that the exclusion of women from STEM will prohibit them from contributing to economic growth and innovation in business (Valdivia, 2019; Muhoro, 2023).

The lack of gender diversity is expected to harm economic activity, resulting in reduced innovation and continued implementation of traditional approaches, leading to a lack of competitiveness in all sectors of industry (Motaung, 2019). The opportunity cost of excluding women from technology industries has been sized at $1 trillion loss in GDP for low and middle-income countries over a period of 10 years (unwomen.org, 2023; Valdivia, 2019). Therefore, bridging the gender disparities in STEM is not only a social issue but a business imperative (Muhoro, 2023). The gender disparity issue is exacerbated by the disruption of industries by technological advancements and innovation, resulting in women losing their jobs (Orser et al., 2012). As long as the traditional gender patterns expect women to fulfil the tasks of caregiving while men are at the forefront of business, politics

and other leadership roles, the future will be shaped without the female point of view since technology reflects its creators (unwomen, 2023; Valdivia, 2019).

Analysts attribute various reasons for the low number of women taking up careers in technology, including societal influences and conscious or unconscious biases in the workplace (Motaung, 2019). According to gender specialists, female students opt out of STEM subjects in school as STEM careers are deemed incompatible with the female gender (Muhoro, 2023). Females are discouraged from joining STEM fields by stereotypical views regarding which gender is more suited to enter the STEM fraternity and which is not. A lack of encouragement from successful women and men in technology makes girls less likely to express and act on interest in the STEM field. Hostile environments towards women in the workplace, a significant lack of pay parity and minimal promotion rates further discourage women who manage to enter the sector (unwomen, 2023).

Based on the above, the problem that the study addresses is the reason why the proportion of women with STEM backgrounds in TechCos is reported to be stagnant or declining, despite the increased focus on the issue by several governments, businesses and civil society to address the gender gap. Recent research indicates that even with the increase of women with STEM qualifications, the percentage participation of women in STEM fields continues to decline. This picture exists even though STEM-related roles pay higher salaries than non-STEM roles, suggesting a variety of reasons exist for the gender gap in TechCos (Jiang, 2021). Bridging the gender disparity in the technology sector requires identifying the barriers to entry and reasons for the high attrition rates of women from the industry. There is an urgent need to accelerate or scale up current and unexplored innovative interventions that can significantly move the needle in addressing the root causes of gender disparities in STEM (Marie-Nelly, 2021).

1.4 Research objectives

The research objectives assessed as part of this study are:

1. **RO1**: to identify factors that motivate and enable women to enter STEM fields, particularly in the technology sector.
2. **RO2**: to identify barriers to entry and retention of women in TechCos.

1.5 Rationale

According to Porfido and Marks (2020), even though the technology sector is growing faster in Africa than in any other region, inclusive participation in the industry remains a challenge. The demographic profile of the largest Telcos in Africa depicts a similar picture. For example, MTN Group (the largest African TechCo in 2022 by market size) reported a workforce that consists of only 20% women in technology in 2022 (MTN Group, 2023). MTN leadership has since publicly committed to achieving gender equity and a higher representation of women in technology to support its TechCo strategy (Abdool, 2022). With a gender profile of 26% women in the Airtel workforce during 2022, and in recognition of the role technology plays in innovation and design of ideas, the Airtel Group has put measures in place to develop its pipeline of female talent (Airtel Africa, 2023). Similarly, the Vodacom Group has identified the need to enhance its female representation to address its male-dominated staff complement. The Group continuously runs programs to provide females across its operations with ICT skills and tools to flourish in STEM fields (Vodacom Group, 2023). The TechCos require a ramp-up of their digital skills and capacities, particularly from a gender diversity perspective.

The execution of this study was intended to either corroborate or dispute the conclusions reached during the literature review on the female composition of the workforce in TechCos. The empirical contribution of the study consists of valuable insights regarding women's life experiences working in STEM industries, to augment existing literature on the low representation of women with STEM backgrounds. The resultant insights can be applied to developing interventions to encourage women to enter and stay in the technology industry.

From a methodological perspective, the study contributes to the existing body of knowledge on the underrepresentation of women in STEM fields. This was achieved by adopting sampling techniques covering a wide range of interests to obtain diverse opinions and perspectives.

1.6 Delimitations of the study

The following delimitations were applicable in this study:

i) The focus of the study was on the African continent. Global statistics and trends were applied in providing context and background to the study however the qualitative research was limited to women in a selected number of African TechCos.
ii) The study focused on a pre-determined sample of participants; therefore, the findings cannot be generalised.
iii) The study referred to the STEM fraternity in its entirety; however, the interviews were limited to the technology field within STEM.
iv) The collection of data was based solely on conducting in-depth interviews.
v) The participants interviewed were employed in STEM roles at the time the interviews were conducted; therefore, the view of those who have switched roles or left employment has not been considered.

1.7 Definition of terms

i) **TechCo** – a telecommunication company that sells a combination of traditional connectivity and platform-based products and services (Patel & Smyth, 2021).
ii) **Telco** – a communications service provider (Patel & Smyth, 2021).
iii) **STEM background** – qualified in one or a combination of science, technology, engineering and mathematics disciplines (Jakobs, 2022).
iv) **Women in tech/STEM** – women working in fields such as physics, technology, engineering and IT fields (Prieto et al., 2022).

v) **Mansplaining** – “a tendency among some men to unnecessarily explain things to women, based on a mistaken assumption that they know more about a given subject” (Abrahams, 2014, par.1).

vi) **Self-efficacy** – “an individual's belief (confidence) about his or her capabilities to execute a specific task within a given context” (Stajkovic & Luthans, 2014, p. 130).

vii) **Gender bias** – perception held about an individual (positive/negative) based on their gender (Motaung, 2019).

viii) **Underrepresentation of women** – low levels of female representation in a field (Motaung, 2019).

1.8 Assumptions

It was assumed that:

i) A disparity between women and men in STEM exists: this assumption served as the anchor assumption for this study.

ii) The underrepresentation of women in STEM is influenced by multiple factors which interact and reinforce each other; these include:
   a. Traditional societal expectations of women as primary caregivers demotivate women from entering or remaining in technical roles.
   b. The digital gender gap, whereby women have limited access to digital tools, contributes to their underrepresentation in tech.
   c. The gender pay gap is a deterrent for women joining STEM-related fields.

iii) The selected participants voluntarily participated in the qualitative interviews and responded honestly and ethically.

iv) The participants have adequate training and experience in the STEM field to provide relevant responses to the questions posed during the interview.

v) The Telcos serving the largest portion of the African market are transforming or have already transformed into TechCos.

vi) Information technology, information systems, engineering, and other technical roles in the technology sector fit the STEM jobs title.

1.9 Chapter Outline

The logical and sequential flow of the study is as follows:

Table 1-1: Study outline

Chapter 1	It covers the introduction to the study on the underrepresentation of women with STEM backgrounds in African TechCos, including the rationale for selecting the topic.
Chapter 2	This chapter covers an overview of existing literature on women in STEM, which forms the foundation upon which this research is built. It also outlines the theories and concepts related to the topic that were reviewed and their relevance to the subject.
Chapter 3	It discusses the overall research methodology. This includes an outline of the chosen research approach and methods of collecting data for the study and how the data collection process was carried out.
Chapter 4	It presents and describes the findings of the interview data collected.
Chapter 5	It discusses the findings of the study.
Chapter 6	It outlines the study's conclusion and the recommendations proposed in response to the data collected.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

A literature review of prior academic writings, journals, and reports, as well as relevant general media articles and databases, was performed to gain a foundational understanding of the underrepresentation of women in STEM, focusing on the state of the TechCo industry in Africa. This review evaluated key discussion points, i.e. concepts, themes and theories relevant to the subject in a thematic flow based on the key research themes. Key findings observed from a critical analysis of each research theme are highlighted below, followed by the applicable conclusions.

2.2 Definition of topic

Several stakeholders have noticed the growing contributions of STEM fields to innovation and technological advancements. In response, policymakers and researchers have dedicated time to investigating key enablers of innovative business in STEM. The resultant findings of the investigations have revealed that women are underrepresented in these ventures (Kuschel et al., 2020). Findings from some studies on the underrepresentation of women across STEM fields indicate that individual, structural and social factors interact to influence women's participation in STEM (Prieto et al., 2022; Kuschel et al., 2020).

Research has also identified factors such as gender bias, stereotypes, organisational culture and inflexible jobs as deterring women from staying in STEM (Munyeka & Maharaj, 2022). The literature review covered two themes: factors that drive women to enter STEM fields and barriers that hinder women from entering or remain in STEM related roles.

2.3 Factors that drive and enable women to enter STEM fields

2.3.1 *Factors that drive and enable women to enter STEM-related fields*

According to a 2017 WEF report (cited in PWC, 2018), it is proposed that interest in STEM fields must be cultivated as early as possible in schools and institutions of higher education through a change in the teaching approach to de-bias classrooms and celebrate non-traditional role models. Advocates for women in tech suggest that it is crucial to showcase the exceptional women in tech as role models to girls from a young age (PWC, 2018). Furthermore, initiatives where female engineers address school children during their formative years can encourage them to take up studies in STEM and continue these at the tertiary level (Bettinger & Long, 2005). Encountering female lecturers at University and women in leadership roles once in the workplace is also credited for the increased number of young girls and women's willingness to enter STEM careers (Prieto et al., 2022). Global statistics indicate that STEM fields traditionally pay higher than non-STEM fields such as humanities, education and social sciences (Botella et al., 2019). The STEM field is synonymous with good economic prospects. Thus, women in STEM fields have been noted to earn more than their counterparts in non-STEM fields (Boedeker et al., 2015; Lopez et al., 2023). Therefore, financial gain is identified as a possible motivating factor for women to take up STEM subjects and enter STEM fields.

"Self-efficacy refers to people's perception of their capability to organise and implement actions required to achieve designated outcomes and performance" (Adebusuyi et al., 2022, p.2). Women's transition from entry to upper management positions may seem improbable to other women due to a lack of information on successful women in tech. The lack of visibility of successful women in tech contributes to reduced confidence in women and fear of incompetence, which leads to reduced numbers of women entering STEM fields. Collective messages highlighting the increase in women entering STEM fields are expected to increase women's self-efficacy for majoring in STEM subjects thus increasing women's interest in STEM careers (Cheng et al., 2020).

The “glass ceiling” is associated with the view of one being blocked from advancing in their careers by a myriad of factors - which are not always obvious, hence the term “ceiling” (Schaap & Shockley, 2020). Research indicates that even though the representation of women in the technology industry is low, the number of women in leadership roles in those companies is significantly lower (Clay, 2023). Multiple scholars have researched the factors contributing to women reaching the “glass ceiling” faster than their male counterparts; in the same breath, many have researched how women can shatter that “glass ceiling”. One author found that women who opt for erratic career paths (sequence of non-traditional role moves) move up the ladder more than men with similar paths (Leung et al., 2019). Literature also indicates that while progress is made by appointing women in middle management roles, the senior management roles remain unattainable (the “glass ceiling” remains intact). The same research reported that global awareness of the “glass ceiling” effects has become more prominent from a global perspective (Schaap & Shockley, 2020). The lack of representation of women in leadership roles in the technology industry is seen as the biggest challenge to women “breaking the glass ceiling”, as they have difficulty identifying women they can relate to and learn from (Clay, 2023).

According to Valdivia (2019), technology leaders must focus on recruiting, training and culture-building to bring more women into the technology sector. The author proposes eight initiatives to accelerate the momentum of women joining technology fields, namely, widening the recruiting base by diversifying school approaches; removing gender bias from job descriptions; leaders advocating for women through membership of women empowerment groups or forums; establishing women-centric mentorship and training programs; being cautious of unintentional exclusion; increase anti-harassment communications training and showcasing women achievements in the workplace (Valdivia, 2019).

In an opinion piece by a woman in tech leader, Lewington (2023) suggested that senior women in tech should demonstrate to girls and young women that they can be successful in STEM, offering them positive role models. Clay (2023) supports this view, proposing the establishment of platforms to celebrate and highlight the success stories of women as a reference point for the next

generation of women in tech. This is expected to inspire girls and women to follow in their footsteps. Another suggestion is that tech leaders (men) should also advocate for gender diversity based on proven statistics of how diverse teams produce more innovative solutions and accelerate competitive advantage (Lewington, 2023). One author claimed that establishing diverse tech teams is a noble gesture and constitutes smart business (Tissier, 2023).

2.4 Barriers to entry and retention of women in STEM

Scholars have identified several barriers that prevent women working in the TechCos from starting or progressing their careers in this industry. The barriers include a lack of female role models, lack of professional mentors, instances of gender bias in the workplace, unequal growth opportunities between men and women, as well as the gender pay gap (Botella et al., 2019). Other barriers reported by researchers are lack of motivation, weaker mathematical skills, gender stereotypes and deficiencies in the education system for girls (Sobieraj & Kramer, 2019).

2.4.1 *Barriers to entry of women in TechCos*

Researchers have put forth numerous reasons to explain why women avoid STEM studies and related jobs, as outlined in the above paragraph. In particular, the role of gender stereotypes has been explored extensively, with some researchers concluding that the stereotypes are inherent in both children and adults and influence their decisions to take up or forfeit STEM subjects. Female students in non-stereotypical classroom environments have been seen to be three times more interested in computer science than their counterparts in highly stereotypical settings (Sobieraj & Kramer, 2019).

According to a 2015 GSMA report, experts in the Telco industry have revealed that local barriers (unique to the African context) hindering the participation of women in the tech sector still exist. They argued that educational resources are prioritised for males as women are expected to focus on the role of primary caregivers for children and older people (Molina et al.,2015). Further studies

indicate that male dominated cultures in the workplace dissuade women from staying in STEM roles (Jakobs, 2022). Although there has been a noticeable improvement in the intake and graduation of women in STEM disciplines, women remain underrepresented in many prominent companies in the technology industry (Peck, 2017). According to a 2018 PWC report, tech-related roles at the top 10 global research companies were male-dominated, with men and women holding 81% and 19% of the jobs, respectively. The leadership in these companies comprised only 28% women and 72% men (PWC, 2018). Research has found that women with STEM qualifications tend to gravitate towards biology and other life sciences due to the stereotype of male superiority in technical roles (Peck, 2017).

2.4.2 *Barriers to retention of women in TechCos*

Research has shown that, although more women enrol in tertiary education, men far outnumber women in skilled jobs due to the significant numbers of women who exit work as their careers progress (PWC, 2018). Furthermore, a noticeable decline from entry levels to leadership positions within the telco sector has been reported (Molina et al.,2015). The “leaky pipeline” is attributed to various factors, including motherhood. Across the tech industry, women have voiced concern about the implications of motherhood on their progression prospects (PWC, 2018). An online survey of South African women in ICT indicated that women faced challenges such as time management, dependent children/adults responsibilities, and home interferences while progressing as professionals in TechCos. These challenges are exacerbated by the additional pressure to find time to upskill or reskill to keep up with the ever-changing technology (Munyeka & Maharaj, 2022). In addition, discrimination, “boys clubs”, low prospects of career advancement and gender pay disparity have been cited as reasons for exiting STEM-related fields (Armstrong et al., 2018).

