



**UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG**

**“EXPLORING THE PERCEPTIONS OF ADOLESCENTS BLACK FEMALE
LEARNERS IN PUBLIC SCHOOL OF STEM CAREERS IN TERMS OF ITS
SIGNIFICANCE TOWARDS INDIVIDUAL ECONOMIC EMPOWERMENT; A CASE
STUDY OF BONA COMPREHENSIVE HIGH SCHOOL IN SOWETO, SOUTH
AFRICA”**

A dissertation on a research study project presented to

The Department of Social Work

School of Human and Community Development

Faculty of Humanities

University of the Witwatersrand

In partial Fulfilment of the requirements for the degree Master of Arts (Social Work)

By research

By

Hope Sikhosana

Supervisor: Professor Thobeka Nkomo

March 2023

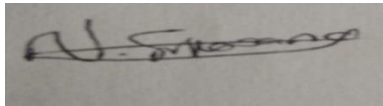
DECLARATION

I, Hope Sikhosana, hereby state that this research report is entirely my own original work, created without the aid of others, and that all sources utilized in the study have been properly and appropriately recognized and cited. I further affirm that measures have been taken to guarantee that the dissemination of this work does not contravene academic standards or ethical guidelines established by the Human Research Ethics Committee at the University of the Witwatersrand (Non-Medical). I further certify that I have never submitted this research report to another university for a degree or examination.

Student number: 1389367

Research Ethical Protocol number: H21/03/25

Signature:

A rectangular box containing a handwritten signature in dark ink. The signature appears to be 'H. Sikhosana' written in a cursive, slightly stylized script.

Date: March 2023

DEDICATION

This one is for you, Ma. I sincerely appreciate your perseverance and unwavering pride in me as your daughter. I appreciate you always being interested in my work and being a sounding board for my thoughts. I appreciate you supporting me mentally and emotionally; you are truly fantastic.

This one is for you, too, Baba. I appreciate you so much for being by my side and encouraging me throughout my academic career. I would not have been able to be in places like Wits University without you. I am grateful that you have instilled work ethic, perseverance, and discipline in me. All your instruction helped me get through this project. I am grateful that you foretold such greatness even before I accepted it as true. Your words were always in my brain and heart as I travelled this path.

This one is also for you, my brother. I appreciate your encouragement and support during my tough times. I appreciate your patience and consideration for me. It is finished; I made it, Ntwana.

This is also for you, Sir, my academic father Mr. Huma. Thank you for developing me and turning me into a writer. Everything began in your class.

ACKNOWLEDGEMENTS

I want to express my gratitude to God for providing the resources and strength I needed to complete this study. God, thank you for providing me the strength and knowledge to continue working on this job until it is finished. I appreciate your confidence in me and providing me with the means to complete this endeavour. I appreciate you being a part of the journey.

I would also like to thank my late supervisor Mr. Mathews Makwela for providing me such a great start on this research endeavour. It felt foolish to start a Master's program during Covid-19. I am grateful that you helped me see things differently and brought me hope despite my difficulties. Your words inspired me to take on this undertaking with boldness and confidence. May you rest in peace?

I sincerely would like to express my gratitude to Professor Thobeka Nkomo. Thank you for your patience, support, motivation, and guidance. Thank you for walking this journey with me. Thank you for shaping my professionalism and for your persistent and consistent care and hope in me Prof. Your Professionalism and work ethic is admirable and one which I chose to learn from going forth as an emerging academic researcher and social worker.

I would especially like to thank my mentors for their unwavering encouragement and support. I would like to thank Aldridge Munyoro, Pride Kandemiri, Hlologelo Malaji, and Nokuthula Nkosi.

Special thank you to my friends: Thakgalo, Bothwell, Lindile , Bradley and Noluthando .Thank you so much for believing in me and supporting me, your efforts in giving me hope and encouragement were heartfelt.

I would also like to express my gratitude to the department of South African basic education and Bona Comprehensive high school for granting me permission to conduct my research at the school. Thank you for your professionalism.

Thank you so much to the National Research Fund (NRF) and Wits University for their financial support throughout the research process. Without money, I would not have been able to complete this project successfully. I would like to also thank Dr. Mamakiri Muluadzi for her generosity,

inspiration, and for giving me experience as a young researcher. May God continue to bless you. Lastly, thank you to the Bona Comprehensive Adolescents STEM girls who took part in the study. I appreciate you sharing such insightful information about your daily experiences in STEM fields.

ABSTRACT

Low enrolment of females in Science, Technology, Engineering and Mathematics (STEM) careers is a persistent problem in South Africa and Globally. The issue was greatly exacerbated

by the history of gender-based discrimination and oppression, particularly in the workplace and in education. This unequal way of life between men and women of different races was established and maintained in large part by power structures like apartheid and patriarchy. Women have been underrepresented in STEM disciplines as a result of discrimination and sexism. But as the balance of power shifted over the years, many women—and particularly those from historically marginalized groups—were given encouragement to enter STEM areas. However, despite the efforts, women number in STEM remains low. The study investigated how Black adolescent female students in public schools perceived STEM occupations to better understand the low representation of women in STEM fields. The researcher conducted a qualitative case study at Bona Comprehensive School in Soweto to fulfil this goal. A purposive sampling strategy was utilized to choose 1 Life Orientation teacher, while an intentional snowball sampling technique was used to sample 10 Black Adolescent Female students. In-depth one-on-one telephone interviews were performed to collect data, with a semi-structured interview schedule serving as the research tool. Thematic content analysis was used to examine the data that had been gathered. Results show that female students view occupations in medical favourably because they see them as safe and feminine, whereas they view careers in electrical engineering and construction as dangerous and masculine. Also, the results demonstrate that participants' positive perceptions were influenced by the good pay associated with STEM fields because they felt that economic empowerment was crucial to changing their lives and the lives of their families. The lack of resources from the school for hands-on learning, however, was a challenge for the female students as they pursued STEM degrees. In order to keep and attract female students in STEM fields, there is a need to better support them throughout their academic careers. In the research report's latter sections, recommendations are given.

Key words: Economic empowerment; Gender inequality; Gender; Public schools; STEM careers; Adolescents

ABBREVIATIONS

COVID-19- Coronavirus Disease 2019

DBE- Department of basic education

GHS- General household survey

GDP- Gross domestic product

GPI- Genuine progress Indicator

HOD- Head of department

HBMS- Health, Biology, and medical sciences

LO- Life Orientation

MPECS- Mathematics, physical, engineering and computer sciences

MDG 3- Millennium Development Goals

NEET- Not in education, employment, or training

OECD- The Organization for Economic Cooperation and Development

STEM- Science, Technology, Engineering and Mathematics

SDG 5- Sustainable Development Goals

UNICEF- The United Nations International Children’s emergency fund

Contents

DECLARATION	ii
DEDICATION.....	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
ABBREVIATIONS	vi
APPENDIXES	xi

TABLES	xii
FIGURES	Error! Bookmark not defined.
Figure 2.1: Representation of women in STEM fields in South Africa	Error! Bookmark not defined.
CHAPTER ONE: BACKGROUND TO THE STUDY	1
1.1 INTRODUCTION	1
1.2 Statement of the problem and rationale for the study	5
1.3 Brief background of Bona Comprehensive School and Orlando Township	8
1.4 Definition of key terms	9
1.4.1 Economic empowerment	9
1.4.2 Gender	10
1.4.3 Gender inequality	10
1.4.4 Public schools	11
1.4.5 STEM careers	11
1.4.6 Patriarchy	11
1.4.7 Apartheid.....	12
1.4.8 Adolescents	12
1.5 The purpose of the study	12
1.6 Overview of research design and methodology.....	12
1.7 Limitation of the study.....	13
1.8 Organisation of the report	13
CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK	14
2.1 Introduction	14
2.2 History of Black women in STEM education in South Africa.....	15
2.3 Purpose of education in Africa and the state of public schools.....	17
2.4 Representation of women in STEM Fields	20
Figure 2.1 – Representation of women in STEM fields in South Africa	22
2.5 Benefits of females being in STEM fields and need for diversity in STEM.....	22
2.6 STEM achievement between girls and boys in South Africa basic education.....	24
2.7 Family role in female learners’ career choices.....	25
2.8 Interventions to improve girls’ participation in education and STEM.....	27
2.9 Legislations.....	28
2.10 Related studies	30
2.10.1 International studies	30
2.10.2 African studies	32
2.11 THEORETICAL FRAMEWORK.....	33
2.12 Chapter summary	36

CHAPTER THREE : RESEARCH APPROACH AND DESIGN	36
3.1 Introduction	37
3.2 Research Question.....	37
3.3 Research Aim and objectives	37
3.3.1 Primary Aim.....	37
3.3.2 Secondary Objectives.....	37
3.4 Methodology.....	38
3.4.1 Research strategy	38
3.4.2 Population and Sampling	39
Participants Inclusion Criteria	40
3.4.3 Research Instrument.....	41
3.4.4 Pre –testing of the research instrument	41
3.5 DATA COLLECTION.....	42
3.6 DATA ANALYSIS	42
3.7 TRUSTWORTHINESS OF THE STUDY	44
Credibility.....	44
Transferability	44
Dependability.....	45
Conformability.....	45
3.8 ETHICAL CONSIDERATION	45
Informed consent	45
Confidentiality and anonymity.....	46
Vulnerable population	46
Application for ethical approval (Wits):.....	47
Avoidance of harm or non-maleficence	47
Reflection / Challenges	47
3.9 Chapter Summary.....	48
CHAPTER FOUR : DATA PRESENTATION AND FINDINGS	49
4.1 Introduction	49
4.2 Participants socio-demographic Information	50
Table 4.1 Participants socio- demographic profile (N- 10)	50
4.3 Perceptions Black girls from Public schools have of STEM careers	51
4.3.1 Main theme: Learners view STEM fields positively	54
Sub Theme : STEM subjects provides better employment opportunities.....	54
STEM careers are good especially medicine.....	56
STEM careers pay well	58