Social expectations are key in influencing women’s endurance to remain or progress in their IT careers. Although social expectations related to the tension between work and home for women are seen to be diminishing with time, social barriers associated with workplace culture remain a barrier for women in tech

(Armstrong et al., 2018). Prior research has supported the view that workplace culture negatively influences women in tech careers due to the pressure to work long hours, lack of social and professional networks within the organisation and structural hindrances to female career advancement (Armstrong et al., 2018).

Research indicates that the gender pay gap for the same skills is a deterrent to the progression of women working in TechCos (Botella et al., 2019). Women are discouraged from entering or progressing in technological firms by noticeable salary differences favouring men with similar training backgrounds, employed in the same field (Rollor, 2014). A 2022 study revealed that male staff earned 1.3 times their female counterparts in African Telcos, further contributing to the gender gap (afr-ix telecom, 2022).

2.5 ANALYTICAL FRAMEWORK

2.5.1 *Theoretical Framework*

Research has been performed over different centuries to develop theories to guide the understanding of the factors that influence the career decisions of individuals. For instance, research from the 1980s found that career choice is preceded by a rational calculation of the cost versus benefit of education, including an assessment of the strength of life plans associated with obtaining an education. Furthermore, the research showed that working-class individuals were more likely to stay in school than middle-class children and individuals from homes with educated parents who favoured education more than those from uneducated homes (Killeen, 2002). Scholars who have researched the factors that influence students to choose careers in STEM have classified them into several categories, mainly personal, environmental and social influencers (Lopez et al., 2023).

2.5.2 *Career development theory*

Career development theory is the study of career journeys - it is applied in exploring career paths, success and behaviour of individuals (Birt, 2023).

Theories under this umbrella are concerned with why individuals choose and progress in particular jobs, thus providing a foundation for career development initiatives for individuals as they enter and grow within specific jobs (Duggan, 2022; Guichard & Lenz, 2005). Career development theory emerges from different areas of study, including psychology, personality and sociology. The theory is grounded on the importance of individuals cultivating a positive association with their work. (Birt, 2023). Based on the features described, it is proposed that career theories can provide valuable insights into why women enter or remain in careers in STEM fields.

2.5.3 *Social cognitive career theory (SCCT)*

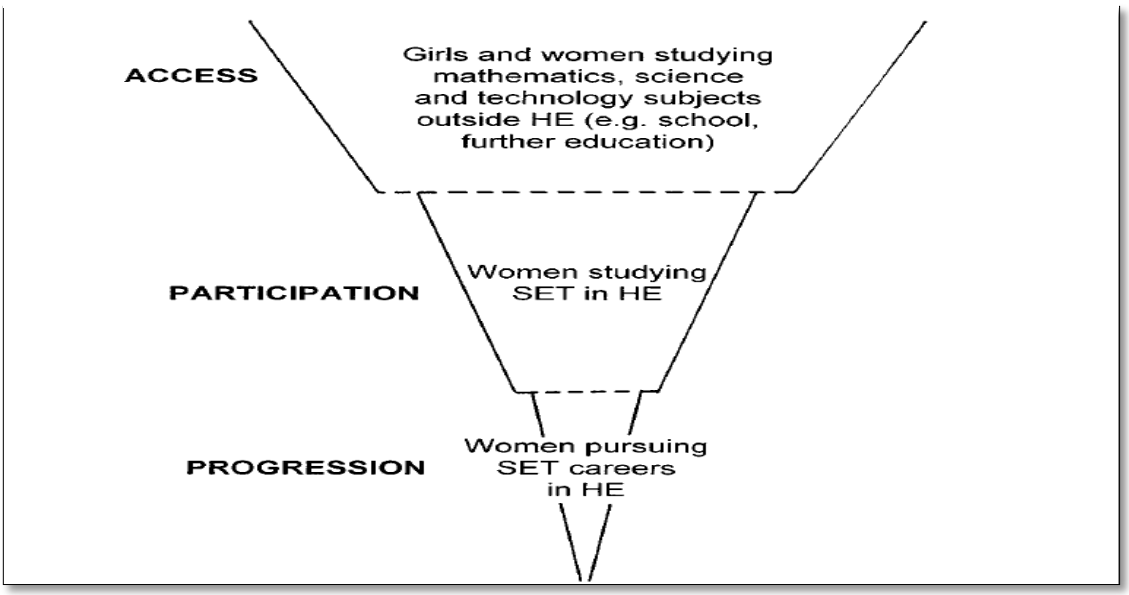
“Social Cognitive Career Theory (SCCT) is one of the theories used for explaining the formation of academic and vocational interest, the selection and pursuit of career-relevant choices, and people's performance and persistence in educational and occupational fields” (Inda et al., 2013). SCCT offers an integrated framework of several career-related theories, mainly interest development, choice-making, performance and persistence in education, satisfaction and well-being (Adebusuyi et al., 2022). The theory combines theoretical foundations such as self-efficacy, barriers to choose and outcome expectations to form a more robust theoretical position (Brown & Lent, 1996). The theory can be broken down into proximal and distal portions: the former focuses on concerns of self-efficacy, outcome expectations and goals. In contrast, the latter focuses on personal traits (race, gender, etc), prior learnings and social class (Adebusuyi et al., 2022). In summary, the theory proposes that career choices are context-driven (individual, organisational or national) rather than process-related (moving from school to work, job searches, etc) (Howe-Walsh et al., 2020).

Scholars have identified SCCT as one of the most commonly applied frameworks to study the factors influencing career choice, particularly in STEM fields. For instance, by applying the theory, some scholars found that some mathematically astute women have avoided careers in technology due to poor social influence, resulting in low self-efficacy beliefs. The results of a study on gender differences

between male and female engineering students indicated that women have less confidence in their ability to complete their STEM studies. The study also found that women perceive family support and barriers as influential in their career choices (Inda et al.,2013). Another tenet concluded that women with qualifications in STEM disciplines have shied away from technical roles due to perceived barriers to entry and advancement in their chosen careers (Brown & Lent, 1996). Researchers in the UAE have been able to reinforce the influence of contextual factors on career choices through the lens of SCCT. By applying the theory, they found that Emirati women placed the national context in high regard in deciding whether to join STEM careers in the region. The government's positioning of women's career development as a national imperative attracted more women to STEM fields. The same research highlighted that family influence, role models and company reputation were key factors driving women's participation in technology sectors – proving the notion of influential contextual factors (Howe-Walsh et al., 2020).

Further studies have found that the underrepresentation of women in STEM fields is both progressive: deteriorates as women advance through the education system) and persistent, continuing over time (Cronin & Angela, 1999). A funnel diagram illustrates how the number of women declines as they advance between three stages of the STEM pipeline: access, participation and progression. Access refers to entering the education system to study STEM disciplines, participation is concerned with studying STEM subjects, and progression involves pursuing careers in STEM fields.

Figure 2-1: Funnel diagram - diminishing representation of women in SET



The funnel diagram depicts how the total number of girls and women diminishes

$^{\epsilon}$Source: (Cronin & Angela, 1999, p. 4) T

(science, engineering and technology) (Cronin & Angela, 1999). The diagram illustrates how the number of women in STEM professions is lower than the number that enrolled in STEM roles, as depicted by the narrowing of the funnel through the different career stages. The funnel metaphor has also been illustrated by a perspective article that reported that although Africa has the highest proportion of female STEM graduates (47%), women remain underrepresented in academia (Rose-Innes, 2022), meaning lower numbers progressed in STEM careers compared to those that accessed (enrolled) and participated (studied) in STEM subjects.

2.6 Conclusion of Literature Review

Based on the research literature identified, the representation of women in STEM appears to be under-researched. Furthermore, researchers have yet to dedicate significant effort to researching the participation of women in less industrialised and developing countries, resulting in limited statistical data on the constitution of women in African STEM fields.

The literature reveals that social and cultural factors are less influential in developed countries. However, the impact is still significant in Africa and contributes to the underrepresentation of women in TechCos. This is mainly influenced by the prioritisation of boys entering the education system while girls are expected to perform care roles within the family system. Role modelling comes out strongly in the research as a key driver to women developing and maintaining interest in careers in tech. The research highlights the need to showcase successful women in STEM careers to encourage those with low interest or confidence to consider pursuing careers in STEM fields. SCCT was adopted as the theoretical framework to explain the formation and pursuit of career interests and choices in STEM fields. A funnel diagram was applied to illustrate how the number of women in STEM professions decreases as they

progress from access to participation, to progression stages of the STEM pipeline.

The literature also indicates a direct correlation between an inclusive workforce, digital innovation and the competitiveness of companies. Companies that are intentionally establishing more diverse teams, particularly gender diversity, have been found to yield more positive financial results compared to their counterparts.

CHAPTER 3. RESEARCH METHODOLOGY

This chapter covers the methodological choices selected to address the findings from the literature review. This comprises the research approach and design, as well as the data collection and analysis techniques adopted for the study.

3.1 Research Paradigm

“A paradigm is a way of examining social phenomena from which particular understandings of these phenomena can be gained, and explanations attempted” (Saunders et al., 2012, p.140). Research paradigms help researchers understand how other researchers approach their work and guide them on how to map their research path (Saunders et al., 2012). This study follows an interpretivism paradigm, which holds that social reality is subjective and based on interpretation and interaction (Quinlan et al., 2020). Interpretivism involves enquiring about ideologies and values that make up the multiple realities people hold. This paradigm typically adopts an inductive, qualitative and exploratory approach (Keong et al., 2023).

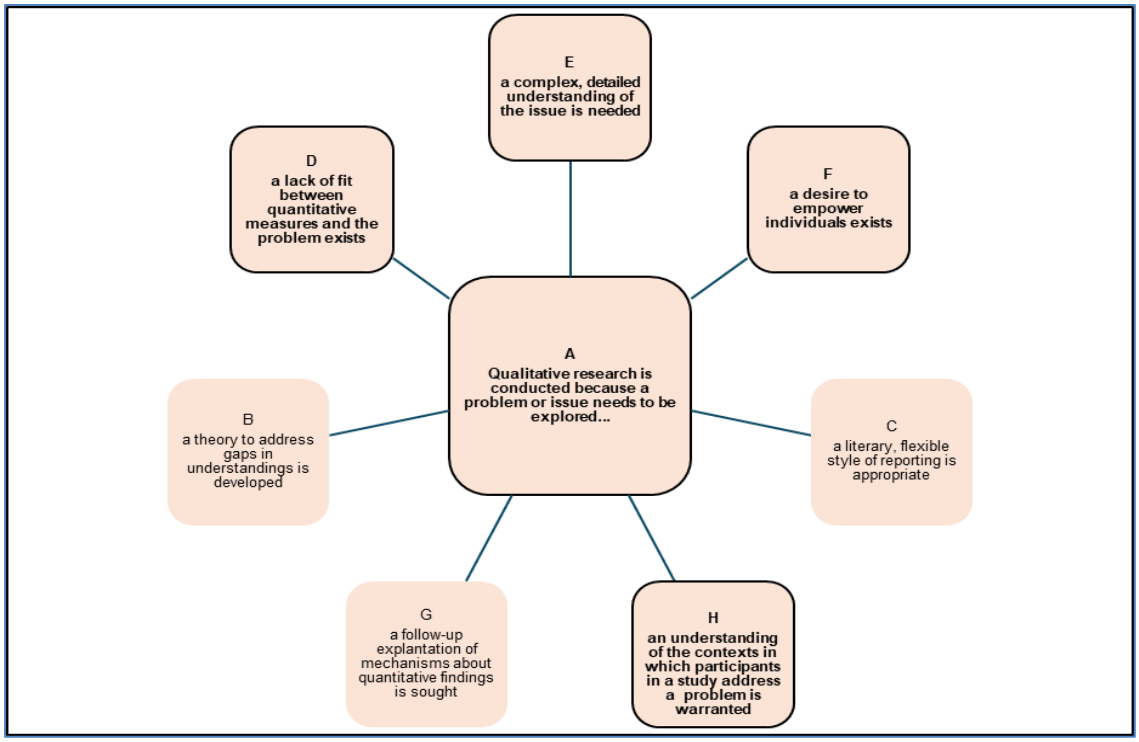
3.2 Research approach – qualitative

Qualitative research is a way to explore and understand the meaning that humans, in their individual or group capacities, ascribe to social problems (Creswell, 2009). “Qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them” (Denzin & Lincoln, 2018, p. 43). It allows the researcher to obtain detailed responses from participants on how they interpret their life experiences instead of only obtaining descriptive statistical information, as is synonymous with quantitative research (Alexander & Hermann, 2016). The process involves collecting data in the participant’s settings, inductive analysis of data by building from particular to general themes, and then interpreting the meanings thereof (Creswell, 2009).

This study's approach is situated on the interpretivism philosophical framework, which holds that knowledge is a matter of interpretation and interaction between the research subjects and their social reality (Quinlan et al., 2020).

Creswell and Poth (2018) propose several factors to consider in deciding whether qualitative approaches are appropriate to address a research problem. The diagram below summarises the factors to consider; those applicable to this study have been highlighted in bold font and will be expanded below the diagram.

Figure 3-1: When to use qualitative research



Source: (Creswell & Poth, 2018, p. 46)

- (A) The study explored the barriers to entry and retention of women with STEM backgrounds in African TechCos as indicated in the statement of purpose in Chapter 1. The exploratory nature, i.e. there is no expectation to reach conclusive answers, warranted the choice to conduct a qualitative study.
- (D) Quantitative data is numeric data, while qualitative data represents feelings, thoughts, ideas, understanding, and non-numeric data (Quinlan et al., 2020). Qualitative analysis is applicable as the study sought to

assess the views and experiences of women with STEM backgrounds, i.e., non-numerical data.

- (E) The research problem is complex in that it cannot simply be addressed by reviewing existing literature; there was, therefore, a need to speak to research subjects to understand the issue.
- (F) Literature review in isolation does not allow the reader to separate what people say from where they were, e.g. home, work, etc (Creswell & Poth, 2018). By adopting qualitative approaches, the contexts were understood clearly.

3.3 Research design

Creswell and Poth (2018) define research design as the plan for conducting the study (how the inquiry will be carried out). A research design involves outlining the most effective strategies for obtaining information to address the purpose of the study, as well as connecting researchers in the empirical world with relevant research subjects, e.g. people, organisations, documents, archives, etc (Denzin & Lincoln, 2018). The research design in qualitative research is emergent, i.e. it may be modified at different phases of conducting the study (Creswell & Poth, 2018).

The identification of a qualitative inquiry approach is necessary to inform the researcher how to engage in inquiry, including how they view the general research process (Creswell & Poth, 2018; Denzin & Lincoln, 2018). “Generic qualitative inquiry investigates people’s reports of their subjective opinions, attitudes, beliefs, or reflections on their experiences of the things in the outer world” (Percy et al.,2015, p.78). The design involves applying multiple methodologies instead of a well-established qualitative methodology in conducting research. It combines various methodological approaches without being limited to one formalised approach (Kahlke, 2014). According to the findings of research performed to demystify generic qualitative studies, this design approach either combines several methodologies or does not claim allegiance to any particular methodology (Caelli et al., 2003).

Since the research objectives in this study are concerned with how women in STEM make sense of their experiences related to self, society and organisations,

and the fluid nature of this topic, a generic qualitative design allows the use of existing methodologies as well as self-developed designs that cover the particular research objectives. To that end, elements of various approaches, including phenomenological ones, were blended to determine the research approach for this study. Phenomenology was drawn on to provide a detailed description of the phenomenon/concept being studied. This approach allowed this study to leverage the strengths of the established methodologies while maintaining flexibility. Furthermore, it allowed deviating from strict methodological requirements (Kahlke, 2014).

Several pitfalls of adopting generic qualitative enquiry have been put forth by researchers, including the lack of a robust approach to guide researchers, research plagued by contradictions due to the “mixing” of elements from several methodologies and research that has no theoretical basis by not adopting a tried and tested framework. Nonetheless, this approach is selected as generic approaches enrich research with new theoretical perspectives and support new fields of study (Kahlke, 2014).

3.4 Data collection methods: in-depth interviews

Data collection methods are used to gather data for the research (Quinlan et al., 2020). Data collection in qualitative research involves transforming the world into various representations, including interviews, notes and recordings, which are obtained from the researcher’s interaction in natural settings with the people and places under study (Creswell & Poth, 2018). The means of collecting data is influenced by the nature of data needed for the research, e.g. data contained in documents or people’s behaviours or attitudes towards life experiences (Quinlan et al., 2020). For a generic qualitative study, the ideal data collection method elicits people’s responses to real events and issues affecting them. As a result, semi- or fully-structured interviews, questionnaires, and surveys whose core focus is external or the real world (Percy et al., 2015) are required.

Research interviews were adopted for this study, whereby purposeful questions associated with the life experiences of women with STEM backgrounds were

posed to the research subjects. The responses were recorded to explore afterwards (Saunders et al., 2012). In-depth interviews were conducted on a one-to-one basis with each interviewee, face-to-face or virtually via an online platform (depending on the interviewee's location). In-depth interviews enable a researcher to understand the participants' thoughts, feelings, perceptions, beliefs, and motivations regarding a particular topic. The open-ended nature of the questions asked in in-depth interviews encourages the interviewees to share openly, resulting in long responses (Quinlan et al., 2020). This approach allowed the participants to offer in-depth responses about their experiences instead of forced-choice responses, thus providing rich insights and detail (Jackson et al.,2007). The interview format provided an opportunity to build rapport with the interviewees, answer questions from the interviewees, and probe the interviewees further based on their responses to the questions asked (Quinlan et al., 2020).

3.5 Population and sample

3.4.1 Target population

“A population is any complete group of entities that share some common set of characteristics, and the term population element refers to an individual member of a population” (Quinlan et al., 2020, p.173). The population for this study is comprised of women with STEM backgrounds who work in TechCos in selected countries on the African continent. The population was segmented as follows:

- Women in entry-level roles (graduates, interns and staff level)
- Women in management positions (managers and senior managers)
- Women in leadership (general managers and executives)

The selected participants were from a range of ages, and their levels of experience and tenure were broad. Most interviewees resided in South Africa, but several were based in other African countries.

3.4.2 Sample and sampling method

Sampling involves using a portion of a larger population to conclude the entire population. The benefit of sampling is reduced costs and time for gathering data. Sampling techniques are either probability or non-probability, whereby members of the population are known for the former and selection is based on personal judgment or convenience. The sample for this study was selected using a non-probability sampling method known as judgmental or purposive sampling. This technique involves the researcher applying judgment in selecting who to include in the sample (Quinlan et al., 2020). This technique is most effective when studying a particular cultural domain with experts (Tongco, 2007). Purposive sampling is appropriate for this study as it allows the selection of interview participants using their judgment, i.e. women with STEM backgrounds accessible from professional networks.

There are no set guidelines for determining the sample size for non-probability sampling. A key consideration in making the decision is the logical relationship between the sample selection technique and the purpose of the research. Therefore, The sample size depends on the research objectives and resources available (Saunders et al., 2012). Since there are limited criteria for selecting samples in purposive sampling, various authors have proposed minimum non-probability sample sizes. According to Saunders et al. (2012), a sample range of four to twelve participants is suitable for in-depth interviews with a homogeneous population. Other authors propose that a sample range of five to eight participants is sufficient for homogenous samples, where variation across the sample is not key (Cooper & Endacott, 2007). In light of these suggestions, a sample size of eight participants was selected to participate in in-depth interviews for this study.

3.6 The research instrument – interview guide

An interview guide was used to conduct the semi-structured, one-to-one interviews (physical and virtual) with the selected participants. The questions were based on themes covering personal experiences, social factors, educational background, organisational structures, and other considerations. The questions were open-ended to allow for the collection of rich data. Where a response from

a participant necessitated further probing, a question was developed on the spot to address the additional information required.

The interview questions were informed by previous literature and the identification of themes of interest for exploration. The interviews were conducted conveniently for participants (either via Microsoft Teams or a physical location of the participant's choice) between November 2023 and January 2024.

3.7 Procedure for data collection

Interviews were scheduled with the selected participants before the date of the interview.

The following process was followed:

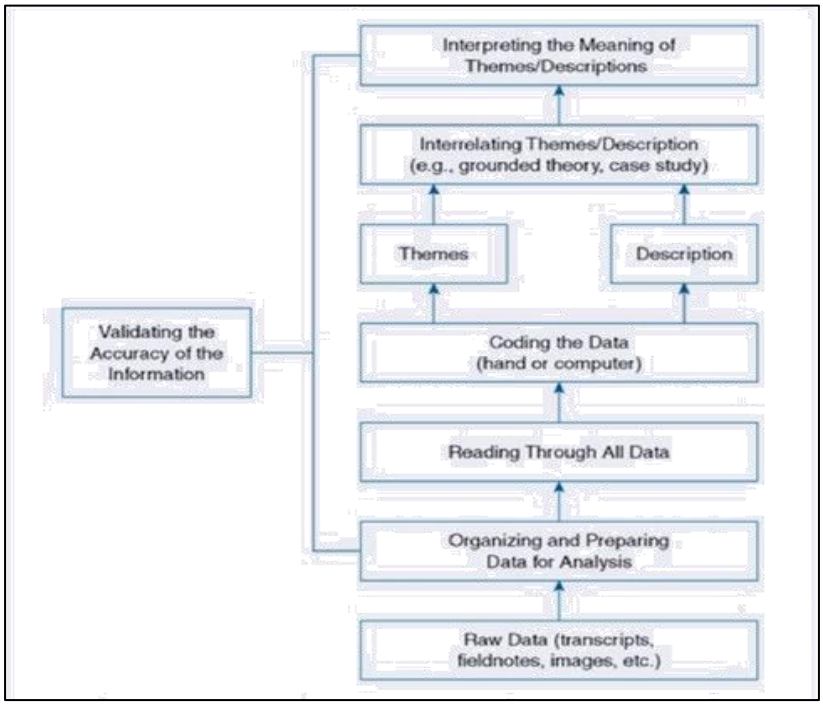
1. Potential interview participants were identified.
2. Requests to interview were sent to potential participants verbally, via email or WhatsApp.
3. Meetings to conduct interviews were scheduled with participants who agreed to participate in the study.
4. The consent form and interview guide were distributed to confirmed participants ahead of the interview process.
5. Preparation for the interview was performed ahead of time, ensuring recording platforms or devices worked.
6. During the interview:
    - Obtained verbal consent to record the interview.
    - Outlined instructions covering the interview.
    - Questioned and recorded the interviewee.

3.8 Data analysis strategies and interpretation

According to Creswell (2009), the data analysis process in qualitative research involves making sense of information collected from research subjects. It requires preparing open-ended data for analysis, performing different levels of analyses,

and interpreting the overall meaning of the data. Thematic analysis was selected to analyse and interpret the data collected through interviews. This method involves carefully analysing data to identify themes/patterns and proceeding with the themes as categories for analysis (Fereday & Muir-Cochrane, 2006). Braun and Clarke (2006) state that a theme captures an important element of the data collected and represents this in a “patterned” response or meaning. At a minimum, it organises and describes a data set in detail and interprets various study aspects. This research method is suitable for qualitative studies seeking to analyse complex data sets due to its flexibility (Braun & Clarke, 2006). A linear and hierarchical approach to data analysis in qualitative research is summarised below:

Figure 3-2: Qualitative research - data analysis



Source: (Creswell & Creswell, 2018, p.194)

The application of the data analysis steps carried out are detailed below:

Step 1. Organising and preparing the data

- Transcribed the audio data recorded during each interview to prepare for data analysis. Any obvious transcription errors were corrected by replaying the recording and comparing it to the notes taken during the interview.

Step 2. Reading through the data

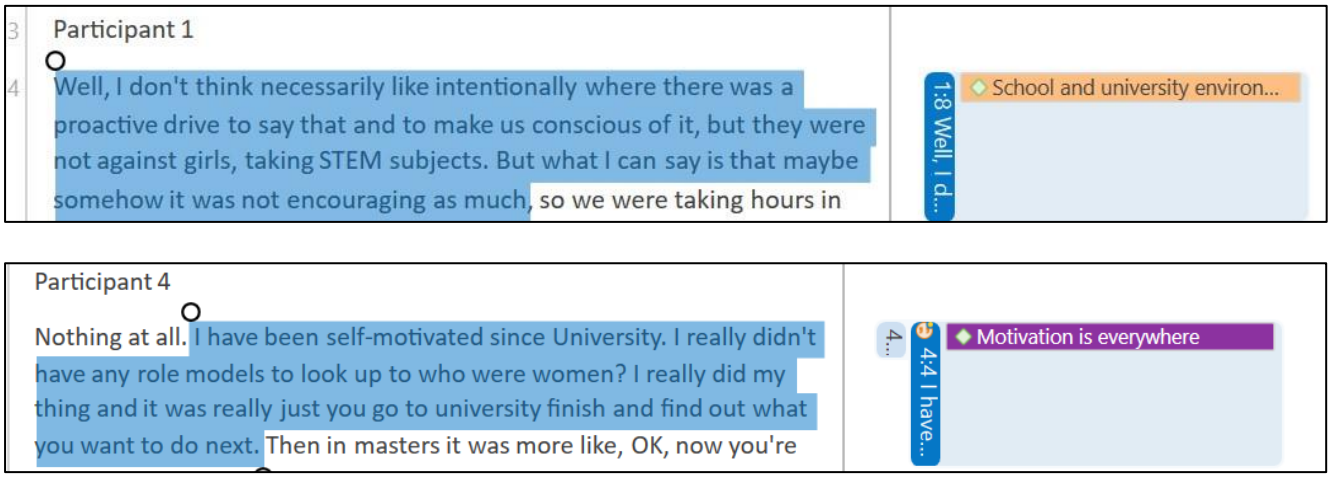
- Read through the transcripts one by one to get a sense of the general sentiments of the interviews.

Step 3. Coding

The majority of the data analysis stages were carried out within Atlas.ti –software used to analyse data in different formats. Utilising software allowed for more efficient organisation and analysis of data. Once all the eight transcripts were uploaded onto the software, the following steps were taken:

- Read through each transcript and identify suitable codes (chunks or segments of text), i.e. labelling similar topics with a term or short sentence.
- Determined the code applicable to each quotation whilst reading each sentence in the transcripts. An illustration is included below:

Figure 3-3: Examples of coded transcripts



Step 4. Generate themes using codes

- Once all the transcripts were coded, the codes were grouped into categories based on the identification of similar partners. By allocating every coded sentence (quotation) to a theme, the unit of data to analyse was reduced.
- Furthermore, each code was coloured-coded based on its category to allow for more efficient data identification.

Figure 3-4: Export of codes from Atlas.ti

	Code	Grounded
2	Career progression slowed by family responsibilities	6
3	Competing demands between work and home	22
4	COVID shifted mindset of men regarding domestic activities	1
5	Cultural and religious practices may be perceived as gender bias	3
6	Develop,communicate and execute succession plans for women	3
7	Direct discouragement from pursuing STEM program	1
8	Domestic support structures assisting women stay in STEM roles	7
9	Establish structures to support women to succeed in STEM	21
10	Family and friends motivate women to take up and stay in STEM	17
11	Family responsibilities have not affected career progression	2
12	Gender bias experienced in STEM field	5
13	Increase awareness of STEM for females in school and university	8
14	Lack of female role models in STEM motivating women to select STEM careers	6
15	Male leaders played key role in career growth in STEM compared to women	2
16	Mentorship programs rarely in place for women in tech	9
17	Motivation is everywhere	11
18	No instances of gender bias experience in tech industry	2
19	Organisation displaying gender neutrality in communication	7
20	Organisation making progress with women initiatives but still lots to do	20
21	Organisation supports the advancement of women and men equally	3
22	Passion for STEM	16
23	School and university environment not quite motivating towards STEM	12
24	Self-doubt hindering women entry and retention in tech	1
25	Sentiments around inequality between men and women	39
26	Societal ills hindering women from advancing in STEM roles	1
27	STEM has better financial prospects	12
28	Subjects automatically selected based on degree choice	1
29	There's a number of females that I think are aspirational	16
30	Upbringing positioning males for STEM and females towards home-making	2
31	Women entering STEM switching roles from STEM during their career	3

Step 5. Convey the findings in a narrative

- Presentations and descriptions of the themes that emerged were included in chapter 4.

Step 6: Interpret the data

- The interpretation of the meaning of the data required to address the research objectives was included in Chapter 5.

3.9 Quality Assurance

Quality assurance in qualitative research concerns whether “the findings can be trusted”. According to Lincoln & Guba (1985) (cited in Korstjens & Moser, 2018), transferability and credibility are critical quality check criteria for qualitative research.

3.9.1 Transferability

Transferability is concerned with whether the findings of research performed can be applied to other contexts or other research settings (Korstjens & Moser, 2017). Transferability is enhanced in this study by providing a comprehensive outline of the parameters of the study to enable other researchers to assess whether this study is “transferrable” to their research settings, e.g. population, sample, sampling method, interview process followed, interview guide, data analysis process applied, etc. Furthermore, thick descriptions – giving an account of participants’ views and applicable context to ensure the data is meaningful to an onlooker (Younas et al., 2023; Percy et al., 2015) are incorporated by including verbatim extracts from the interview transcripts in the presentation and interpretation of the findings from the study.

3.9.2 Credibility

According to Korstjens and Moser (2017), credibility is concerned with whether the research findings correctly represent the participants’ original responses and correctly interpret their original views. Credibility was maintained by ensuring prolonged engagement during the interviews, whereby follow-up questions were asked whenever the participants’ responses were vague, and requests were also made for examples to support the responses given. This approach is in line with the proposal that by “keeping questions open, we allow ourselves to be informed by the data” (Bazeley & Richards (2000)) (cited in Prieto et al., 2022, p.4).

Furthermore, credibility was enhanced by relying on the research committee and the allocated research supervisor to guide the research process, including double-checking the correctness and accuracy of the data interpretation process.

3.10 Ethical considerations

The following steps were carried out to ensure the study was ethical:

- Applied for ethics approval in line with the Wits University ethical committee.
- Issued a consent letter to all confirmed participants once ethics clearance was received.
- Maintained anonymity for all participants. Each participant was assigned an identifier, e.g. Participant 1.
- The end-to-end interview was outlined verbally to each participant before starting the interview, and verbal approval to record the interview was sought before the commencement of each interview.
- All voice recordings of the interviews were password protected on the recorder as well as the downloaded audio.
- Participants were allowed to decline to answer questions they were uncomfortable answering.
- Confidential data was not sought as part of the interview process.

CHAPTER 4. PRESENTATION OF FINDINGS

4.1 Introduction

Eight one-to-one, in-depth interviews were carried out with women with STEM backgrounds working in TechCos across several African countries; to explore their lived experiences as women in tech. In this chapter, the findings from the qualitative interviews with the participants are presented and described.