STEM fields provides growth and development	60
4.3.2 Learners view STEM fields negatively	63
STEM careers are not safe.	63
4.3.3 Female learners understanding of female underrepresentation in STEM fields	65
Girls cannot draw	65
STEM is for males' stereotype.....	66
4.4 Experiences of Black Adolescent girls from Bona Comprehensive school in STEM subjects	68
4.4.1 Encouragement from teachers	69
4.4.2 Teachers teaching style determine comprehension level	72
4.4.3 STEM subjects are difficult	74
4.5 Challenges of Black Adolescents girls from Bona Comprehensive School in STEM subjects	75
4.5.1 Electricity Problem.....	77
4.5.2 Home circumstances.....	78
4.5.3 Unconducive environment.....	80
4.5.4 Lack of resources from the school	81
4.5.5 Participants limited knowledge about STEM careers	82
4.6 Objective four: Learning support programs accorded to Black girls from public schools within STEM subjects	84
4.6.1 Extra assistance with studies.....	85
Study groups / tutor	85
Extra lessons.....	86
4.7 Objective five: Reasons/motivation the Black girls selected STEM subjects	87
4.7.1 Senior peers served as motivation and inspiration for the participants.....	89
4.7.2 Personal Interest.....	90
4.7.3 Social media as a strong Influence.....	92
4.7.4 Career Interest.....	93
CHAPTER FIVE	95
MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS	96
5.1 Summary of main findings	96
5.2 Perceptions Black girls from Bona Comprehensive have of STEM Careers	96
5.3 Experiences of Black Adolescent girls from Bona Comprehensive School in STEM subjects	98
5.4 Challenges of Black adolescents girls from Bona comprehensive school in STEM subjects	99
5.5 Learning support programs accorded to Black Adolescent girls in Bona Comprehensive within STEM subjects.	100
5.6 Reasons / Motivation the Black girls selected STEM subjects	100

5.7 Recommendations given by Adolescents Black girls on how the school could better support their studies	101
5.8 Conclusion.....	102
5.9 Recommendation for department of education; STEM sector; department of Higher education and department of infrastructure	102
5.10 Recommendation for future studies	103

Appendix

Appendix A: Letter of permission to conduct the study from Bona comprehensive school.

.....

Appendix B: University of Witwatersrand Human Research Ethics Clearance certificate

.....

Appendix C: Adolescents Black girls in STEM subjects participant Information Sheet

.....

Appendix D: Adolescents Black girls in STEM subjects guardian /parent information sheet

.....

Appendix E: Life Orientation educator participation Information sheet.....

Appendix F: Guardian/ Parent consent form for Adolescent Black girls participation and audio recording of the interview.....

Appendix G: Adolescents Black girls assent form for participation and audio recording of the interview.....

Appendix H: Life Orientation Educator consent form for participation and audio recording of the interview.....

Appendix I: Interview Schedule for Adolescents Black girls.....

Appendix J: Interview Schedule for Life Orientation educator

Tables

Table 4.1: Participants socio –demographic profile.....

Table 4.2: Perceptions Black girls from public schools have of STEM careers findings.....

Table 4.3: Experiences of Black girls from a public school in STEM subjects findings.....

Table 4.4: Challenges of Black girls from a public school in STEM subjects findings.....

Table 4.5: Learning support programs accorded to Black girls from public school within STEM subjects finding.....

Table 4.6 : Reasons/ Motivations the Black girls selected STEM subjects findings.....

Table 4.7 : Career Interests.....

Table 5.1 : Recommendations.....

CHAPTER ONE: BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Gender inequality in the STEM domain is a persistent problem globally and in South Africa, that is seemingly difficult to eradicate. Globally several studies attest to this as they show that there is underrepresentation of women in STEM fields (Kahn & Ginther, 2017; Microsoft, 2017; OECD, 2017; Rattan et al., 2018; Seo et al., 2019). The trends are similar in South Africa; numerous scholars agree that the number of women in STEM is low compared to men (Barwell, 2015; Idahosa & Mkhize, 2021; R Moletsen, 2011). Gender inequality in STEM education is intertwined with social problems which hinder the progress of parity. These social ills specifically negatively affect women, these include teenage pregnancy and gender based violence (Bysiewics, 2018; Maluleka, R, 2021; Moletsan et al., 2015). Teenage pregnancy and gender based violence have long been contributing hindering factors to women success in education (Martineau, 1997). In 2019 GHS shows that 6% of girls between 14-19 years were pregnant. According to Maluleka (2021) there is evidence that shows that women who had their first child between the ages of 15-24 are less likely to obtain a tertiary qualification when compared to women who get their first child later in life. These are some of the structural problems within family system, education system and society at large which contribute to gender equality specifically in education.

The state of public schools must be seen within the broader context. South Africa has an unequal socio economic state (Shenilla, 2020, pg 12). Public schools within the South African context does not provide good learning environment for learning due to lack of facilities, social ills confronting the learners in public schools and poor teachers teaching skills (Shenilla, 2020). Predominantly schools located in rural areas and townships. This is a challenge for children who attend public schools in those geographical areas. This implies that the children are at a disadvantage and have lowers chances of moving to the next level of education (Shenilla, 2020). “According to the Department of basic education statistics for 2018 shows that out of 23,471 public schools, 20,071 have no laboratory” (Shenilla, 2020). Furthermore, “18,019 have no library, while 16,897 have no internet (Shenilla, 2020). Almost 1,000 schools have no sports facilities, while 4,358 have only illegal plain pit latrines for sanitation; 1,027 have no perimeter fencing, essential for teacher and pupil safety, while 239 have no electricity, and 37 have no sanitation facilities at all “(Shenilla, 2020). This environment is not good for learners and lessens

the quality of education they receive because of these other issues confronting them in a learning institution in addition to academic challenges.

Many schools and communities continue to live with the consequences of the apartheid regime political and economic decisions (Shenilla, 2020). This implies that yes systems of power have changed and contemporary policies and frameworks which promote equality are the opposite of apartheid principals. However, some people still suffer the end results of apartheid. In addition, women face female gender specific struggles. School experiences are different and this is determined by class, race and residential area (Shenilla, 2020).”A recent survey of school principals across OECD countries reported that 71% of South African teachers work in schools with over 30 % of socio –economically disadvantaged students” (OECD, 2020). This implies that in addition to navigating challenges of curriculum content, learners still need to navigate poverty and other challenges experienced at home. Example might include finding other means to generate income to sustain living and be able to get necessary school resources, in most instances these learners need to do school without those necessary resources. Specifically, Black learners in public schools suffer the consequences of the apartheid regime political and economic decisions. Communities such as Orlando, which is the community where majority of the population of this study resides, experience these after affects.

Moreover recently COVID-19 pandemic has proven to be gendered, it has exacerbated women’s pre-existing vulnerabilities and worsen gender equality gap in all spheres including education (Siriwardhane & Khan, 2021). Existing inequalities creates a gendered pandemic vulnerability (Siriwardhane & Khan, 2021).This implies that even before Covid-19 there has been inequalities and the pandemic have made the conditions to be worse (Cantillon et al., 2021). Domestic violence is one social ill that shows evidence of this inequality. “Covid-19 disrupted the world, domestic violence was one of the major human rights violation “.(Siriwardhane & Khan, 2021). In 2019 there was “approximately 243 million women and girls worldwide aged 15- 49 who may have been subjected to sexual or physical violence by a close partner, in 2020 this percentage raised “.(Siriwardhane & Khan, 2021b). A total of 137 women were killed by a family member globally in the year of 2020 (Siriwardhane & Khan, 2021). Gender based violence can be attributed to the following factors : these include among others gender norms that favour male privilege and limitations placed on women autonomy and also high level of poverty , unemployment and alcohol and drug abuse(Siriwardhane & Khan, 2021b). Women continue to suffer compounded struggles.

In addition to covid-19 there is a strong correlation between hunger and gender inequality (Maluleka, 2019). According to Maluleka (2019) on average 40.6 % of female –headed households had no one working in the family. This implies that there are still a high percentage of women and the families who are economically disempowered. In 2019 the GHS shows that 11.1% female –headed households reported having suffered from hunger as compared to 9.7% of male-headed household. It is important to take note that Black female headed households are recorded as the poor of the poorest, with regards to unemployment and NEET (Not in education or training). In the mist of transformation and efforts directed towards racial and gender equality, Black women are still yet to bear the fruit. The rates of unemployment are particularly high among Black female youth (Mvulane & Dlabzana, 2021).It is for this reason that UNICEF (2021) proposed young women participation in STEM as a solution to eradicate poverty. This proposition also supports the 2030 agenda for sustainable development, particularly SDG 5 which states that “STEM education for girls can strengthen their use of information and communication technology in ways that improve their lives and work –related opportunities (UNICEF, 2021). Black women from low socio economic backgrounds need economic empowerment, and this could possibly be achieved through involvement in STEM fields as these fields have proven to have more employment opportunities and wages.

Part of research shows that there is an increase in the number of girls in high schools who take STEM subjects (Zhao & Perez-Felkner, 2022). This implies that there is an interest from girls to explore this domain. Motivating reasons to choose STEM might include personal interest or economic benefits associated with the fields (Bysiewics, 2018). However, despite this interest, part of literature shows that there is still a large number of girls who lose interest in STEM fields (Frenzel et al., 2010; Valla & Williams, 2012) thus creating an imbalance in most STEM occupations. Research shows that females in STEM subjects are more interested in Biology and medical science occupations than mathematics, physical, engineering and computer science(Chalim & Anwas, 2018; Cheryan, 2017; Eccles & Wang, 2016; Wiebe et al., 2018). This shows evidence that gender stereotypes are still prevalent, and women still prefer professions which are more nurturing than those historically labelled as masculine. High schools and teacher can play a vital role in changing these perceptions.

The view of STEM disciplines among female students can be significantly changed with the help of teachers. Science teachers have little knowledge of gender equity issues in science education, according to Mdlolo (2017) study titled "Exploring physical science teachers' opinions and understandings concerning gender equity in science education in high schools in the KwaZulu

Natal province of South Africa." This is troubling because it suggests that high school instructors are not doing much to promote gender equity in science and mathematics . According to Mdlolo (2017) teachers from public high schools need to be sensitive in order to effectively inspire students, including girls, to pursue professions in science. This is essential since this is the context in which students spend the majority of their time, and get influence in decisions students take specifically about the career choice (Mdlolo, 2017). Many stakeholders are concern about the decline of females in STEM, there is negative implications attached to having low female number in STEM.

The South African government and STEM department globally is concern about the decline of females in STEM. Globally part of research shows that closing the gender gap in STEM would contribute to an increase in EU GDP per capita by 0.7- 0.9% in 2030 (Preda, 2015). Hakura (2016) propose a similar argument and state that gender gaps in employment and education hamper GDP growth in South Africa. Furthermore, there is an expected employment growth between 2013 and 2025 in engineering and IT occupations, this increase rate is relatively high when compared to the zero expected employment growth in careers like pharmacy for example (Preda, 2015). This suggests that it is of paramount importance to include women in STEM, women need to also benefit from this opportunity given the current economic status and history in the labour market. Women inclusion would be a good opportunity that would promote equality and empowerment. In addition, STEM skills have proven to be key drivers of the fourth Industrial revolution.

As Africa is moving towards the 4th industrial revolution, STEM fields are leading in providing skills which are of demand in the labour market and therefore can foster human development and women economic empowerment (Duflo, 2012; Lesseig et al., 2017). The operations of the world are transitioning, every sphere is becoming automatic in nature and it is evident that for survival all human beings including women will have to acquaint themselves with the technological skills. Additional many jobs are becoming obsolete, new occupations are emerging and these are occupations which demands technological skills which STEM training could provide. In addition, women involvement in STEM can eradicate poverty and provide economic liberation (Pols, 2019). MDG3 and SDG5 goal is in support of this notion and state that “To eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015 (MDG3)”. while SDG5 state that “Achieve gender equality and empower all

women and girls.” The preceding points evidently show that gender equality is a key priority to address in South Africa.

Since 1994, the South African government has made significant efforts to promote change and gender equality (Leibowitz & Bozalek, 2014; Musetsho et al., 2021). This suggests that to move from the era of segregation to a more democratic one, the government concluded that it was crucial to rectify inequities. The creation of Chapter 2 (Act 108 of 1996) of the South African constitution, which establishes the groundwork for defending women's rights, is one of the major initiatives. "The state may not unfairly discriminate directly or indirectly against any person on any ground, including, but not limited to, race, gender, sex, pregnancy, marital status, ethnic or social origin, color, sexual orientation, age, disability, religion, conscience, belief, culture, language, or birth," the amendment continues. A "law for women's empowerment and gender equality" was also established by the minister of women, children, and human rights (Kornegay, 2021). "Making provisions for the establishment and implementation of public education programs on activities that unfairly discriminate based on gender is one of the goals of the law" (Kornegay, 2021). All these rules are progressive, but despite the excellent work that has been done, there are still obstacles that make it difficult to put the policies into practice and, eventually, achieve gender equality.

Some of these challenges of attaining gender equality includes women access to employment; women access to science and technology and economic empowerment of women (Kornegay, 2021; Mvulane & Dlabzana, 2021). This suggests that as much as there are actions in place which aims to address gender inequalities, there is still an issue with the implementation and women accessing some occupations within the employment sector and the science and technology sector. The representation of women in these spheres particularly the STEM domain evidently supports this as there is an underrepresentation of women in the domain (Cheryan & Plaut, 2010). Despite the challenges highlighted the interventions are good stride however they still yet to bear positive results as girls continue to lose interest in STEM careers and are underrepresented in STEM careers.

1.2 Statement of the problem and rationale for the study

The problem at hand is that women are underrepresented in the STEM fields. According to Statistic SA, women account for 23 % of STEM professionals in South Africa (Makunga, 2020). This percentage is relatively low when compared to men number in STEM professions and women who graduate in STEM qualifications (Makunga, 2020). This demonstrate that STEM

fields are still male dominated, it further suggests that this is only in some STEM careers and not education. Women are entering STEM education however there is a number imbalance between women who do graduate in STEM qualifications and those who enter the STEM labour market (Makunga, 2020). Part of research shows statistics on this imbalance, according to Karatopouzis (2022) more females are graduating than male students, the index indicates that the number of female students graduating were 20 % higher than the number of males graduating with STEM qualification (Khuluvhe & Negogogo, 2022). This underrepresentation of females have become the focus area in literature.

A handful of scholars are focusing on understanding this underrepresentation. According to Master and Meltzoff (2016) the reason why females lose interest in STEM is because they do not feel belonging despite their ability to enter and successfully complete a STEM qualification at high school and tertiary level. This indicates that the climate of STEM is still not female friendly. Other scholars argue that females, specifically adolescent's girls have negative math self-concept (Seo et al., 2019). This suggests that most females in high school do not believe that they can successfully perform in maths subjects or thrive in a career that are maths orientated which leads to them choosing not to pursue maths. South African scholars are also in agreement and argue that young females have negative perceptions and challenges within Mathematics which contribute towards their low performance and decline in the STEM field ((Hanna & De Villiers, 2012). This suggests that there is a need for intervention to be focused on dealing with the perception women have on their ability to be successful in STEM and on STEM domain as a space the females could enter. It further suggests that there is a need to focus on adolescents as this is the time where learners decide on their career path.

Engaging the girls while they are still in high school could assist in retaining them in STEM fields. According to Pols (2019) at the age of 15, only 4.7 % of girls reported that they expected to have a career in engineering or computing compared to boys at 18%. This proves that indeed there is a problem of decline and retention of women in STEM especially in STEM occupations. It further supports that adolescent time is an ideal time to engage the girls with intent to attract and retain them in STEM fields (Pols, 2019). It is for this reason that this study invested in exploring girls' perception of STEM careers while they are still in high school to develop informed initiatives directed towards attraction and retention of girls in STEM careers. The problem is not new in literature.

A handful of scholars have been concerned with the decline of females in STEM careers. For example, Makarova, Aeschlimann & Herzog (2019) “conducted a research investigating the impact of the masculinity image of three school subjects- chemistry, mathematics and physics on secondary students’ career aspirations in STEM fields “. The study findings revealed that female students rated all the subjects as strongly masculine (Makarova et al., 2019). Findings also suggested that less pronounced masculine image of science has the potential to increase the likelihood of STEM career aspiration for females (Makarova et al., 2019). Girls find STEM careers more interesting after the role-model sessions, especially ones that include female role models who are successful in STEM and have broken the glass ceiling (Makarova et al., 2019). In addition to female underrepresentation in STEM being a research focus of many scholars, intersectionality has also proven to be visible theory in literature. Existing literature shows that Intersectionality is an emerging theory used by scholars however it is dominantly utilized in studies that focus on STEM underrepresentation of women in higher education and employment and not much in High Schools. Idahosa & Mkhize (2021) and Rankin and Thomas (2020) studies are examples of such studies. Both the studies give insights through Intersectional lens of how the interlocking systems of oppression negatively impact retention of Black women in the STEM domain (Idahosa & Mkhize, 2021; Rankin & Thomas, 2020). There is paucity of literature that focuses on understanding women underrepresentation in STEM by focusing on Black girls in STEM subjects in South African public high schools using intersectionality as a theoretical lens.

This study fills a gap in the literature by reporting findings that focuses on adolescent girls in STEM, a scarce focus group in the existing literature. Several academics advise that girls should be involved in STEM during their adolescent years because this is when students determine their career routes. This is important for female retention in STEM (Bodnar et al., 2020; Frenzel et al., 2010; Valla & Williams, 2012). This study is significant since it also advances theory. The study employed an intersectional approach as a lens to analyse the difficulties faced by Black female students in STEM courses and their perspectives of STEM jobs. This study is distinctive since it examined female learners’ participation in STEM across the intersections of race, gender, and class. To explain this underrepresentation, several academics concentrate on either race or gender. A study by the following scholars serves as an example (Mutarubukwa & Mazana, 2017). The study will focus on the interaction of race, gender, and class as mentioned above to analyse the type of oppressions encountered by women in STEM. The results are also supposed to help educators better understand how to support Black female students with relation to the difficulties

that they have in the classroom and in STEM fields, which prevents them from succeeding in these fields.