4.2 Demographic profile of the participants

Table 4-1: Demographic profile of participant

Participant	Location	Level	Experience
Participant 1	South Africa	Senior Management	11 years
Participant 2	South Africa	Management	3 years
Participant 3	Nigeria	Management	17 years
Participant 4	Ghana	Management	17 years
Participant 5	Botswana	Leadership	6 years
Participant 6	Botswana	Entry-level	21 years
Participant 7	South Africa	Leadership	17 years
Participant 8	South Africa	Leadership	16 years

The anonymity of the participants was maintained by labelling each one as a participant (1-8) instead of their names. The demographic profile consists of the African country in which the employer is based, the participant's position of employment (level) and the number of years the participant has been employed by the current company (experience). The experience of the participants was deemed sufficient to qualify each participant with the required knowledge and lived experience to participate in the study.

4.3 Emergent themes

Themes are extended phrases or sentences that identify what data is about or what it means. These are consequences of coding, categorisation or analytical reflection of the data collected (Saldana, 2016). The themes that emerged from this study are outlined below:

- The primary motivators for women to enter and persist in STEM fields
- The degree of readily available and prominent female role models in STEM
- The role of educational systems in encouraging women to take up STEM careers
- Work and family – competing demands influence the career progression of women in STEM
- The perceived gender inequality in the workplace fosters negative perceptions about the experience of being a woman in STEM roles.

4.3.1 *Theme 1: The primary motivators for women to enter and persist in STEM fields*

All the participants referred to the opportunity to earn a respectable living from a STEM career as the key motivator in choosing STEM subjects in school and university and ultimately pursuing and sticking to roles in TechCos. Two key factors dominated this theme: societal perceptions and impressive financial prospects.

4.3.1.1 Societal perceptions

According to the interview data, women in STEM gain respect and adoration from the societies in which they reside, be it from family members or the extended community. The perceived adoration from society stems from the societal view that STEM subjects are a stepping stone to a prosperous future for those who choose the career path. Example participant responses are included below:

> *"So it was it was few things. It was the societal view of what success is, that it lies in STEM. And then it was the financial potential."* ***Participant 1***

"I think in our society in the black society I may say, there was always the view that math and science is something that you need to survive. It doesn't matter what career you're going to do. It felt like it was the entry to other careers, so I think that's the reason" ***Participant 1***

"The emphasis on education being the steppingstone to having a better life was really the driving force." ***Participant 2***

"Because my mother suddenly would say you need to have maths and science as a minimum. Whatever subjects you take. So that's how I ended up choosing those subjects because of the societal view that for me to have a future." ***Participant 1***

"We were told you do the sciences. You'll get a better job. That's just the way it was." ***Participant 2***

4.3.1.2 Impressive financial prospects

STEM professions are associated with impressive financial prospects as the roles are associated with higher pay cheques compared to roles in other sectors. Most of the participants commented that they chose careers in STEM in pursuit of a career path that provides a range of opportunities, financial and otherwise. Some participants shared:

"I wanted to give myself the widest range of range of options that I could. So that's how I ended up choosing the science subjects, and also those were where the scope was for good jobs." ***Participant 7***

"So as much as technology was not my first love, the fact that it was together with business, because I've always had a keen interest in business is the reason why I took it." ***Participant 1***

"I could see, oh, there is a future here, because when you look at space there are various opportunities, even if currently I am a security engineer, it gives you various opportunities, like next time you can be a security analyst. I could go very far with this career." ***Participant 6***

It was also evident from the responses related to financial prospects that the socio-economic backgrounds under which the participants grew up made it necessary to enter a career that provided financial security. Five of the eight participants grew up in low-income, single-parent-headed households. This ignited the motivation to study hard to earn a good living to support both the immediate and external families in the future.

Some example responses:

> *"Why, because my mother had been doing piece jobs and she was getting old. She was starting to have problems with her knees and all of that. And for me, that was a shortcut. The allowance was better than the allowance at University and I wanted the shortcut to work."* ***Participant 5***
>
> *"And my mother realized the value of education, and that's why she didn't give up because others could just have said I don't have money to go to Gaborone."* ***Participant 5***
>
> *"The motivation has to come from self because you know our parents weren't able to provide as much."* ***Participant 2***

4.3.2 *The degree of readily available and prominent female role models in STEM*

The interview data indicates that the lack of visible, successful women in STEM that girls and young women can look up to during their school days reduces their willingness or eagerness to enter and stay in STEM careers. Most participants indicated that they had barely been aware of or encountered female role models in STEM during the stages when deciding on subjects to study in school and university. This according to Participant 8 puts women at a disadvantage since "*just sharing your experiences, you can really help another lady if they have challenges, you give them hope. And then she can see oh, she also went through this similar challenge. This is how she did. Maybe I can try something like this*." ***Participant 8***

Additional responses shared:

> *"I didn't see any female figures that I can relate to, whether in high school or varsity, a lot of the influence in fact, was from the male side."* ***Participant 1***

> *"I have been self-motivated since University. I really didn't have any role models to look up to who were women. I really did my thing and it was really just you go to university finish and find out what you want to do next."* ***Participant 4***

> *"I would say most of the time, because the job is viewed as a men's job, I would say there was a lack of female role models. There wouldn't be those role models that they look up to, so they wouldn't have the encouragement to enter into the technology space."* ***Participant 6***

> *"They weren't really examples that I could look to. I had one or two in the extended family instances for example, an aunt was a doctor, but there were few and far between."* ***Participant 7***

Some participants claimed that role modelling for female students is not limited to women in corporate STEM roles, they proposed that teachers and lecturers of STEM subjects also played a key role in igniting a passion for STEM in them. Example responses:

> *"I just enjoyed maths and physics but I think it's also your teachers. Hey, that passion in those STEM subjects, from their knowledge of the subject, they pass that passion to you."* ***Participant 8***

> *"So I think that was the key message. It was good teachers, excited, passionate about those subjects, those subjects opened up the opportunity that I could study engineering."* ***Participant 8***

> *"So we had a lot of lady lecturers. We actually had a lady that I really looked up to and that lady is from another part of my country. I'm from the northern part of the country where women are not really encouraged to go to school. So when I saw a woman from the northern part of the country that is, you know, she is a go-getter and has gotten to that pinnacle of her career in terms of getting to become a professor of chemistry. Chemistry is not an easy thing. There's some lecturer that I really looked up to."* ***Participant 3***

For participants 1 and 2, the inspiration was closer to home, as the female teachers or lecturers who inspired them were their mothers. They shared:

> *"And in fact, also talking about my mom. My mom started in nursing, went on to do a doctorate, and then finally got to become a professor in educational psychology."* ***Participant 3***

> *"She has no STEM background, but she was an English teacher and then became a school head at the time before moving into corporate. And I think for her, I mean, she was in an environment where it was underprivileged that she always believed in the potential of those, you know, learners in the same way she pushed that to me."* ***Participant 1***

> *"You know they always used to say not everybody can do maths and that's OK, you know, it was one of those. And to be honest, if I didn't have the mother that I had, I probably would have thought I'm not good at maths."* ***Participant 2***

> *"There's also friends, families, colleagues, even my mom because she was a single mom. She's had a career, she's worked the entire time. From the time we were little to be able to look after us, so just taking all her experiences, how she's dealt with things, how she's handled everything and using her as a guide as well."* ***Participants 7***

Most participants described their current organisations as lacking in establishing and maintaining mentoring programs for women in tech. As a result, the women did not have access to successful women in tech within their organisations to encourage them and showcase what success in STEM looks like. Some participants shared:

> *"OK so for the general women in tech program, we didn't have mentors."* ***Participant 4***

> *"I know we have general mentorship, but not necessarily for tech women, but also a lot of people don't even know about it so again, how can you access now if you don't know information, then you can't even use it."* ***Participant 1***

> *"We just don't have specific mentorship programs for women in tech."* ***Participant 5***

"I think we need to inject within that structure that we have mentoring. To introduce the mentoring facility because I've looked at it as a need for myself, and I've had to go outside the organization to find interventions that will help me for my personal development." ***Participant 3***

The interview data also indicates that, even though the organisations that currently employ the participants have limited mentoring opportunities for women, all the participants have identified female role models that are influential to the career stage that they find themselves in. The women attributed their persistence and eagerness to enter and advance in their STEM roles to inspirational female role models who showcase success in STEM. Some participants shared:

"There's a number of women that I think are aspirational in the sense that if I'm going to different events, I listen to them at that point and I take their wisdom." ***Participant 1***

"I like a few people that I aspire to that I feel they don't know me, but I feel like, you know, when I see them, I'll be amazed because I've listened to their talks, their podcasts." ***Participant 2***

"I just follow them closely, see what they're doing and then sort of admire them there. There is one in Vodacom Carisa Rama in South Africa. But I don't have personal contact with them on LinkedIn just to drop a few words of encouragement." ***Participant 4***

"OK, so there are, yeah, a number of women that made me believe that this is possible." ***Participant 3***

Furthermore, it emerged from most participants that for women in STEM, role models are not limited to women in tech. Many of the women declared how they draw inspiration from successful women who operate outside technology or STEM roles. Some example responses:

"To be honest I don't look up to role models in tech only." ***Participants 5***

"To be honest I don't look up to role models in tech only. But there was a woman called Meg Whitman. She was the CEO of HP. I think she's retired now. She has her own company. I once attended a conference where she presented and she really impressed me just the way she carries herself among all the men surrounding her." ***Participant 5***

"You know, we've got a female CFO, we've got a female Chief of HR. We have other women, other female executives. It's just nice being able to talk to them and everybody experiences the same things, same challenges and you know, just sharing how each one deals with it." ***Participant 8***

4.3.3 *The role of educational systems in encouraging women to take up STEM careers*

Most of the participants acknowledged that their school environments were not encouraging females to take up STEM-related subjects in school and/or in university. This contributed to the women's being unaware of STEM roles as viable options for future careers during their childhoods. The lack of encouragement came in the form of direct discouragement of female students from enrolling in STEM programs or the absence of initiatives intended to point them toward STEM subjects.

4.3.3.1 Direct discouragement from enrol in STEM programs

In some instances, the women were intentionally steered away from STEM during their school days due to gender stereotyping. Teachers and members of society are reported to have often tried to convince girls to opt for subjects perceived as easier to pass for young girls. Some participants shared:

"But I recall a particular time in my high school career when one of the teachers, in particular, was convincing us to downgrade to standard grade and enticing us with the fact that we would be getting higher marks like distinctions, etc." ***Participant 1***

"I did get some hesitation from like teachers in school who asked me why I wanted to study engineering." ***Participant 7***

"I think there were 3 black girls. And the Dean called us at the time and said to us, you know, this is not an easy career path, and we should consider doing a BA degree like a Bachelor of Arts." ***Participant 2***

"She's a girl and you're sending her to university, she's just going to waste your money. Get her married, they would say to my parent". ***Participant 8***

4.3.3.2 Absence of initiatives to encourage taking up STEM

Participants indicated that there was a lack of initiative to encourage or incentivize young girls to pursue STEM in the schools where they studied. The education system is deemed unintentionally in establishing and rolling out interventions to improve access to STEM for girls in school, including programs promoting maths and science literacy for female students. Some participants expressed their dissatisfaction as follows:

"OK, so I was influenced by computers in high school. Right. But it was more of a social subject. It wasn't necessarily like a marked subject, so just for us to understand and explore the internet and the computer itself. But there wasn't necessarily some teacher who showed me the interest and what you can do and gain from using it." ***Participant 1***

"Well, I don't think necessarily like intentionally where there was a proactive drive to say that and to make us conscious of it, but they were not against girls, taking STEM subjects. But what I can say is that maybe somehow it was not encouraging as much." ***Participant 1***

"I never even saw a counselor ever. I never had any guidance. I don't know if it's different now. I don't know. Maybe because I went to university in 1997. I don't know, because that was more than 20 years ago." ***Participant 4***

"So, the school at the time, no, I really don't recall any programs, any talk, nothing. It was really hard." ***Participant 5***

"I was in matric 1998. Back then to be totally honest, no, there wasn't much about STEM." ***Participant 8***

4.3.3.3 Friends and family countering deficiencies of the education system

Despite the gap in the education systems in creating awareness regarding the options and benefits of STEM as a career path, the home environment appeared to have nullified this issue for some of the participants. The role of family and friends emerged as the most common factor that influenced the uptake of STEM programs by the participants during their years in school. Specific evidence is noted in some of the responses outlined in Theme 1, where the role of societal influences in motivating women to take up STEM is described. The following examples outline instances where the participants directly attributed family and friends to influence their uptake of STEM:

"So, the encouragement always came from home." ***Participant 2***

"but finally my dad's sister convinced him and then let me continue with computer science and that's where I am in my career today because of that." ***Participant 3***

"So, I got the encouragement to push on. I got the encouragement from my family." ***Participant 6***

"I got support from my parents like my dad was going to support me, whatever I chose." ***Participant 8***

4.3.4 *Theme 4: Work and family – competing demands influence the career progression of women in STEM*

The family responsibilities faced by the interviewees stood out as the most common barrier to their career progression. The majority of the participants cited the challenges of balancing work demands with their growing roles as primary caregivers in their households.