1.3 Brief background of Bona Comprehensive School and Orlando Township

The study was conducted at Bona Comprehensive secondary school, one of the high schools in the township of Orlando in Soweto. The school is located within the city of Johannesburg district in the city of Johannesburg metropolitan municipality, Orlando east, South Africa. The school is a public non –fee paying school (Mbedzi, 2018). It is an ordinary and technical school (Mbedzi, 2018). This implies that it provides more theoretical subjects that are offered by all schools in South Africa such as English and History, but it also provides more practical in nature subjects such as technical engineering at FET (Further education and training level), which comprise of grade ten to twelve. The school has 36 teachers and 699 students (Mbedzi, 2018). This implies that one teacher teaches a high number of children and that means over work load for the teacher and less quality education for the learner. It is worth noting that the school offers technical subjects such as technical maths, construction and also physical science, technical science, technology and pure maths among other STEM subjects. Students are given options to choose which stream of subjects they want to take in FET. In this particular study, the sample group was inclusive of individuals who are all taking one or two STEM subject. Most of the learners at the school reside around Orlando east which is the area the school is located (Mbedzi, 2018). This school and Orlando Township was ideal for the study as it comprised of a population that has individuals who are eligible for this study.

Orlando east township is a host to 62, 210 people. There is about 22, 416 households. 51 % of the population is males while 49 % is females. Representation by gender in communities plays a crucial role in the development of social norms that govern those geographical areas. Adolescents (15-19) make 7% of the population. This implies that there is a need for activities aimed at engaging this cohort for the development in all spheres. 99% of the people are Black Africans. This arrangement could be attributed to the policies during the apartheid regime. Many households depend on low and unreliable sources of income and unemployment is high, especially among youth (Gasennelwe, 2019). These streams of income include grants or working as a domestic worker or security guard among other jobs. There is scarcity of employment in the township (Gasennelwe, 2019). Most people are involved in Informal sectors to making a living and sustain themselves. Some of the Jobs the people are involved in include being a street vendor, having house shops and petty trade (Gasennelwe, 2019). In addition, most households in Orlando

have access to water and connections to the electricity cables however there is a pressing issue of non-access to electricity. In the month of May in 2022 it was reported that Orlando east did not have electricity for 9 months and this was due to broken transformer (Madlala, 2022). Community members reported to have communicated the matter to Eskom however despite the complaints Eskom still does not come to fix the transformer (Madlala, 2022).

The issue of electricity has led to an increased rate of crime. The darkness in the streets in the mornings and afternoons have given criminals an opportunity to conduct crime. It is important to note that a community characterised by crime is not conducive for adolescents and young people. Lack of electricity access has also greatly affected school children as they have to take cold baths , use candles to do school work and walk to school in the dark in the mornings as the street lights are off (Madlala, 2022). It is important to note that females are the most vulnerable when walking in unsafe dark environments in South Africa. On the 19th of July 2022, it was reported that there was a case –in-transit heist that took place in Orlando east (Madlala, 2022). This was apparently the 3rd time the incident happened. This incident involved gun shots and a damage of property for one of the residents (Madlala, 2022). This evidently shows that the environment is not conducive for learners.

In addition to the preceding environmental social problems affecting the young people is social ills that are pressing includes unplanned teenage pregnancy among schoolgirls and substance abuse among youth in townships including Orlando. Scholars concur and state that when there is limited developmental opportunities in a community often people tend to be exposed to social ills such as crime, teenage pregnancy, substance and violence(Ardington & Gasealahwe, 2012; Jewkes et al., 2009). These challenges are additional issues that young people including girls face in their academic journey.

1.4 Definition of key terms

1. 4.1 Economic empowerment

Economic empowerment is defined differently by several scholars. To this study economic empowerment of women should be understood through the lens of the following definitions. According to the definition of female economic empowerment, it is "a process through which women and girls' lives are changed from one in which they have little control over and access to economic resources to one in which they experience economic advancement"(Pereznieto &

Taylor, 2014). The ability of each capable member of society to earn enough money to live a life with respect and one in which the basic requirements of food, shelter, and clothing can be met is known as economic empowerment(Hawkins & Kim, 2012).

1.4.2 Gender

Scholars have long had a debate on whether gender is a product of nurture or nature (Akala & Divala, 2016) . Gender, according to some academics who lean toward the naturalistic side of the argument, is the existential perception of oneself as either female or male, which typically reflects elements of biological sex (Miller, 2015). Other scholars oppose this stance and are more inclined to the nurture side of the debate , for example Bass (2018) argues that a person's internal sense of "gendered self" and place in the universe is best described as their gender (Bass et al., 2018) . Bass et al., (2018) argues that a person's internal sense of "gendered self" and place in the universe is best described as their gender. The definition above is also true of gender. According to Tamale, "gender is a term utilized by feminists as an analytical tool via a political-historical perspective, that enhances our comprehension of how human beings connect to one another as "men" and "women"(Tamale, 2020). Racial traits complicate it beyond culturally particular masculine/feminine identities and power dynamics (Tamale, 2020). Gender serves as a colonial and modern institution that restricts the scope and range of possibilities for what it means to be a man or woman in this world (Tamale, 2020) . For the purposes of this research, gender should be viewed through Tamale definition.

1.4.3 Gender inequality

Gender equality can be understood as a state of being when men and women have the same rights and opportunities in every area of society, including the economy and decision-making, and when the various behaviors, desires, and aspirations of both sexes are equally valued and given preference (Eckstein, 2012). The concept is not only about the number of women but when analysing it within the school space, it talks to representation, resources, rights and realities (Eckstein, 2012). Representation talks to figures and numbers. Resources talks to what access do females have in comparison to males and realities talk to attitudes and perceptions on gender equality (Eckstein, 2012). The unfair glass ceiling of gender disparity in education prevents women from enjoying the same educational chances and privileges as their male counterparts do in society (Ikechukwu-Ilomuanya et al., 2020).

1.4.4 Public schools

In South Africa there are two types of public schools, there is public fee-free schools which are subsidised by the government fully and parents do not have to pay any fees (Fiske & Ladd, 2004). These schools are only available to the poorest areas (Fiske & Ladd, 2004). Then there is also public private schools which are schools that are also subsidized by the government however parents are charged school fees, these fees are responsible for school needs like books and uniforms however the school have an option (Fiske & Ladd, 2004). Parents that cannot afford to pay the school fees, they can apply for an exemption or reduction on fees (Fiske & Ladd, 2004). Conditions in both these types of schools are similar (Fiske & Ladd, 2004). To this study public school refers to the public fee-free schools as defined by Fiske.

1.4.5 STEM careers

STEM careers are careers that involves science; technology; engineering and mathematics. Examples of these occupations include being an Actuarial scientist, Computer scientists, Civil engineer and Mathematician (Breiner et al., 2012; Metz, 2018). Actuarial scientists deal with the quantification of risk using math, probability and statistics (Breiner et al., 2012). Computer scientist deals mostly with software systems, additionally computer scientist design and analyse algorithms to solve programs and study the performance of computer hardware and software (Breiner et al., 2012; Metz, 2018). "The role of a civil engineer is to develop conceptual and design solutions for civil engineering projects using analytical techniques". (Breiner et al., 2012; Metz, 2018). Projects like road works; storm water drainage; sewer and water reticulation (Breiner et al., 2012; Metz, 2018). Mathematician revolves mostly around numbers, mathematicians can work in a variety of fields, and the most common are business administration, management, accounting, engineering and banking (Breiner et al., 2012).

1.4.6 Patriarchy

Patriarchy traditionally was a term used to describe a specific type of 'male-dominated family' which included women, junior men, children, slaves and domestic servants all under the rule of this dominant male (Bhasin, 2006). In modern times, term is used more broadly "to refer to male dominance, to the power dynamics by which men rule women, and to characterize a system by which women are kept submissive in various ways." (Bhasin, 2006). Sultana (2010) also defines

the term similarly and state that patriarchy refers to the male domination both in public and private spheres. While feminists primarily use the term "patriarchy" to explain the power dynamic between men and women, it is more than just a name; rather, it is an idea that, like all concepts, serves as a framework for understanding the experiences of women (Sultana, 2010). To this study, patriarchy should be understood as a feminist analytical tool as defined by Sultana.

1.4.7 Apartheid

Historically, South Africa practiced apartheid, a system of racial segregation or discrimination. The national party of South Africa introduced the term apartheid as a campaign promise during the 1948 general election, promising to strictly uphold the racist beliefs that those with white skin were superior to those with dark complexion (Mphambukeli, 2019).

1.4.8 Adolescents

Adolescence is a stage of growth and development that occurs between childhood and maturity. Anybody between the ages of 10 and 19 is considered an adolescent according to the World Health Organization. This age group is considered young people by the WHO, who define them as being between the ages of 10 and 24.

1.5 The purpose of the study

The primary purpose of the study was to explore how Black girls from Bona Comprehensive School in Soweto perceive STEM's significance towards economic empowerment.

1.6 Overview of research design and methodology

The study employed a qualitative approach which was exploratory-descriptive in nature. The participants were all adolescents from Bona comprehensive school in Orlando Township, Soweto, South Africa. The participants are all aged between 15-19 years. A purposeful snowball sampling technique was utilised to recruit 10 participants for the study. Additionally, a purposive sampling technique was used to recruit an LO teacher who also participated in the study. Interview schedule was the research tool used to gather data. Specifically, in-depth telephone one-on-one semi-structured interview. Thematic content analysis was used to analyse data.

1.7 Limitation of the study

The study had the following limitations:

- The researcher is a female. Some of the participants gave responses which were bias. Participants gave some responses which are socially desired and not accurate. For example, in addition to participants expressing a STEM related career, they would express that alternatively they could study social work because of helping nature.
- Time proved to be a limitation. Interviews were conducted after school hours through the telephone. Most participants found it hard to schedule time to have the interviews, this resulted in some interviews being shorter than the proposed interview schedule. In some instances, the researcher had to wait for schools to close as that is the period the learners were more available to schedule the interview.
- Conducting telephonic interviews was a limitation. Network proven to hinder the effective progress of interviews, leading to struggles in retaining some participants and struggles in capturing all Information through record. The researcher had to engage participants on WhatsApp after the calls to gather more responses and clarification of some responses.
- The study scope was limited to only one high school. This resulted in having a small sample size which limited the contextualization of the findings. Future studies on this topic area should consider including more than one secondary school to have a better understanding of Adolescents perceptions towards STEM careers.
- The schedule was administrated telephonically and the researcher had challenges in keeping the participants on the phone for an extended period of time because of issues such as network, background noise and interruptions were a challenge hence the researcher saw a need to be quick and short in the asking of questions and discussing the posed topics

1.8 Organisation of the report

The first chapter provided the background /Introduction of the study; the statement of problem and rationale for the study; brief background of the study site; key definition terms; purpose of the study; overview of research design and methodology and limitations of the study. Chapter

two will focus on literature review and theoretical framework. Chapter three will focus on the study methodology and research design. Chapter four focuses on presenting and discussing the study findings and analysis. Lastly chapter five provides a summary of the main findings, conclusion and recommendation for future studies, practice and policy development.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

The role of women in education has long been a contested topic internationally, nationally, and locally in scholarship. Given the history of marginalization and exclusion of women in education and more specifically in STEM education in many parts of the world, government systems such as democracy saw it fit to place effort in changing that status quo and transforming the conditions and including women more in education, peculiar in STEM education. Great strides have been in place and gender equality is gradually coming to life in many domains. STEM field is one sphere that is still a concerning field in relation to gender equality given the low representation of women. A handful of scholars have been concerning especially with adolescents' involvement in STEM. Some research findings demonstrates that throughout the middle grades, there was a reduction in middle school students' interest in math and science, which emphasizes how crucial it is to spark that enthusiasm early on (Frenzel et al., 2010; Valla & Williams, 2012). The focus will be predominantly on unpacking intersectional issues with intent to portray the unique position and realities of Black adolescent females in public high school in Soweto. Intersectionality approach is the identified gap in scholarship specifically in high school context hence the focus.

The following subtopics that will be unpacked: History of women in STEM education; Purpose of STEM education and the state of public schools in South Africa; Representation of women in STEM education; Benefits of females being in STEM fields; STEM achievement between girls and boys in SA basic education. The role of family in female learner's career choices; Interventions to attract girls in STEM; Legislations and related studies. The chapter ended with a discussion of the theoretical framework which is the lens that the study findings should be viewed in.

2.2 History of Black women in STEM education in South Africa

Historically in South Africa access to education was unequal. Prior to democracy, segregation policies of apartheid denied Black people access to basic elementary and secondary education (Martineau, 1997). Moreover Black women were confronted with gender –based discrimination (Martineau, 1997). First school for Blacks in South Africa was opened in 1799 which was a century later than when the first white school was open (Martineau, 1997). National party in 1953 introduced Bantu education which had a syllabus that focused on skills such as punctuality, obedience, communal loyalty, and acceptance of allocated social roles among others conversely education for whites provided technical skills essential in the labour market for specialized roles (Martineau, 1997). This suggests that White people were trained with high skills that will equip them for access in critical economic activities while Black people were trained for lower skills Jobs, this arrangement automatically set the segregated economic status between the different races.

Bantu education was designed to keep Black people subordinate. Martineau (1997) concur and argued that Bantu education was a calculative attempt to subvert the political and economic aspiration of Black people. One of the ways to achieve this was through limiting and denying access in certain educational opportunities such as STEM education. These legacies of this arrangement are evident even in currently and women were the ones who suffered the negative effects mostly hence they are currently the most underrepresented in STEM.

In addition to racial discrimination that Black people were subjected too in education, women faced also gender discrimination. Early schools gave less priority to girls, from the beginning the education system boys and girls were steered into different curricular (Martineau, 1997). This socialization of segregated curricular and occupations was a trend even as years went by , this is still the case to some extend even contemporary (Martineau, 1997). This socialization also accounts for the low representation of females in STEM as this domain was a space that boys were encouraged into (Martineau, 1997). Bariham (2017) argue that the socialization of boys and girls results in different life experiences that have an impact on the educational system, both in the classroom and afterwards in higher education and career choice. An example is that girls

might be more inclined to choosing nurturing careers because that is what they believe their gender role allows them to be while boys tend to choose STEM related professions as the nature of these professions are more masculine and fitting to what it means to be a boy (Bariham et al., 2017).

Historically economic activities were gendered. In the early 19s girls were instructed into domestic duties while boys into trade (Gaitskell, 1979). This automatically directed which labour activities women can be involved in and which men can take part in (Gaitskell, 1979). In this case this arrangement meant women occupied lower paying Jobs than males. What this implied is that women were less economically empowered. Furthermore, women were not allowed to obtain an academic education or skill training (Gaitskell, 1979). The only trade women were taught was sewing and housewifery training (Martineau, 1997). This limitation had dire consequences on women, more especially on Black women. It was evident in 1985 as less than 5 % of the Black females in South Africa did not complete secondary school (Martineau, 1997). Furthermore throughout the nation many African girls did not have access to compulsory education until after 1994 (Martineau, 1997).

The small percentage of women who were able to get into the labour market went into professions such as nursing and teaching (Martineau, 1997). These are the professions the women were mostly allowed in. As years progressed women also penetrated other fields, in 1992 a small number of South African women were employed in engineering, accounting and law (Farmer et al., 1995; Tinker, 1990). However, there were several factors that affected women participation specifically in STEM fields.

Historically factors that affected women's participation in STEM fields included Gender societal norms; parental expectations; educational environment and popular images (Garson, 1996). Patriarchy was one of the hegemonic dominant system and it allowed and promoted women being in occupation that are more nurturing such as nursing as opposed to engineering for example, it was viewed as a masculine fields (Garson, 1996). Parents also expected the female daughter to follow this order (Garson, 1996). Schools also promoted and encouraged this way of gender segregation in skills training and occupation selection (Lockheed & Gorman, 1989). School textbooks and social media also advertised and portrayed STEM fields as sphere for males. Scholars have been concerned about this issue even historically.

Historically scholars have studied racial inequalities in education. Much focus in women in education has been on higher education and the focus on only race and not gender. Consequences

of Bantu education have been investigated but the gender perspective have been excluded (Martineau, 1997). Moreover specifically Black women have been largely excluded from the educational analyses in scholarship during the 90s (Martineau, 1997). For example scholars such as Christie Collins (1982) among other argued that “the main characteristics of Bantu education was on subservience and cultural domination”. However, they fell short in showing how Black women and girls were oppressed by the system. Kallaway (1984) analyses also omitted the limitations imposed on Black women in his study of exploring the racial inequalities in education. The scholars failed to show that Black women were limited to work only in jobs that did not need formal skill or education, Jobs such as being a domestic worker or prostitute (Martineau, 1997). This was problematic as this gap is crucial in laying foundation in understanding why Black women are economic disempowered when compared to women or other races and men.

Internationally scholars during the 90s also reported that many women were concentrated in unskilled and semiskilled work. Those who were educated were predominantly in occupations such as teaching and nursing rather than scientific and technical occupations (Coats, 1994). Unterhalter (1992) is one of the few scholars who at this time focused on Black women and noted that Black women were educationally deprived despite the increased educational opportunities that came with political and economic changes as the years went by. He further noted that white women had privileges through access to political and economic power which placed them at better position to secure employment than Black women (Unterhalter et al., 1992).

This history and development of women access in education and specifically STEM education plays a huge role in the representation of women in STEM today. A legacy of the racial, class and gender discrimination are still evident and shows in the low number of women in STEM. Most female learners are still confronted with patriarchal ideology in the family system, school context and socialization they go through which influenced they career selection and how they view STEM fields.

2.3 Purpose of education in Africa and the state of public schools

Many scholars across the globe are all in agreement that that education is important especially STEM education. Bybee (2010) argues that science and technology is important to enable people to develop solutions that could aid in current day challenges. Diverse people need to be trained in STEM for innovation to transpire in different parts of the world for functionality and survival (Bybee, 2010)). For example, one of the problems the world is currently facing is overpopulation and Bybee (2010) argues that one of the solutions might be colonising another planet and

transporting some people however such innovation will require great expertise in science and technology. This implies that STEM education is the now important training for survival and development globally.