4.3.4.1 The role of motherhood as a barrier to career progression

Motherhood was isolated as the family responsibility with the most influence on the trajectory of the participants' careers, impacting them negatively at different stages i.e. as new mothers and parenting young children. Participant 4 stressed the issue quite strongly, examples are included below:

> *"I got married in 2010. I had my first child in 2011. And that was a bit difficult because you go for maternity leave and you come and everything has moved on. And how do you catch up? How do you get that back, you know? And it's a very difficult time. Because one you have a new child the first six months to one year is filled with trepidation because we are now responsible for like a new tiny life."* ***Participant 4***

> *"You have to think of the child. If the child is one, you go back to working full days. But you get a phone call from school, maybe they fell down. It's all these things. So, it became a bit difficult for me."* ***Participant 4***

> *"I know a lot of my friends in the banks who have sort of given up and just going to entrepreneurship sort of working for themselves, trying to sell stuff, you know."* ***Participant 4***

"The fact that you're afraid because you don't want to kill this child, you don't want to make a choice that will kill this child so it's a very difficult time coupled with work and they give you 3 months to sort of get yourself together. It's not enough time." ***Participant 4***

Participant 5 added to the topic by expressing:

"So it's very difficult. That's why people don't stay. You are given three months of maternity leave. It's very difficult to leave your baby when they're only three months, you know, they're still very small."
Participant 5

"It is difficult to balance taking care of the family and working. Secondly, you get one hour of breastfeeding. So the three months is short should really be six months." ***Participant 5***

Some of the participants expanded on the issue by explaining how the time spent away from the workplace after giving birth impaired their career growth, especially in the technology industry, which is very fast-paced. The challenge presented itself in the need to catch up on developments that occurred whilst on maternity leave and those currently in play. Some participants emphasized the issue as follows:

"You have the three months and you've missed all that in that fast-paced environment like technology. How do you ever catch up? So much has happened without you, you know, and you can never catch up, because now you come back, and your brain is split into four different parts. You're trying to find things that fit you. Trying to sort out your life. You're thinking about your baby." ***Participant 4***

"I remember in the olden days, men used to complain that we're getting pregnant too quickly, too soon. What do you mean you're pregnant? They don't say it like that anymore, but back of your mind, it's a disadvantage to disappear for three months, things move on." ***Participant 5***

"so I've never thought I have to choose between the two, but the reality is that as a woman, I am a primary caregiver. I mean, I fell pregnant twice in my career. So basically, six months, six months out of a whole year, I was out of my career. So one can argue opportunity cost maybe that six months I could have done something more to get career progression." ***Participants 1***

In addition to maternity leave slowing down the pace of career growth for the women who are mothers, two of the eight participants decided to pause their careers while they fulfilled the role of motherhood. Both participants attributed the decision to the guilt they experienced from being absent at the early stages of their children's lives. They explained as follows:

"So, there was a period in my life when I stopped working. I consulted on consultancy. Just so that I could have more time to build for the family and the kids. And I think those years have set me back." ***Participant2***

"My husband was very supportive, but I personally had guilt with the first child when I was pushing my career and he stepped up and did a lot of the duties. But I noticed the bond being stronger with the dad than with the mum. And I felt so guilty. And so with my second child, I stepped back a little bit on my career." ***Participant 8***

The pitfalls to career growth associated with motherhood above are mainly driven by the perception that the primary care responsibilities in the home are predominantly those of the woman. The fact that women and men do not fully or partially share the responsibilities in the home in some instances, disadvantages the women's work-life balance compared to their male counterparts at home and work. Some participants shared:

"The other obstacle being that it's quite a demanding environment, so how will you eventually start up a family and if you do that you have to choose between the two." ***Participants1***

"yeah, I think it was even more prevalent during COVID because you couldn't outsource that to the schools and it was quite clear that, you know, homeschooling, you had to balance work and making sure your child is still getting an education and you had to be primarily there to make that happen." ***Participant 1***

"here there is still the perception that the women take care of kids. So as soon as you have little kids, there's the perception that you won't be able to dedicate as much time to your job." ***Participant 7***

"the man just comes to work and focuses on his tech, goes home, the wife is cooking dinner and singing to the kids and whatever, and he can still, you know, while she's making dinner, go into his phone, read an article, make comments, do some work. Meanwhile, a woman has to pull those long hours in the office, get everything done, then come home, switch from being that powerful woman to caring, seeing to the kid's needs, spending time with them, doing the dinner, prepping them for school the next day, checking the homework, making sure the house is in order. You remember you are still the manager of your house." ***Participant 8***

4.3.4.2 Women working longer hours to keep up with men

Participants reported their belief that they work longer hours to deliver the same or better quality and quantity of work as their male colleagues. This is attributable to performing both domestic and professional roles within a limited time. The participants commented that their ambition to climb the corporate ladder whilst

fulfilling their family responsibilities also ignited the drive to work longer hours to keep up with the men in the same role. Some examples:

> *"But I wouldn't necessarily say that I've not been able to manage both, even with the demands of the actual work. But again, it takes so much more. So I think you have to put in much effort versus a man who can quickly just step up."* ***Participant 1***

> *"So when things are not right, obviously that's got to be a priority as a parent. You will feel a beating, so you overextend yourself. You're working into longer hours, you are fatigued, you know, it becomes a kind of a vicious circle because you are trying to do many jobs at the same time."* ***Participant 2***

> *"Yes, because there is still the perception that the woman is taking care of kids. So as soon as you have little kids, there's the perception that you won't be able to dedicate as much time to your job and you actually have to be there and put in the hours slightly more than a male who's just had children to show that this is you, you still giving 100% to your job."* ***Participant 7***

> *"And then sometimes you're pulling late nights because after doing all of that, you know you want to keep up at that man's level. So you also read those articles and things like that. So that's why I say the woman kind of works longer hours and harder than a man."* ***Participant 8***

> *"You work long hours and it's very difficult to balance family and work."* ***Participant 5***

4.3.5 *Theme 5: The perceived gender inequality in the workplace fosters negative perceptions about the experience of being a woman in STEM roles.*

A prevailing sentiment that men and women do not possess equal abilities to perform STEM roles has been noted as a key factor discouraging women from entering or remaining in STEM. Every participant in the study acknowledged having experienced negative stereotyping in the workplace based on their gender. "*..the default setting is she can't do it",* said Participant 5 whilst explaining how her ability to carry out a role in STEM has been met by doubt or reservations from her male counterparts in the technology industry. Most of the women interviewed have been negatively affected by instances of sexism in the workplace. Some participants shared:

> *"I remember in the early days when I used to go to even regulatory meetings, the then CEO was a Portuguese guy. They would go in and sort of look around and then ask where are the technical guys? " Participant 5*

> *"where you would as a woman make a point and it would be overlooked and then continue with the conversation and then somebody decides to say exactly what you said and then somebody actually makes a point to acknowledge it. So yeah, I definitely have seen that happening in the industry."* ***Participant 1***

> *"I've had a few people report me to my manager and it has always been a man. They'll turn to the man and say well, if she's not interested, can we do something to get it, right in front of me."* ***Participant 4***

> *"There are so many sessions that I have attended in Ghana, like in the industry where people don't probably take you seriously because you're the woman."* ***Participant 4***

> *"I think that you could see that in the technical teams as well where in the beginning it was very hard for people to relate to us and things like that, especially male colleagues. Now suddenly having to work with females and they are doing the same things as you."* ***Participant 7***

4.3.5.1 STEM is for boys mentality

The responses above indicate that further to women being discriminated against purely based on their gender, they are also discriminated against based on the perception that technical roles are more suited for men than for women. Some of the participants reported instances where their abilities or qualifications were in doubt or scrutinized in an attempt to paint the picture that they fell short. Participant 5 was particularly vocal on this issue; some examples of her responses are as follows:

> *"I don't know if you've come across mansplaining where people try to teach you your job, they tell you what you already know, condescending men trying to tell you how to do it. It's like trying to teach a woman who's had five children how to breastfeed."* ***Participant 5***

> *"I experienced that a lot or they would say you know, Lily, maybe this is too technical for you. Maybe this is going to be difficult for you. I have experienced a lot of it."* ***Participant 5***

> *"The other thing is when you're a woman and you come into a room people suddenly get the courage to ask you the most difficult questions. They would subject you to more scrutiny"* ***Participant 5***

Other participants shared:

> *"What does she know, you can't really trust her opinion because it's coming from a woman. A man knows more in a technical field. You're going to get that a lot."* ***Participant 8***

> *"I think there was a perception in the beginning that women couldn't handle it."* ***Participant 7***

> *"I think it's the unconscious bias that's one of the key things that creates the broken ring. So it's about, you feeling that a woman is not resilient. She's not going to be able to deliver. So you second guess her".*
> ***Participant 3***

> *"I think that's why you don't see a lot of them (women) because there's still a perception that it's mainly male dominated and that men are good at it and they should be doing it."* ***Participant 7***

"So there's actually been a tipping point in the past year where they've been promoting females even more than males, so it might be negatively impacting the perception that females are getting these jobs just because they're female and not because they're capable." ***Participant 7***

4.3.5.2 Women in tech allocated non-technical tasks

For one participant, the apparent reservations from her team about her STEM skillset when she first started working in a technical department, resulted in her being allocated non-technical tasks: *"I was most of the time sent on errands to go to the shops to buy one or two things or go buy food. And I did it for like a few months and even the people that they said I should shadow were not necessarily giving me anything to do."* ***Participant 3***. Participant 4 also reported being continuously misidentified as someone fulfilling a non-technical role due to her gender: *"everybody assumed I was Mazen's PA. It was sad, so to say but for me, this wasn't my first and only time."* ***Participant 4***

4.3.5.3 Gender stereotyping not limited to men in the workplace

According to some of the participants, the perception that men are more suited for STEM roles than women is not perpetuated by men only, some women reported that this view is shared by women in STEM and society as well. Some participants recalled instances where they experienced self-doubt regarding whether they were a good fit for a STEM role. The respective participants explained that this view is influenced by society during childhood and adulthood.

"I think it starts from a young age. We always bought these dolls and dress-up things for girls and boys got Legos and scientific toys. So it starts from there, so you never even know if you have an affinity for those things, because girls are not exposed to them." ***Participant 7***

"The biggest problem is perception, not only from men but from women and ourselves". ***Participant 5***

"The other issue, we think men should do certain roles, not women, jobs like rigging - actually going up the tower. I have never met a woman who used to do that too." ***Participant 5***

"My mom was a bit concerned thinking it's such a male-dominated field. Are you going to cope? Are you going to make it? Should you not study something else?" ***Participant 8***

4.3.5.4 The "boys club" mentality persists

According to one participant, women in tech often experience isolation in the workplace due to a culture where men interact outside working hours on a personal level, thus building stronger relationships. Other responses on this issue indicated that some of the participants experienced gender bias where women are "left out" in a misguided attempt to protect them from physical or excessive work on the premise of their gender. Some examples are included below:

"There's still too much of a boys' club and it's so evident, you know. When you even pick it up in how executives will know the personal lives of other people that are on your level but they've never taken an interest in you." ***Participant 2***

"My boss might not involve me in things because he is trying to spare me the load because he knows I've got little kids and things like that." ***Participant7***

"Just recently they wanted to move ladies from the transport network department and the radio network. Why, they don't want to drive at night, so we're just wasting time because we always have to partner them with someone else." ***Participant5***

4.3.5.5 Gender Pay Parity negatively impacting women

Some participants believe that women are paid less than men performing the same roles in the technology industry, contributing to their negative experiences in the industry. An example response:

"over the years it's been quite clear that as you do the same job, same level and there's always a percentage difference between what the male counterparts. And in fact, you find that the women carry more of the load in terms of their additional activities that get loaded on their portfolios, but the pay parity is still there and in structural in the sense." ***Participant 1***

4.4 Summary of the findings

In conclusion, the research indicates that the primary motivators for women to enter and persist in STEM fields are societal perceptions and impressive financial prospects. However, the lack of visible, successful women in STEM and the absence of initiatives intended to point them towards STEM subjects reduces their willingness or eagerness to enter and stay in STEM careers. The family responsibilities faced by the interviewees stand out as the most common barrier to their career progression. Furthermore, a prevailing sentiment that men and women do not possess equal abilities to perform STEM roles has been noted as a key factor discouraging women from entering or remaining in STEM.

The key findings are outlined below based on the themes identified:

- **Primary motivators for women to enter and persist in STEM fields**: The interview data show that women in STEM are mainly driven by the opportunity to earn a respectable living and the societal perception that STEM subjects are a gateway to a prosperous future.

- **The degree of readily available and prominent female role models in STEM**: The interview data indicates that the lack of visible, successful women in STEM during the participants' school days reduced their willingness or eagerness to enter and stay in STEM careers. However, some participants also acknowledged the role of teachers, lecturers, family members, and other women in the industry as sources of inspiration and support.

- **The role of educational systems in encouraging women to take up STEM careers**: Most of the participants reported that their school environments were not encouraging females to take up STEM-related subjects or programs. This was due to direct discouragement from some teachers or the absence of initiatives to promote STEM literacy for girls. Some participants also mentioned that their family and friends played a key role in influencing their uptake of STEM.

- **Work and family–competing demands influence the career progression of women in STEM**: The family responsibilities faced by the interviewees, especially motherhood, stood out as the most common barrier to their career progression. The majority of the participants cited the challenges of balancing work demands with their growing roles as primary caregivers in their households. Some participants also claimed that they had to work longer hours to keep up with their male colleagues.

- **The perceived gender inequality in the workplace fosters negative perceptions about the experience of being a woman in STEM roles**: every participant in the study acknowledged having experienced negative stereotyping in the workplace based on their gender. Some of the participants reported instances of sexism, discrimination, mansplaining, and being assigned non-technical tasks. The participants also noted that the perception that STEM is for boys is not only held by men but also by some women and society at large.

CHAPTER 5. DISCUSSION OF THE FINDINGS

5.1 Introduction

This study was conducted to explore the barriers to entry and retention of women with STEM backgrounds in African TechCos. Two research objectives were identified to guide the study, namely:

- **RO1**: to identify factors that motivate and enable women to enter STEM fields, particularly in the technology sector
- **RO2**: to identify barriers to entry and retention of women in TechCos

Based on the research objectives guiding the study, qualitative interviews were conducted with a sample of eight women with STEM backgrounds, and the findings thereof were presented in Chapter 4. This chapter discusses and explains the main findings of this study and contextualises them with existing literature to address the study's research objectives. The data analysis phase of the study revealed five dominant themes, these will guide the discussion of the findings from the study in the sections that follow.

Recap of the emergent themes

- **Theme 1**: The primary motivators for women to enter and persist in STEM fields
- **Theme 2**: The degree of readily available and prominent female role models in STEM
- **Theme 3**: The role of educational systems in encouraging women to take up STEM careers.
- **Theme 4**: Work and family – competing demands influence women's career progression in STEM.
- **Theme 5**: The perceived gender inequality in the workplace fosters negative perceptions about the experience of being a woman in STEM roles.

5.2 Discussion regarding role modelling

5.2.1 *Discussion pertaining to Theme 2*

The lack of visible, successful women in STEM was identified as a strong barrier to young girls entering the STEM field by this study. This finding is shared by various research reports; one researcher quotes an interviewee's comment, "You can't be what you can't see" (Prieto et al.,2022, p. 5). This is to say that girls in school and women deciding on their choice of career have limited foundation on which to base their decision due to limited exposure to success stories of women in STEM. Girls who see more women holding prominent positions in STEM are expected to start to picture themselves there (Lewington, 2023). This notion was proven by a study on women in engineering which showed that female mentors inspired female students to take up engineering, improved their self-confidence and improved retention of women in the STEM field (Jakobs, 2022).

This study found that some participants were not adequately equipped to make career choices whilst in school due to a lack of visible women to "look up to". This extends mostly to the women whose social backgrounds meant that they were breaking new ground as the first high school or university graduates in their nuclear and extended families and the communities in which they were brought up. As a result, they missed out on career guidance and adequate encouragement from people in the know of what it takes to succeed in the STEM field. The lack of female role models in STEM is expected to deter women from joining technology-related industries and from chasing leadership roles in technology companies (Makola & Kgosinyane, 2020). "The stereotypically male-dominated image of STEM continues to discourage many talented women from pursuing careers in the field" (Christine Lewington, 2023, para. 6).

According to advocates for educating girls, the lack of female representation in STEM should not simply be attributed to a lack of interest; instead, focus must be placed on the lack of encouragement for girls to explore STEM. This involves applauding girls for taking up STEM subjects and not swaying them from careers in STEM as is the current norm. Most participants described setting up initiatives to provide mentorship and enhance their visibility to act as role models for future

women in tech. They have established platforms to share their experiences in the hope that females in STEM will be helped by the lived experiences relating to overcoming challenges faced in the technology industry.

5.3 Discussion regarding social and cultural structures

Women face a myriad of barriers in their STEM career paths. These include factors such as “old boys’ club”, a lack of female role models, work-life balance challenges and outright sexism. The barriers form the concept of a “glass obstacle course” – an indication that the structural barriers are unseen and unbreachable (Prieto et al., 2022). This concept is synonymous with the Schaap & Shockley (2020) idea of the “glass ceiling” discussed in Chapter 2. The findings of this study support most of the contents of the “glass obstacle course” as discussed below.