Society has evidently shown that there is great inequalities and social injustices. This implies that there is a need for people who are trained and skilled to be able to tackle challenges that comes with these inequalities and injustices. Scholars such as Westheimer (2017) argues that education enables individuals to ask critical questions, it exposes them to different perspectives and equip them to challenge injustices. STEM education in particular is important for individuals to be able to compete in this modern world , it increases chances of employability and develops essential 21st century skills (Bybee, 2010) . However, in reality and more especially in Africa the ideal intent of education and particularly STEM education is not realised.

One of the purposes of education is to enable individuals develop society. Allmendinger (2016) describes good education as one that is reacting to societal challenges in a proactive manner ; one that ensures smooth transitions into vocational training . The latter characteristic is pivotal as it highlights the need for education to ensure that all individuals despite their differences get prepared for labour market (Allmendinger, 2016). Ideally issues such as unemployment should not be an issue in society where education is provided equally to everyone because one of the purpose is to ensure all individuals are involved in economic activities and can sustain themselves while contributing to the country (Allmendinger, 2016). Education must promote the growth of an open mind, a scientific perspective on topics, creativity, problem-solving skills, and the capacity to think for oneself, interpret decisions, learn from others, and reject or adopt them in accordance with specific requirements and circumstances (Masanja, 2010). Education must instill the knowledge and abilities necessary for family life as well as engagement in the growth and upkeep of the community (Masanja, 2010). In Africa education certainly has proven to be flawed and fails to carry out its mandate.

South Africa is no exception, the state of education is not good especially the public schools. Some scholars in literature all are in agreement that the education system is bad, scholars use different terms to describe the education state, terms such as crisis, national disaster, dysfunctional and that the system is in tatters (Letseka et al., 2012). Public schools in South Africa are the ones which are not well functional. The challenges in public school range from lack of resources, ineffective use of resources, infrastructure not in good condition, incompetent educators among other challenges (Charles Simkins et al., 2007). This educational state has

drastically negatively impacted on the learning experience of the learners and ultimately the learner's right to basic education. Learners from public schools often get poor results especially for Maths and science and that in turn limits their academic development to the next level (Charles Simkins et al., 2007). In addition, most learners in dysfunctional schools do not develop the requisite skills and attributes necessary to master reading and mathematics (Letseka et al., 2012; Shenilla, 2020). South Africa's Department of basic education (DBE) acknowledges that the education system performs badly (Carnoy & Chisholm, 2008; Chisholm, 2005), however despite efforts towards improving the system, the state is still bad.

Bad education system in Africa is not a new problem. After Independence era many African countries recognised the important role that science education in particular play in the socio-economic development of any country (Ghebru & Ogunniyi, 2017). Much effort was placed in expanding educational facilities which was good however it compromised the quality of science education (Ghebru & Ogunniyi, 2017). What this implies is that there were now many schools and many people started attending school however the number of teachers allocated in various facilities did not increase. This meant that teachers now have to teach a large group of learners which to a great extent compromised the quality of education to the learners (Ogunniyi, 2017). Overcrowded classes often have challenges such as disruptions (Ghebru & Ogunniyi, 2017). Learners often also have unique needs and in overcrowded classes teachers cannot identify and intervene effectively to all learners needs (Ghebru & Ogunniyi, 2017). This challenge went on for years and is still present till date. Part of literature suggests a need to redesign the education system. Letseka (2012) argues that education in South Africa is dysfunctional and needs redesigning for it to be effective more especially for Black people given that they were previously disadvantaged. Many schools needed and still need more teachers, resources such as science labs (Ghebru & Ogunniyi, 2017; Shenilla, 2020). In addition, the medium of instruction for Black learners have proven to be problematic.

Most learners in public school have English as they second language and this means that even before tackling the content of different subjects there is a need to learn English as that is not the language spoken at home (Webb, 2010). Scholars argue that science literacy requires proficiency in science language. Science in particular use sophisticated and complex words (Webb, 2010). This suggests that there is a need to bridge the gap by firstly teaching the learners the language of teaching vocabulary before the learners could efficiently and independently learn science (Webb, 2010). This is especially more applicable to learners who use a different language from

English at home as English particularly in South Africa is the mode of learning. The challenge of bad education for Black people is one that is experienced globally.

Part of literature shows that African American parents in America are not pleased with education afforded to their children. Mazama (2015) reported that some African American parents have challenged the education system in America and resorted to home schooling their children. The parents were unhappy and believed that the system was discriminatory and slavery in nature as it prepared their children for working in an already existing system (Mazama & Lundy, 2015). This implies that the parents are concerned about the effectiveness of the transformation in the education system, seemingly segregation is still prevalent and African learners still get subordinate education service. Furthermore, the education system lacks cultural and historical relevance (Mazama & Lundy, 2015). History and culture play a prominent role in education as it allows learners to understand the role of history in current affairs. The challenge of bad education system only exists in public schools which are schools normally attended by Black learners from low socio-economic class, this reality further worsens the inequalities that exist between White and Black race and low and high socio-economic class.

2.4 Representation of women in STEM Fields

The problem is not that nothing has been done to increase women in STEM number, in fact several initiatives have been in place to increase the number however there are gender issues that still need to be dealt with for the number of women to increase. Dlodlo and Beyers (2009) concur and maintain that a number of programs and initiatives have been put in place on a global level to entice women to pursue jobs in science, engineering, and technology. More women are participating in science than ever before, according to the literature, but the difficulty is that gender issues in science education have not yet been overcome. (Dlodlo & Beyers, 2009; Gilbert, 2001). Worldwide, women have been found to be highly underrepresented in Science, Engineering and Technology. Moletsane and Reddy (2011) assert that the promotion of gender equity and equality and the underrepresentation of women in STEM professions are not only a South African issue but also a global responsibility.

Values and beliefs seem to play a vital role in women deciding to choose STEM careers or not. Women globally and in South Africa are underrepresented in STEM fields ((Adelakun, O. A., 2015; Morrison et al., 2021). The underrepresentation has different extents from country to country. Part of literature shows that countries governed by patriarchal ideology seem to have

more severe underrepresentation of women in STEM than countries which are characterized by strong gender –egalitarian ideology (Bradely, 2000). In South Africa, in particular despite being a democratic county finds it challenging to eradicate gender discriminatory policies and improving gender inclusivity in spaces of education and labour. The efforts are there however it is still an ongoing process and yet to bear greater results.

Moreover, patriarchal ideology specifically in schools greatly contributes to the decline of young women in STEM. Negative stereotypes regarding girls' academic performance in STEM fields still have an impact on their learning possibilities (Rarieya et al., 2014). This includes routine educational procedures that may deter girls from majoring in math, physics, or other technical fields, as well as gendered conventions around the domestic and physical labor associated with maintaining the classrooms.(Rarieya et al., 2014). As other analysts have suggested, these gender stereotypes are a central characteristic of exclusionary practices that result in girls underachieving in, as well as leaving, school ((Chabaya et al., 2009; Mugaga & Akumu, 2010) This suggests that there is a need to look into school policies specifically those directly towards gender inclusivity and teachers training and teaching. Particularly looking into the knowledge and practice of gender inclusivity in schools with regards to girls in STEM given the segregation historical context.

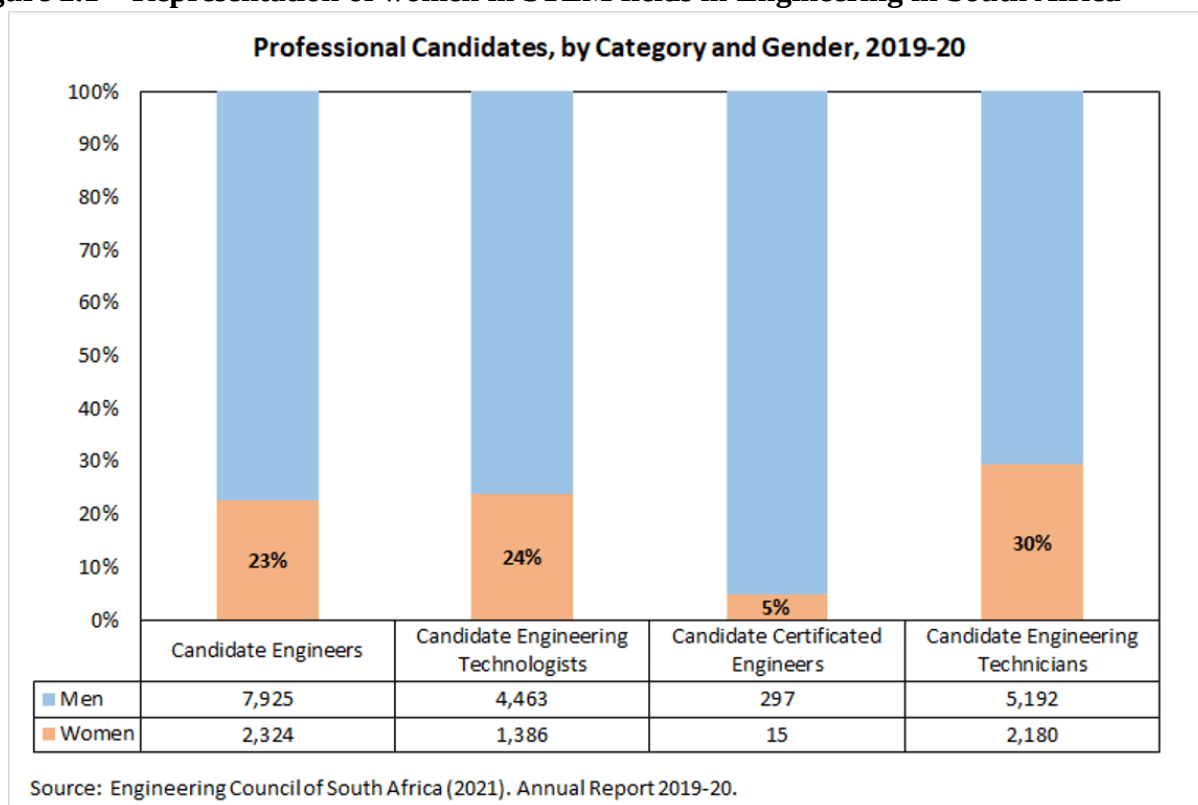
Schools are the most important context to focus on for an effective change in the number of women in STEM to show. Some scholars reported that the problem of this underrepresentation starts at a younger age. According to some studies, middle school students' interest in math and science is declining (Frenzel et al., 2010; Valla & Williams, 2012). This research chose adolescents as its target age range since the tendency of female disinterest persists, even in the STEM labour market. In agreement, Bodna (2020), argues that adolescence is a vital period for retaining females in STEM fields because this is the time when they make career decisions.

In addition to age being demography to consider in dealing with the underrepresentation of females in STEM, there is a need to also look at socioeconomic status. Internationally the gender gap continues to persist in STEM fields between private and public schools. Notwithstanding that, many females now have high self-efficacy; part of research shows that male students in private schools with high socio economic status and math self-efficacy are mostly likely to choose a STEM related career than females from low socio economic status from public schools (Ketenci et al., 2020). The underrepresentation of minority groups such as Black females from public schools is then not only attributed to race and gender but also class. In South Africa statistics shows that the trends are similar.

According to statistic SA, women account for 23% of STEM professionals in SA, of them 17% are in leadership positions (Writer, 2020) According to OECD, fewer than 1 in 3 engineering graduates and fewer than 1 in 5 computer science graduates are girls. At age 15, only 4.7 % of girls reported that they expected to have a career in engineering or computing compared to boys at 18% (Writer, 2020).

The latest annual report (2021) from the engineering council of South Africa (ECSA) indicates that women are severely underrepresented in STEM fields.

Figure 2.1 – Representation of women in STEM fields in Engineering in South Africa



Black women underrepresentation in STEM limits their participation in many well-paid, high growth professions and deprive nations the full benefit of their talents and perspectives (PCAST, 2010) . Example of a field that evidently shows women underrepresentation is engineering.

2.5 Benefits of females being in STEM fields and need for diversity in STEM

The most common reason highlighted in scholarship as a reason for women to be in STEM is that the field has potential to provide financial benefits to women. Women disempowerment and challenges in general such as gender-based violence is closely linked to lack of financial independence, this trend is particularly evident in developing countries. Some scholars argue that

the pattern of female underrepresentation in science is a problem of both developed and underdeveloped countries (Siann & Callaghan, 2001). This suggests that in underdeveloped countries it reduces female economic empowerment as they continue to be marginalized in STEM fields. It is for this reason that one of the important reasons for women to be in STEM is to ensure that women can sustain themselves. Several scholars agree that women involvement in STEM is essential for them to be economically empowered ((David, 2013; Klosters, 2017; Lesseig et al., 2017) .Furthermore STEM education have proven to be able to give women higher chances of getting higher paying occupations (Adelakun, O. A., 2015). In addition, STEM fields are leading in providing critical skills that align with the transformation that came with technological advances and digitalization.

Literature shows that STEM skills are important for several reasons. STEM is significant for skills such as critical thinking and technology core skills which are important for the 21st century in addition to economic empowerment and therefore women should not be marginalised in these careers but attracted and retained (Mone, 2013; Silver & Snider, 2014; Hacioglu,2017 and Ozcelik, 2017). Most government globally and in South Africa supports and agree to this as there is investment in STEM education (Banks & Barlex, 2014; Langen & Dekkers, 2005). Most scholars agree that for women to enter STEM , there is a need for them to do STEM education as it will increase the success and interest in STEM related courses and ultimately careers ((Annamma et al., 2019). There is correlation between women involvement in education and labour and a decrease in several social ills.

There are positive results associated with having more women and girls in education. Education improve the standard of living for women in different spheres such as the economic, social and health domain (Bysiewics, 2018). UNESCO data shows that if all females in developing countries completed their primary education child mortality and maternal death would decrease (Bysiewics, 2018). This suggests that future population would be secured as women are the child bearers. School is a space that could provide girls with life skills, reproductive health knowledge and a social space to discuss these issues (Bysiewics, 2018). Girls' education is beneficial not only to them but future generations. Girls are future mothers and them receiving education means that they are more likely to make education a priority for their children(Bysiewics, 2018). It is important to focus on the education of women because of the points mentioned above however in studying Black women, there is a need to consider the intersecting identities.

The experiences of girls used in this study cannot be simply viewed as experiences of girls generally. Their experiences are unique as their identities are intertwined and all play a role in their lived experiences. It is unfortunate that Black adolescent girls' experiences are often overlooked due to the colour-blind approaches and complexities of multiple identities (Annamma et al., 2019; Muhammad, 2012). This implies that experiences of all girls are generalised even to Black girls whereas that is incorrect generalisations as experiences of Black girls, particularly those from low socio economic status greatly differ from females in other races. This is an issue because it contributes to them being disempowered and more likely than any other group to be suspended or expelled from school (Annamma et al., 2019; Morris, 2012). This suggests that school policies lack the unique understanding of this cohort.

To deal with this gap in schools scholars such as Rudduck and Flutter (2000) argue that for schools to improve. There is a need to look at schools from the pupils perspective and that means turning into their experiences and views and creating a new order of experiences for them as active participants (Rudduck & Flutter, 2000). The group of focus of this study is Black girls from low-socio-economic status who are often subjected to challenge like poverty which forces them to stay at home and work for an extra income which is vital for livelihood. In addition to the extra workload of having to work, this cohort is often subjected to heightened level of violence; physical assaults and in rare cases child marriage (Rudduck & Flutter, 2000). All these challenges tend to keep young girls away from school (Bysiewicz, 2018; Rarieya, 2014). These often happens in rural and township schools. These challenges are known however they not yet eradicated. South Africa needs to comply with both its own constitutional and international human rights obligations with respect to education (Shenilla, 2020). This suggest that major change are needed urgently,” said Shenilla Mohamed, Executive Director of Amnesty International South Africa (Shenilla, 2020).

2.6 STEM achievement between girls and boys in South Africa basic education

Girls and boys in South Africa today have equal access to STEM fields. In South Africa, students begin studying math, science, and technology in fourth grade and continue through ninth grade. The students then have a number of options to choose from for their FET learning in grade nine. Children are frequently urged to choose STEM fields, especially girls because of the gap that is known to exist. According to certain study, many South African girls have studied STEM over the years, and they have consistently beaten boys in all previous international reading tests (Isdale et al., 2017). Results from a number of regional and international tests, such as TIMSS, PRILS,

and SACMEQ, all demonstrate that girls in South Africa surpass boys in terms of academic achievement (Isdale et al., 2017). This implies that the gender pay gap is no longer an issue.. This suggests that gender gap is no longer a problem in some STEM subjects, but rather the inequality is prevalent in STEM careers. Scholars concur and argue that the gender gaps in mathematics as a subject have become smaller or insignificant over the last few years ((Isdale et al., 2017; Spaull & Makaluza, 2019; Van Broekhuizen & Spaull, 2017) .

At grade 9 level, girls achieve significantly higher mathematics and science test scores compared to boys in Quintile 1 to 3 schools (Mdlolo, 2017) . These are schools that do not charge school fees (Fiske & Ladd, 2004) .While the gender differences in fee-paying schools and independent schools are not statistically significant (Fiske & Ladd, 2004). This suggests a contradictory stance particularly in the public schools, as much as much research shows how girls are often experiences numerous challenges, boys also encounter challenges which affect their learning journey and often not researched (Burgess & Mensah, 2022). This is a common trend in public schools when compared to private.

Despite the gender differences in maths achievement being small in grade nine, result shows that in grade 12 also known as National Senior Certificate, boys perform better than girls in mathematics (Mdlolo, 2017). In 2018 part of research shows that boys have on average five percentage points higher test scores (Mdlolo, 2017). Moreover, boys outperform girls in six out of 13 subjects including physical sciences, while girls outperform boys in subjects such as life orientation and English (Mdlolo, 2017). In summary, in most countries as well as in South Africa girls do significantly better in reading while the evidence in mathematics and science is less clear. The reason behind these differences by gender is not clear.