5.3.1 *Discussion pertaining to Theme 1*

5.3.1.1 Prestige associated with STEM

The thematic analysis performed signalled the prestige associated with being a STEM professional as the key driver for pursuing careers in STEM. “An occupation with a higher prestige is regarded as more desirable due to the social recognition and financial rewards that they provide” (Mouton et al.,2023, p. 3). Firstly, the particular participants were attracted to the robust earning potential promised by STEM career paths. The potential economic benefits associated with STEM were viewed as attractive channels for achieving a “better future”. This finding strongly supports a statement made by the President of the Republic of South Africa following the release of the 2023 matric results: “In a country such as ours, universal access to education is by far the most impactful intervention in breaking the cycle of inter-generational poverty” (South African Government, 2024, para. 8). STEM skills equip girls and women with tools to transition from the education system into employment thus improving their livelihoods and contributing to poverty eradication (Sánchez-Tapia & Alam, 2020). This is

consistent with the premise outlined in the literature that financial gain is a key career driver for women to pursue STEM subjects and subsequent STEM careers. The second element of the prestige factor is the perceived respect from the society. The participants frequently mentioned that they were motivated by the respect afforded to STEM professionals i.e. social status. STEM professionals have higher earning potential and contribute to their communities through increased spending, tax revenue and various investments thus paving the way for a more prosperous future for the communities in which they support (Díaz-Rodríguez, 2023).

Prestige as a career driver is not a prevalent finding in global literature on the representation of women in STEM. According to Wilkinson et al (2017) (cited in Munyeka & Maharaj, 2022), global research on women in the workplace is often undertaken in developed countries where women experience different socio-economic issues compared to their peers in Africa and other developing countries. To illustrate, similar to this study, a South African study found that women are heavily influenced to enter STEM professions by the belief that their careers are respected by society (Motaung, 2019). On the other hand, studies in Australia and America identified aptitude and a personality seeking a sense of belonging as common motivators for women accessing and maintaining STEM careers (Prieto et al.,2022; Motaung, 2019).

5.3.1.2 Social influence

Halim et al (2018). (cited in Makola & Kgosinyane, 2020) define social influence as the influence of those nearest to a student e.g. parents, peers, family members, teachers, role models and local communities (social circle). Studies have shown that the self-confidence of students has improved when they have been told of the importance and significance of STEM by their social circles (Makola & Kgosinyane, 2020). Although a lack of female role models in STEM was observed (see section 5.2), this study observed that other role models are highly regarded for steering some of the participants towards STEM. The

encouragement from role models fell into three categories, namely: family and friends, passionate teachers and other role models/mentors.

5.3.1.3 Family and friends

Family and friends were highly ranked as sources of encouragement and support systems for women to enter and remain in STEM roles. All participants acknowledged encouragement coming from “home” as a key contributor to their success in STEM. The role of the mother within the family context was strongly highlighted by most of the participants. Participants reported fond memories of mothers relentlessly enabling and pushing them to succeed, particularly with their STEM studies, even under difficult circumstances e.g. financial constraints. The overall finding on the role of family and friends echoes findings from similar research and opinions of women in tech. One study found that parents are highly influential when it comes to students’ interest in STEM. This is attributable to the role they play in the student’s decision-making process, as most students are usually intellectually and emotionally underdeveloped at this stage (Tey et al., 2020). According to Jakobs (2022), parents play a significant role in their children’s academic and career paths. The author proposes that those parents who value their children’s education and encourage them to participate in extra-mural activities related to STEM increase their interest in the field.

Supportive family structures stood out as a key enabler for the participants to enter STEM programs and were acknowledged in several interviews as instrumental for career progression in STEM. The participants in question attributed supportive spouses who shared the primary role of caregiver and other domestic responsibilities as key to their success at work. This is consistent with similar research that found that supportive family environments enable women’s path into and within STEM. The support involves receiving “all the help needed” to succeed, be it being encouraged to pass at school, or a partner who shares the family responsibilities. It has been found that the ability to move up the ranks is significantly impacted by whether a woman has an “extremely supportive” partner or not (Prieto et al., 2022). In another study, it was found that the low levels of enrolment in STEM streams could be attributable to a lack of parental influence and limited encouragement received by the students (Tey et al., 2020).

5.3.1.4 Passionate teachers

Although the overall education system was reported as lacking in implementing and executing interventions to promote STEM to young girls in school (see 5.3.2), the role of passionate teachers in motivating several of the participants was observed. Existing research has identified teachers as instrumental in providing early support that leads women into STEM programs (Prieto et al., 2022). “While in college, professors play an important role in impacting their students. If professors can actively try to reduce any implicit biases in the classroom, it might allow for more females to thrive and gain confidence” (Jakobs, 2022, p. 11).

Teachers' role is not limited to encouraging girls to pursue STEM; they can also serve as role models themselves. Some women looked up to female lecturers in STEM as evidence that a woman can be successful in this field.

5.3.1.5 Other role models/mentors

This study observed that the career trajectory of some of the participants was influenced by male leaders in their respective organisations. According to Matsenjwa (2020), the fact that technology companies are currently male-dominated means that they hold the positions of leaders and managers in the STEM field. It is, therefore, logical that men coach women on their work, give feedback to assist them in developing and expose them to professional networking opportunities. The allyship of men came up during the interviews, where participants mentioned that their male bosses picked up on their potential early in their careers and nurtured their growth through training and access to career growth opportunities. The role of men in empowering women in STEM is said to be changing positively in recent years, although more can be done (Matsenjwa, 2020).

5.3.2 *Discussion pertaining to Theme 3*

The findings suggest that the education systems in the countries where the participants reside do not explicitly encourage women to take up STEM-related subjects. Many of the participants criticized the leadership and the school environment in which they studied for not being intentional about promoting STEM as a career option for girls and women. A proactive drive to improve awareness or to make young girls conscious of STEM and its related benefits was noted as lacking. These findings confirm previous research that found that education strategies and school environments that promote active participation in STEM-related activities inspired students to pursue STEM. The effective strategies include school curricula that incorporate technology subjects such as coding and robotics, as well as informal education events such as attending hackathons and robotics competitions, interviews with role models in STEM and studying in science centres (Makola & Kgosinyane, 2020). Dabney et al (2017) (cited in Makola & Kgosinyane (2020)) found through their study that participation in informal learning activities in high school increased female students' interest in STEM.

An important element contributing to the deficiency of the education system to encourage girls to take up STEM subjects in school is the willingness of the teaching staff to steer them in that direction. Teachers often encourage boys more than girls to pursue careers in technology due to gender stereotyping (Motaung, 2019). According to a 2020 UNICEF report, "education systems have allowed gender divides to be perpetuated and to disproportionally affect the most marginalized girls. While girls tend to outperform boys in reading skills in most regions, they continue to be under-represented amongst top performers in STEM subjects, and women continue to be under-represented in the STEM workforce" (Sánchez-Tapia & Alam, 2020, p. 3). Although governments, in collaboration with corporate and relevant agencies have made efforts to improve access to education by girls, the report mentions that girls are limited from learning to their fullest potential due to limited gender-responsive environments perpetuated by the teachers (Sánchez-Tapia & Alam, 2020). These results align with the findings under theme 1.

One study found that many education systems across the world have been reinforced by integrating STEM elements into the education system to overcome shortages in STEM. The most popular integration approach has been integrating STEM subjects, projects and outreach programs in high schools. However, the same study found that focusing on the knowledge content of STEM in the curriculum alone does not result in increased awareness of the opportunities related to STEM careers (Tey et al., 2020). The results of the study are supported by the evidence cited by Makola & Kgosinyane (2020), which showed that despite the numerous programs and initiatives adopted by the Department of Basic Education in South Africa to inspire female students to enrol in STEM subjects, the numbers of girls taking up STEM subjects in higher institutions of learning (university and technikons) remained low. Jakobs (2022) suggested that the increase in female students' interest in STEM can be improved by STEM-related activities carried out outside of the school grading system i.e. after-school STEM-themed activities (Jakobs, 2022). Programs that allow girls to immerse themselves in STEM activities are expected to pique their interest.

5.3.3 *Discussion pertaining to Theme 4*

Women have been cited acknowledging that their career paths were smooth until they decided to start a family. Motherhood has been found to negatively impact the professional status of women for a myriad of reasons. For one, the time taken off work for maternity leave is viewed as disadvantageous to any career momentum built over time. Secondly, once the children are born, women are expected to dedicate more time to family responsibilities than their male peers (Prieto et al., 2022). "Since childcare responsibilities often fall upon the mother of the family, women are less likely to stay in their career, especially when they have young children" (Jakobs, 2022, pp. 20 - 21).

Research on women in tech has found that balancing professional and private lives remains a concern for women in the tech industry. Consequently, women in tech who are mothers appear to limit their career aspirations when work-family conflicts occur (Schmitt et al., 2020). Similar to previous literature, it is apparent from this study that there is a strong conflict between career advancement in STEM and fulfilling family responsibilities. Responsibilities associated with

motherhood stood out as a major hindrance to climbing the corporate ladder. The challenges stem either from negative perceptions in the workplace that once a woman becomes a mother - they cannot dedicate as much time to work or the internal guilt the women face from the perceived neglect of parental duties to meet growing career demands. The negative impact of maternity leave was obvious, where challenges were experienced in catching up with technology developments on return to work.

Although a modest finding, this study found that the impact of work-life balance challenges has been reduced by a shift in the family environment towards being more supportive. Some participants sang praises to their supportive partners who relieved the burden of carrying all the family responsibilities, enabling them to dedicate the required amount of time to excel at work.

5.3.4 *Discussion pertaining to Theme 5*

Literature suggests that social gender stereotyping limits the number of women entering and staying in STEM. The estimated 30% of women receiving STEM training in SSA results in a male-dominated technology industry. The few women participating in the industry end up experiencing challenges in the workplace as a result of instances of gender bias (Porfido & Marks, 2020; Motaung, 2019). The research found that girl who encounters stereotypes are forced to believe that they are not “the right fit” for STEM fields as compared to their male peers. There is a persistent societal mindset that boys are better than girls at Maths and would therefore be more successful in STEM-related professions (Jakobs, 2022). The STEM profession is viewed by society as “a smart profession often reserved for technical males” (Motaung, 2019, p. 34).

Research by Munyeka and Maharaj (2022) found that women face unfavourable conditions daily due to gender discrimination. Recurring topics included unequal opportunities and being sidelined for being less competent than male counterparts. The finding is echoed by this study that attributes gender bias to various sentiments about females, including a supposed lack of STEM skills, unsuitability to STEM, the impact of motherhood and the “old boys club mentality. The sentiments are discussed in the following sections.

5.3.4.1 Girls lack the skills and abilities for STEM professions

The gender stereotype that girls and women lack the prerequisite skills and abilities to perform well in STEM was a major feature of the findings of this study. Participants reported their work and qualifications being scrutinised or second-guessed based on their gender. It was found that due to the notion that technical work is complex, women were subjected to misguided offers of assistance and mansplaining. A supportive study of this finding revealed that perceptions of gendered ability hampered women's willingness to enter STEM. Women were found to experience self-doubt from perceptions that they cannot be as good as men in STEM (Prieto et al., 2022).

This study discovered that the work prepared by women was often dismissed unless a man presented the same, as women are not expected to contribute effectively to the field of STEM. This was explained as one of the factors that hamper women's willingness to participate in thought leadership sessions such as industry conferences. Furthermore, participants reported instances of gender bias where supervisors allocated basic or administrative duties to them instead of technical assignments, whilst trusting men with technical tasks from the onset of their careers. It was also found that the misconception that women lack the aptitude to work in STEM often translated into the expectation that in a room filled with engineers - the few women presents would serve as supportive structures to the men e.g. personal assistants or minute-takers.

5.3.4.2 Boys are more suited for STEM roles than girls

This study discovered that parents raising boys and girls differently is a limiting factor to developing an interest in STEM in the girl child. This research showed that women are not exposed to STEM during their childhood due to a parenting approach that promotes girls playing with dolls and boys with mentally stimulating toys like Lego, as well as gendered activities in the school environment. This finding is supported by Prieto et al (2022), who identified childhood conditioning towards "more appropriate" female careers as a barrier to STEM careers. This study found that participants believed that exposure to toys and other materials

traditionally bought for boys would foster cognitive skills in girls. Sanchez-Tapia and Alam (2020) endorsed this view in their proposal that exposing girls to STEM-related toys and activities reduces girls' disposition that they are not competent in STEM and improves their self-confidence.

This study also indicated that the belief that boys and men are more suited for STEM is more prevalent in industries where there are physical elements to the role e.g. rigging a network tower. This results in women being sidelined for such roles on the premise that they lack the required physical strength. In a study on why women leave engineering, Fouad et al. (2017) discovered that working conditions in STEM, which are synonymous with loud, dusty, smelly and hazardous environments, influence women's decision against engineering. Participants in this study disputed the notion that women are not suited for engineering roles on the basis that the engineer's role has evolved with the advent of opportunities to virtualise more engineering tasks.

5.3.4.3 Motherhood is distracting to performing STEM roles

This study provided insights into the fact that women still face significant obstacles in their careers once they become mothers. It was found that women often struggled to catch up with the trajectory of their male counterparts upon returning from maternity leave. The participants recalled experiencing numerous instances of discrimination due to their colleagues' misconception of competing demands between work and home for the women. This culminated in women being passed up for promotion based on their inability to dedicate the same amount of time to work as their male peers. Supporting this finding is an observation by Prieto et al (2022), that women avoided announcing intentions to start a family out of fear of being excluded from training opportunities. Fouad et al (2017) confirm these findings in their observation that women with young children rated inflexible working environments with heavy workloads and substantial travel requirements as top reasons for leaving careers in STEM.

5.3.4.4 The workplace is designed to benefit men

The findings of this study reveal that women in STEM have negative perceptions about being women in STEM due to prevailing structural work environments that

disadvantage them. The participants reported emotions associated with isolation from obvious exclusion from “the old boys club”. The unfair treatment that emerged from obvious favouritism towards men in the workplace stood out as an obstacle to career advancement. This finding supports a proposition by Armstrong et al (2016) that the old-boy network may encourage conscious and unconscious discrimination. Another researcher found that women decided against STEM jobs because of pervasive old-boys-club tendencies where organisations failed to transform to integrate women (Fouad et al., 2017). These findings are in contradiction to Munyeka and Maharaj (2022), who concluded in a study of women in a telecommunications company that most participants believed they were treated fairly and experienced fewer burdens of operating in a male-dominated industry.

5.4 Discussion in relation to the theoretical framework

Most of the findings described in the preceding sections are consistent with the principles of SCCT – the selected analytical framework for this study. Previous research adopted SCCT as a guiding framework for investigating the impact of self-efficacy (the main construct of SCCT) on work enablers and barriers. SCCT was deemed useful in depicting how employee decisions are based on intrinsic (desire) and extrinsic (environmental) motivation. Employees with low self-efficacy were observed to exhibit self-doubt regarding completing tasks successfully while those with high self-efficacy were motivated to succeed even under adverse circumstances (Stajkovic & Luthans, 2014). Based on the theoretical principles and research findings reported by other researchers, SCCT appeared to be a suitable framework for investigating factors (intrinsic and extrinsic) that motivate or pose barriers for women when choosing to enter or stay in a career in STEM.

The findings of this study support the notion that encouragement from family and friends, teachers and other role models positively influences girls’ and women’s self-efficacy beliefs (Makola & Kgosinyane, 2020). For example, encouragement from family and friends (environmental) was shown to fuel interest (desire) in pursuing or remaining in a STEM profession. Additionally, it was shown that

negative experiences of perceived inequality in the workplace can be associated with low self-efficacy i.e. women playing into societal norms that they lack the abilities to succeed in STEM, men are more suited for STEM roles, motherhood is distracting, etc.

5.5 Researcher reflexivity

Research reflexivity refers to the process of thorough self-assessment by the researcher regarding possible biases, preconceived ideas or notions, relationship to participants and closeness to the topic (Korstjens & Moser, 2017). It is noted that the position of the researcher as a female working in the technology industry could be perceived to have influenced the conduct of this study, as well as the interpretation of the findings thereof. This could have culminated in questioning that led participants towards a particular response or overlooking unfavourable responses based on their own lived experiences. Any potential blind spots were mitigated through focused attention on facts rather than emotions or reference to own experiences. Facts were supported by literature review and interview data. An open-minded approach was adopted throughout the research to “learn” from the literature and interview data, rather than inferring. Before each interview, a comprehensive explanation of the interview process was outlined to each participant, including the option to refuse to answer any questions of their choice or end the interview. Self-assessment (introspection) exercises were carried out at each stage of the research to ensure the accuracy and authenticity of the process, including the interpretation of the data collected.

5.6 Conclusion

In conclusion, numerous themes emerged from the qualitative analysis of the data collected through in-depth interviews. The key drivers identified for pursuing careers in STEM include the prestige associated with being a STEM professional and the social influences of family, friends, teachers, and role models. It was noted that women face various barriers to entry and retention in STEM, including a lack of female role models, challenges with work-life balance, and gender stereotyping. The education system was also identified as playing a crucial role

in encouraging or discouraging girls from taking up STEM subjects. Ultimately, the findings of the study support the notion that both intrinsic and extrinsic factors influence women's decisions to choose, enter, or stay in a career in STEM.

Overall, the findings of this study confirmed findings from the literature review and proposed other enablers and barriers for women in tech entering and remaining in STEM roles. The study confirmed that visible role modelling by successful women with STEM backgrounds, occupying technical roles and leadership positions in technology fields **is** key to elevating female self-confidence and interest in pursuing careers in the technology sector. In addition, this study demonstrated that for women in tech, role models are not limited to successful women in STEM. Family, friends, teachers and other male mentors were identified as key players in motivating, encouraging and inspiring women to pursue and progress in careers in STEM. In particular, unwavering commitment from family and friends to foster girls' interest in STEM, and passionate teachers that steer them towards STEM subjects were identified as highly influential.

Furthermore, the study confirmed that societal and cultural structures are significantly influential on the low representation of women in African TechCos. Compared to the findings of previous literature, this study found that cultural structures have evolved from serving as barriers to enabling women to succeed in STEM. This was evidenced in the notable impact of supportive family environments in encouraging and supporting women to move up the ranks in STEM. Although the role of the primary caregiver was evident in the findings, it was shown that partners are reducing the burden of household responsibilities to lessen the competing demands between work and home for women in tech. Unlike the literature reviewed in Chapter 2, the role of prestige in society associated with STEM professions was prominent in this study. It was found that the financial prospects and perceived respect from society for STEM professionals were notable motivators to pursue a career in STEM. In addition to the societal barriers of stereotyping, gender bias and sentiment of inequality between men and women, organisational barriers were also identified. It was evident from the study that the education systems in some African countries have not been designed to enable girls to pursue STEM careers. Furthermore, the work

environments were shown to be inhibiting to women progressing in STEM for reasons such as “old boys club mentality” and organisational culture that excludes or prejudices women in the workplace. It is therefore concluded that societal, cultural and organisational structures influence the representation of women in tech.

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

6.1 Introduction

This study investigated the underrepresentation of women with STEM backgrounds in African TechCos. Two research objectives were developed to address this subject, as detailed in Chapter 1. The literature review conducted throughout the various stages of the research process indicated that this topic is under researched, particularly in developing countries. The literature showed that cultural factors, such as the prioritisation of boys in education and the expectation of girls to perform caregiving roles for children and the elderly, play a significant role in the participation of women in STEM in the African context. Role modelling was reported as a key driver for women to develop, maintain interest and be encouraged to pursue careers in tech. In addition, previous research indicated that an inclusive workforce, particularly with regard to gender diversity, has a direct correlation to digital innovation and the competitiveness of companies. Companies that intentionally establish more diverse teams were observed to yield more positive financial results than their less diverse industry peers.

The overall findings of this study suggest that the issue starts from childhood where girls are often given dolls and dress-up toys while boys are given scientific or cognitive toys. This results in boys' affinity to STEM being encouraged while girls are steered toward supposedly non-technical careers. A combination of this issue with other social, organisational and structural factors was found to contribute to the low levels of female representation in African TechCos. The results of the study were presented and discussed in chapters 4 and 5 respectively.

6.2 Conclusions regarding research objective 1

Research objective 1 was to identify factors that motivate and enable women to enter STEM fields, particularly in the technology sector. The primary motivator for entering STEM fields was identified as the prestige that comes with higher paying jobs and the resultant respect from society for holding a job in STEM fields. Family and friends stood out as enabling by encouraging STEM interest in girls and subsequently providing supportive structures for women to perform well in their STEM roles. Teachers passionate about STEM subjects were also shown to be influential to girls opting for STEM career paths.

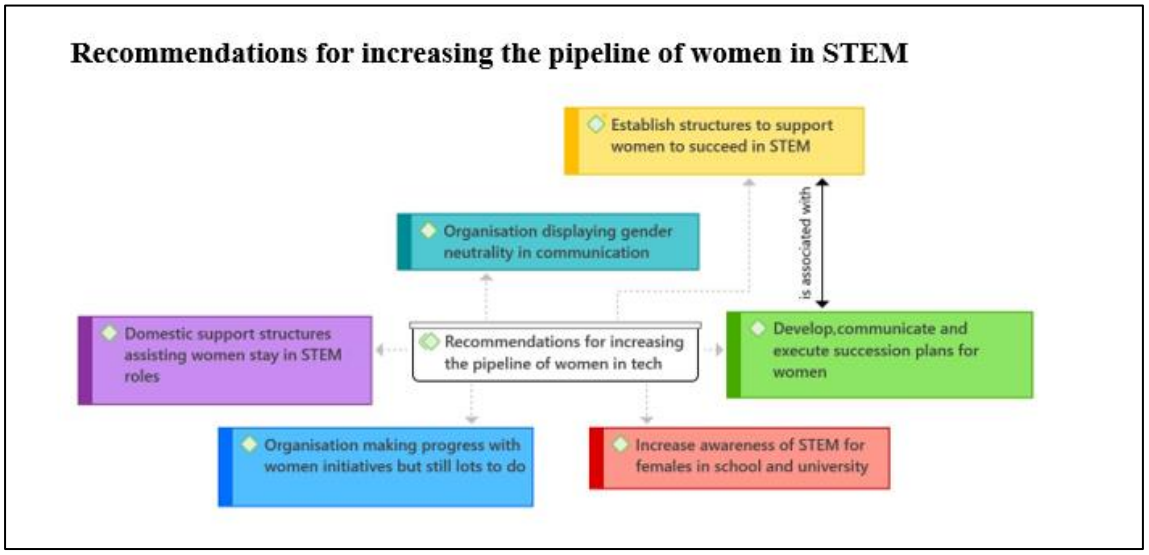
6.3 Conclusions regarding research objective 2

Research objective 2 was to identify barriers to entry and retention of women in TechCos. The two research objectives were found to have linked and reinforcing effects i.e. the opposite aspects of research objective 1 contribute as barriers to entry and retention in STEM. For instance, a discouraging and non-supportive family environment is a barrier for women in tech, and teachers that sway female scholars towards supposedly easier subjects in school and university hinder the increase in the representation of women in STEM industries. In addition to these barriers, this study identified barriers such as education systems barely promoting STEM subjects for female students, competing roles between work and home, stereotypes about gender capabilities and suitability, as well as male-dominated work environments that foster negative experiences for women in the workplace.

6.4 Recommendations

Based on the literature review and findings from the data collected through the qualitative interviews, proposals to increase the representation of women with STEM backgrounds in African TechCos have been identified. The recommendations have been clustered for discussion below.

Figure 6-1: Clusters of recommendations from interview data



Source: (Author's own)

6.4.1 *Establish structures to support women to succeed in STEM*

- **Leadership commitment**: Leadership must "walk the talk". Commitment from senior management to support women in STEM is crucial for the success of interventions being implemented in their organisations to close the gender gap in STEM fields. Leaders must demonstrate their commitment by setting and tracking measurable gender targets, quantifying and reporting on the benefits derived from diverse teams, and taking on mentorship roles for women in tech. Leadership must clearly demonstrate their intention to support the career advancement of women in tech.

- **Work-life balance interventions**: to ensure women can adequately manage the dual roles of working woman and parent, support systems must be put in place in the work environments e.g. flexible working hours, childcare facilities and lactation rooms. These interventions are aimed at balancing work and home to enable the women to perform at their best in both roles.
- **Male mentorship**: Mentorship interventions must not be limited to women in STEM. Male leaders must be incentivized to mentor female employees, especially those in positions that women aspire to.
- **On-the-job learning/training**: Considering the statistics noted in reports on the limited pipeline of women in tech, women in STEM should be given the opportunity to learn on the job and develop their skills. It is proposed that organisations must revise their recruitment policies to focus on behavioural instead of technical skills to encourage more women to apply for STEM roles, following which training or on-the-job training can be used to bridge any technical gaps identified.
- **Develop, communicate, and execute succession plans for women: Organisations must prioritise the trajectory of women in tech by identifying those demonstrating leadership potential and developing plans** to equip them to move up the ranks. These plans must be communicated to the women to reduce the risk of them switching roles in search of career growth**.**

6.4.2 *Increase awareness of STEM for females in school and university*

- **Address the root cause**: Girls should be exposed to STEM from a young age. This includes awareness and access to STEM-related toys and activities to build their interest and passion for STEM. Parents must applaud and cultivate interest in STEM-related activities and programs demonstrated by girls and boys.

- **Increase the visibility of successful women in tech**: Successful women in tech should be visible and accessible to young girls from pre-school to

schools and universities. The sooner girls can identify women in STEM they look up to, the sooner they can grow an interest in the field.

6.4.3 *Domestic support assisting women to stay in STEM roles*

On the home front, family and friends should provide strong support systems by sharing household responsibilities with women in tech to allow them to flourish on the work front. Where affordability is not an issue, additional support can be sought through recruiting drivers, chefs and housekeepers for the home, to allow women to focus on work when necessary.

6.4.4 *Additional initiatives*

Transformational interventions are required to address the low levels of female representation in STEM. This requires the collaborative efforts of various stakeholders to ensure the demographic profiles of the STEM industry are representative of the global population. Governments and civil society must challenge gender stereotypes and biases in the tech industry and hold the relevant companies accountable for bridging the gender gap.

6.5 Suggestions for further research

This study focused on the experiences of women with STEM backgrounds working in African TechCos. The influence of the age and work experience (in terms of years) of the women were not incorporated into the research analysis. Additional research could expand on the findings of the study to consider whether the lived experiences of women in tech are impacted by their age or how long they have worked in the industry.

This study also did not expand on the impact of the gender pay gap, as it was mentioned in passing and not deemed a key barrier by the participants interviewed. Future studies could explore the impact of the gender pay gap on influencing women to enter or stay in STEM fields.

The participants interviewed had stayed in the STEM field and were employed by their current employers for extended periods, so the study did not reveal reasons women leave STEM careers. This can also be explored in future studies.

The population researched was limited to Sub-Saharan Africa. Studies can be conducted in the future to expand on the geographical scope of the study to other regions of Africa as well as other developing countries, to validate the socio-economic influences of choosing STEM careers.

6.6 Possible limitations and challenges of the study

- A key limitation of qualitative research is poor generalisability i.e. not being able to generalise the findings from the sample interviewed over a larger population (Dudovskiy, 2023). The sample size was limited to eight participants and their views cannot be assumed to be presentative of the majority of women in STEM working in African TechCos.
- Due to the geographical spread of the sample interviewed, virtual interviews were conducted with participants residing outside South Africa. Some of the participants were not on video, so it was not possible to gauge their body language in response to the questions, which could have influenced follow-up questions.
- Time constraints to carry out in-depth interviews were a major limiting factor. The participants all work in fast-paced and demanding roles; therefore, the interview time could not be extended, and more follow-up questions could have provided richer insights due to diary availability.
- Only one participant in the sample held an entry-level position in a TechCo, so the voices of women who have recently joined STEM may have been missed.

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APPENDIX (A): PARTICIPANT INFORMATION SHEET

Dear Sir / Madam

My name is Mabedi Ruby Mufahothe and I am currently studying towards my Masters' degree in Management: Digital Business with the University of the Witwatersrand, Johannesburg. The completion of a research project is required for the completion of my studies.

In light of the above, I am conducting a research study on the low representation of women in technical roles within African telecommunications companies transforming to technology companies. The study title is the **underrepresentation of women in African Techcos**. I am inviting you to take part in an interview as a form of data collection for the study. If you agree to the request, the interview will take place at (online/venue and date of your choice), for approximately 45 minutes. With your permission, I would like to audio record the interview. This data will be stored in a password protected recorder and a digitally encrypted folder on a password protected computer and only the researcher will have access to this recording. It will be deleted after 5 years.

During the research activity, I will need to ask for some personal information about you, including your personal experiences in the workplace. The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on. If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits or rights you would normally have if you decide not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life. If any of the questions upset you, I will stop the interview and continue at another time. This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor, Ms Ayanda Magida, on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Mabedi Ruby Mufahothe

Researcher:

Mabedi Ruby Lusithi, 2627719@students.wits.ac.za, +27 (0) 83 212 1156

Supervisor:

Ayanda Magida, ayanda.magida@wits.ac.za, +27 (0) 11 717 3953

APPENDIX (B): CONSENT FORM

Studying the underrepresentation of women with STEM backgrounds in African TechCos

I,..... , agree to participate in this research project.

I agree to the following (please circle the relevant options below):

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree to the length of time of the interview of approximately 45 minutes	YES	NO
I agree that the interview may be audio recorded	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report	YES	NO
I agree that other researchers may use the information I provide in my interview (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on	YES	NO
I agree that should I have any further questions I can contact Ms Mufahothe directly either via email (2627719@students.wits.ac.za) or telephone (+27 83 212 1156)		

.....(signature)

… .....(name of participant)

… .....(date)

… .....(signature)

… .....(name of researcher)

… .....(date)

APPENDIX (C): INTERVIEW GUIDE

Introduction:

Good Day (Name of Participant)

Thank you once again for agreeing to take part in this interview on the underrepresentation of women with STEM backgrounds in African Techcos. Through this interview, I hope to gather valuable insights that will enhance my understanding of the topic and contribute to bridging the gender gap in the technology industry.

Please note that you are welcome and free to refrain from answering or stop the interview at any stage you do not feel comfortable or are uneasy with the line of questioning

This interview will be structured around the following themes:

- Personal experiences
- Educational curriculum and approach
- Social and cultural factors
- Organisational culture and structures

The interview will be structured as follows:

- Personal experience questions to set the context for the insights to be shared
- In-depth questions based on the above themes; and
- Any additional details the participant may wish to share that may add value to the research
- Wrap up and conclusion of the interview

Personal experiences

1. Please introduce yourself and provide an overview of your current role in your organisation?
2. How long have you been with the organisation and how many roles have you held during your tenure?
3. How many women do you currently work with in your department?
4. Have you personally experienced any instances of gender bias in the technology industry?