Many ideas have been put out to explain how biological variations may account for variations in academic achievement, notably in the subjects of science and mathematics. According to certain theories, variations in spatial aptitude or brain structure may account for some variations in STEM accomplishment (Wilder & Powell, 1989). Some contend that because girls acquire cognitive skills earlier, they perform better in school (Gierl et al., 2003). According to Ceci et al. (2009), the evidence is inconclusive. The literature is divided on the extent to which biological differences have an impact. Therefore, it is unlikely that biological reasons fully account for the situation (Buhl-Wiggers et al., 2021)

2.7 Family role in female learners' career choices

Patriarchal gender norms seem to play a vital role in influencing the female learners career choices. Part of literature shows that the effect of family values on STEM occupational choices was only evident for females (Eccles & Wang, 2016). This means that females career choice also dependants on the work flexibility to allow them to also be able to perform the home duties. This reflect the fact that even in dual families, females still put more time into family chores than do males, and they may believe that being in the STEM fields will make it harder to fulfil their prescribed roles within family (Eccles & Wang, 2016). This also indicates that there is a believe that STEM fields are demanding and require more time than other occupations. In addition, having parents who are already in STEM occupations have proven to have a significantly positive influence on learners career choices.

Research shows that students who take STEM courses in high school is linked to parent's occupation title. (Plasman et al., 2021) conducted a study investigating the relationship between Parent STEM occupation and student STEM course taking in high school. Results showed that students are likely to take STEM courses when there is two parents at home who are in STEM occupation (Plasman et al., 2021). The paper argues that learner's decision to choose STEM is linked to having STEM capital. The term is derived from Bourdieu's theory of social reproduction and how advantages/ privileges become established and perpetuated in society (Plasman et al., 2021). (Archer et al., 2012) argue that having access to STEM capital or someone in STEM fields already enables learner to access knowledge, social networks, experience and influence attitudes / beliefs about the science role in their lives. This particular study has majority of participants who have parents who are unemployed and therefore do not have access to STEM capital which might greatly account for some of the difficulties and lose of interest the participants encounter in their STEM journey. Moreover, the family socioeconomic status plays an even greater role in learners learning experience.

Economic inequalities are very much prevalent and plays a significant role in learner education experience. Socio economic status intertwined with gender norms plays a crucial role in how boys and girls experience education differently. Part of literature shows that socioeconomic status (SES), are likely to influence gender differences in achievement (Buhl-Wiggers et al., 2021). Parents might have to choose which child they would invest the majority of their resources in if, for instance, household resources are limited as a result of an income shock. According to certain studies, parents support their sons ((Alcott & Rose, 2015; Björkman-Nyqvist, 2013) . One of the prevalent gender understanding discourses holds that investing in men makes more sense because men are responsible for growing and carrying on the family name while girls might marry

into other households. Research from South Africa demonstrate the significant interactions between SES and gender (Zuze & Beku, 2019). Likewise, more schools are available to wealthy households. They typically enroll their kids in schools with higher quintiles with greater resources (Zuze & Beku, 2019). Hofmeyr (2020) also discovers that the achievement gap between boys and girls narrows as students move up the school quintile. This implies that while the gap is large in lower quintile schools, girls and boys often perform the same in higher quintile schools.

2.8 Interventions to improve girls' participation in education and STEM

Many parts of the world support women involvement in education. As discussed above it is evident that the education of girl child is important. Many role players have invested greatly in girls' education. For example the world bank group set several goals in 2017 aimed at improving the education girls receive (Bysiewics, 2018). One of the interventions included the work bank group since 2017 providing scholarships, trainings for female teachers and ensures that there is gender- sensitive discussions in the classrooms(Bysiewics, 2018). This suggests that there is a clear understanding that teachers and schools play a crucial role in how girls get to experience school and academics. Internationally part of girls' promotion in education included reforms in the curriculum.

In the United stated STEM curriculum as part of a way to increase participation and quality was reformed to be more rigours with an intention to foster higher level skills (Eisenhart et al., 2015). In an era where STEM skills have become critical and in high demand, there is a need for training to be intensive and of high quality (Eisenhart et al., 2015). However, these attempts were less effective for learners from low-income backgrounds because they have other issues to deal with. For example, designing the course to be harder increases failure and lack of interest thus this intervention unintentionally maintains inequalities. For curriculum intervention reform to be effective there is also a need to take into account of other issues that learners are confronted with which directly have an influence in the school work (Eisenhart et al., 2015). A holistic intervention possibly might be effective and increase the number of female participations in STEM.

Increasing the proportion of female students enrolled in higher education institutions is still an issue in South Africa and other nations. Although though higher education institutions have established transformation committees, employment equity plans, and equity plans at all levels,

gender inequality still exists. This is due to educators' increased emphasis on correcting math problems rather than on cultural transformation (Ruiters, 2008). Similarly, Davis (2003) claims that gender equity in science education is still not at the level that is required despite significant efforts to transform science classrooms. According to Mlambo (2021), institutional barriers and societal norms prevent women from working in this field. According to Moletsane (as stated in Rarieya, et al., 2014), girls face inferior educational outcomes in as a result, they do poorly on the Matric exam. at high schools. These pupils ultimately struggle to achieve high results, which makes it more difficult for them to get accepted into academic institutions (Bunyi, 2003). There is competition between male and female students for the few available spots in universities, which are overwhelmingly taken by male students. Similarly, Diko (2007) contends that women continue to predominate in disciplines that are seen as being feminine.

Most teachers were not aware of national or international strategies and policies that promote girls' participation and gender equity in Mathematics and science(Moletsane & Reddy , 2011). According to a survey on gender equality in the mathematics and science school curriculum that Moletsane and Reddy (2011) conducted with 735 educators from the provinces of Mpumalanga, KwaZulu-Natal, the Eastern Cape, and Gauteng. They found that 40% of teachers admitted that textbooks are male-oriented, and 77% of these teachers believed that activities should be used to encourage girls' interest and participation in mathematics and science. About 80% of teachers agreed that different teaching strategies were necessary for the teaching of mathematics and science (Moletsane, & Reddy, 2011). This demonstrates that in order to address the number of girls in STEM must also address teacher views and knowledge development, particularly with the need of gender diversity in math and science.

2.9 Legislations

The South African government introduced numerous legislation that is aimed at promoting gender equality in education and employment sphere. This includes The Measures for the Prevention and Management of Learner Pregnancy Guidelines (2007) which seeks to eradicate the expulsion of and unfair discrimination against girls who fall pregnant while in school. It also allows girls to return to school no later than 24 months after giving birth. Teenage pregnancy has been identified as a major reason for girls dropping out of school (Mojapelo, 2019). Therefore, the adoption of a 'return to school' policy for girls who fall pregnant while in school is an attempt to ensure the retention and equal participation of girls in schools.

The Guidelines for the Prevention and Management of Sexual Violence and Harassment in Public Schools (2008) is another set of guidelines that was introduced. Its goal is to address gender violence in schools by improving teacher and student awareness of and ability to address gender-based violence in schools. The Employment of Educators Act (1998) and the South African Schools Act (1996) have both made significant contributions to promoting gender equality in schools. The first, which is based on the Constitution of the nation, emphasizes the right to education for all and forbids the maintenance of gender inequities in the classroom. On the other hand, the Employment of Educators Act (1998) aims to address the problem of instructors sexually abusing students by making it illegal to hire a teacher who has sexually abused a student. Interventions at the institutional or systemic level, such the creation of the Gender Equality Unit and the Gender Equity Directorate, have been made in conjunction with the approval of these policies. From the aforementioned policies and programs, it is clear that some steps have been taken to address gender inequalities in education. The former is tasked with the responsibility of overseeing gender issues in education from an advisory perspective, while the latter is tasked with the responsibility of coordinating and monitoring gender issues in education. However, the fact that these disparities continue to exist suggests that the policies may not be easy to execute. This is not meant to suggest that significant effort has not been put forth, but rather to draw attention to the fact that more work must be done in order for better results to manifest. South Africa has developed numerous laws.

The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) and other international organizations that deal with gender discrimination have South Africa as a signatory. The South African government has worked very hard since it came to power in 1994 to try and mend the wounds left by apartheid laws, policies, and practices, including prejudices against women. Earlier laws favoured men, particularly White men (Mathur-Helm, 2005). Women and girls are seen as having poor social profiles in South African communities, according to United Nations Children's Emergency Fund (UNICEF., 2006). In addition to being subject to male authority and control, women and girls frequently experience sexual harassment, gender-based violence, and high rates of HIV and AIDS infections due to their sense of inferiority. According to UNICEF (2006), girls and women are socialized to become housewives and mothers. They lack motivation to pursue jobs in science even when they excel in math and science-related courses (UNICEF, 2006). The South African government has developed and put into effect a number of laws, policies, and regulations that support gender equality. Yet, additional work must be done if better outcomes are to be seen.

Some scholars argue that the reason behind implementation failure might be linked to low representation of women in the policy-making table. Burnet (2011) argues that the broad representation of women in different economic; political; social and legal spaces influence policy decisions. What this means is that women are most suitable in creating an environment highly favourable for other women in society. There is need for sufficient women representation in the policy –making table to be the voice of females and create policy that clearly understands the lived experiences women go through. The representation of Black women is particularly crucial because of the intersecting identities they embody. Findings by (Zawistowska, 2017) reveal that the present approach to dealing with gender inequalities in education does not acknowledge other identity markers that often intersect with gender.

These policies intend to ensure that female learners are protected within school premises and to ensure that their learning path is supported and encouraged. This is in light of the historical context in South Africa of racial and gender discrimination.

2.10 Related studies

2.10.1 International studies

There is various international studies that have explored girls in STEM fields. The perceptions, experiences and challenges. Part of literature shows that girls perceive STEM to be more attractive when there are women. For example Steinke et al, (2017) conducted a study with a similar interest, the study examined middle age girls and boys attitude towards women