Social and cultural factors

1. What influenced your decision to pursue a career in STEM?
2. Did you receive encouragement from your community (friends and family)?
3. Would you say society enabled you to pursue a career in STEM?
4. Have you noticed any obstacles that prevent women from entering or advancing in the technology field?
5. How have your family responsibilities impacted your career progression?
6. Have you experienced any work-life balance challenges that impact women negatively compared to the male counterparts?
7. Do you have a female role model in tech, if so what role have they played in your career?

Organisational culture and structures

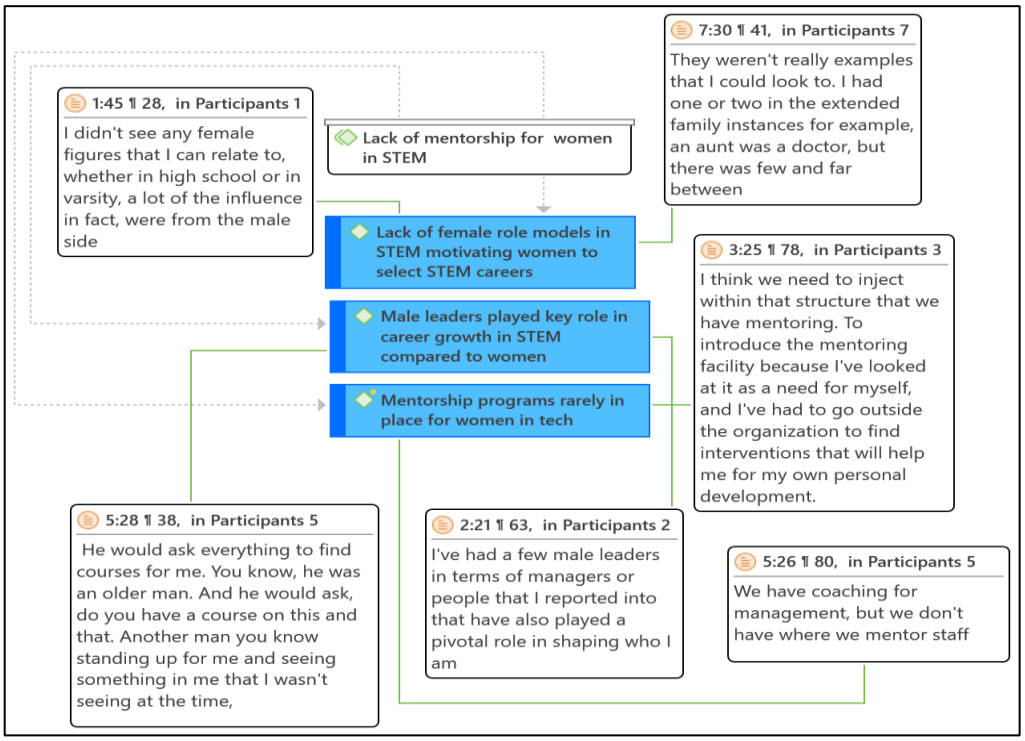
1. How would you describe your current organisational culture regarding gender diversity and inclusion?
2. Does your organisation support the advancement of women and men equally?
3. Is your organisation gender conscious in communication?
4. Are you satisfied with the initiatives your organisation is running to increase the number of women in tech within the organisation?
5. Are there mentorship programs to support women in tech in your organisation?
6. What would you suggest as initiatives to accelerate the pipeline of women in tech?

Additional information

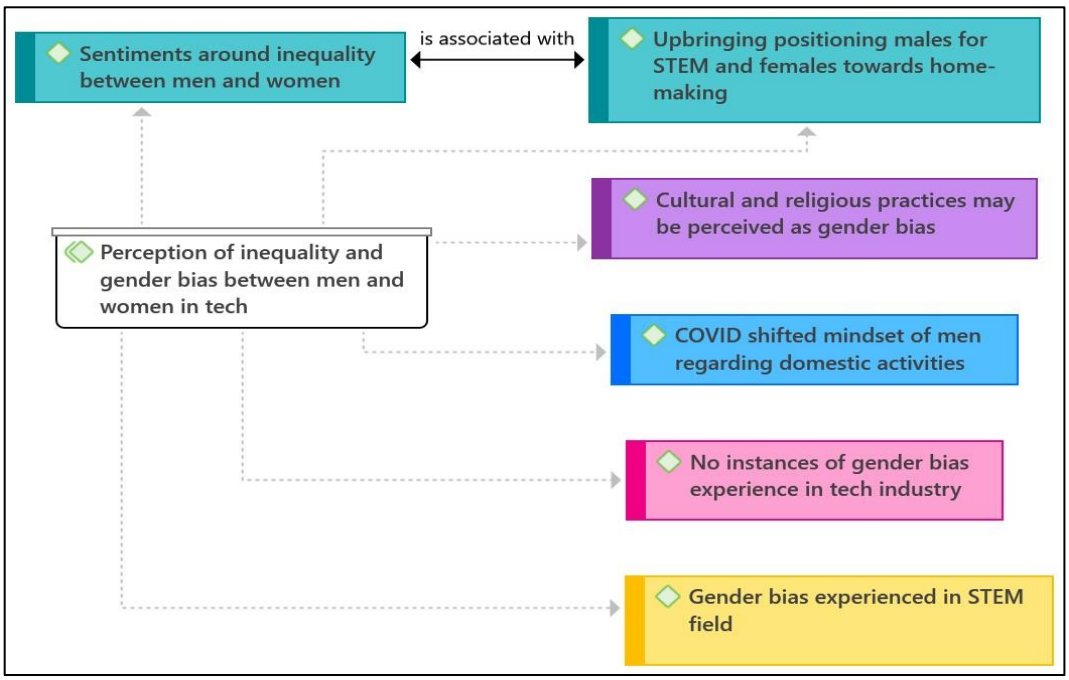
Is there anything else that you may like to add regarding the topic under discussion

APPENDIX (D): Atlas.ti – CODE CLUSTERING

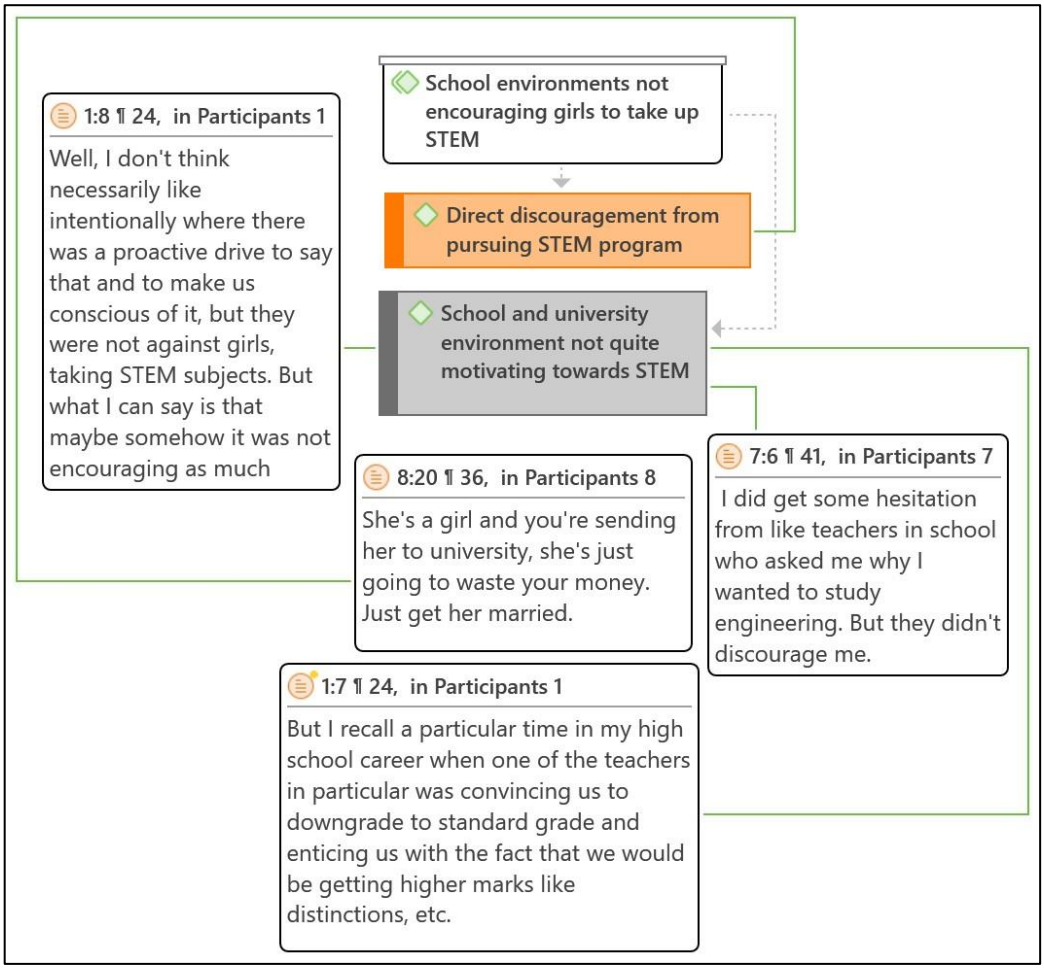
Lack of mentorship for women in STEM



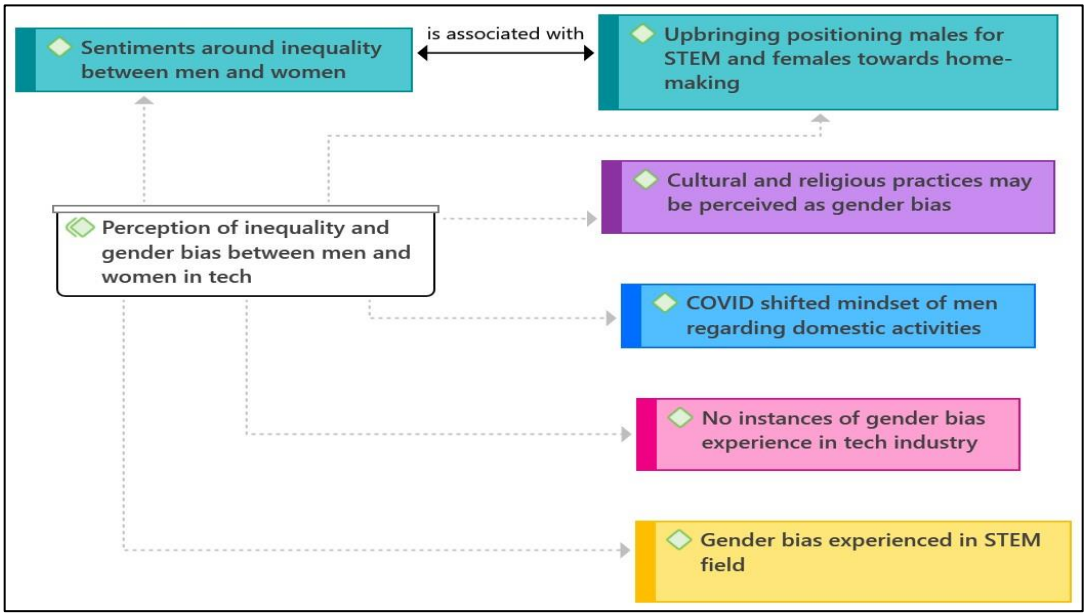
Perception of inequality and gender bias



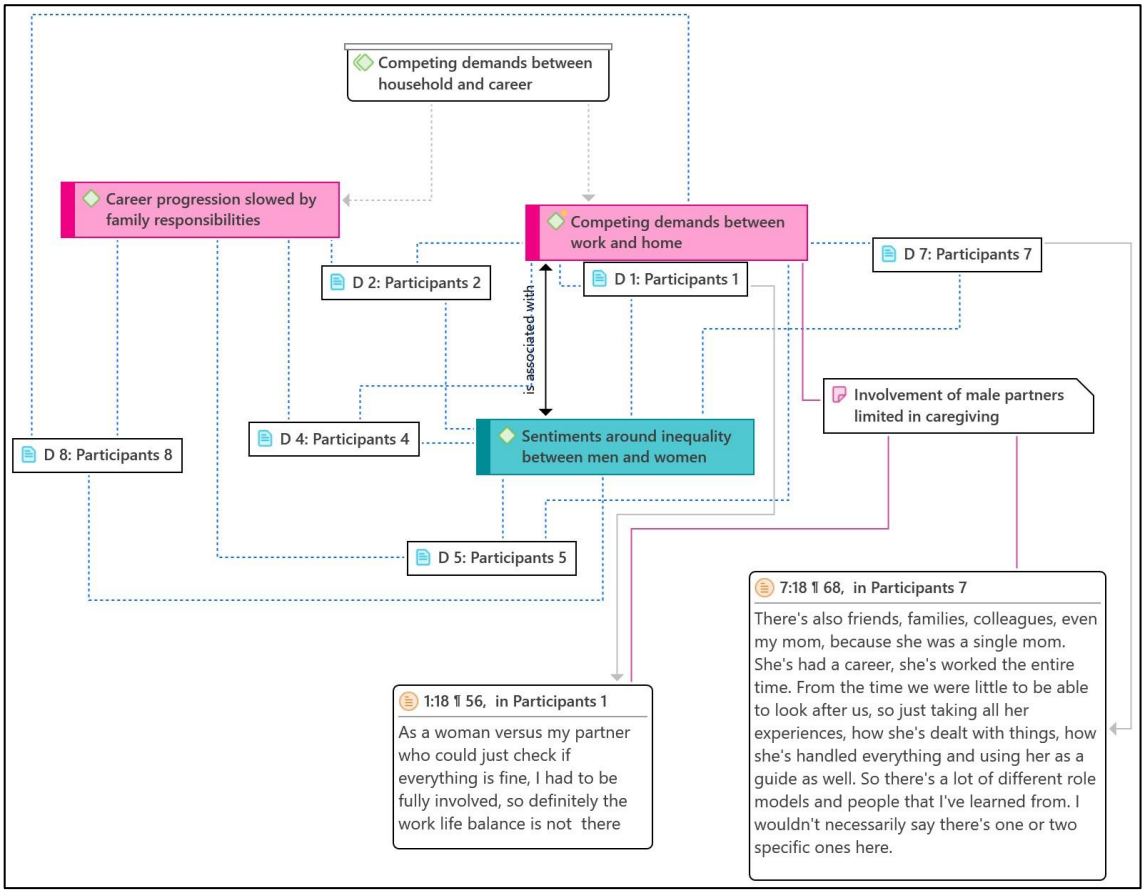
School environment not encouraging girls to take up STEM



Perception of inequality and gender bias



Competing demands between households and career



APPENDIX (E): ETHICS CLEARANCE CERTIFICATE

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/DB2627719/252
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	The underrepresentation of women with STEM backgrounds in African technology companies (TechCos)
Investigator / Researcher	Ms Mabedi Mufahothe
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentialty.
Issue Date of Certificate	2024/02/13
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba +27 11 717 3976 +27 82 733 6587 pius.oba@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

13-02-24
Date: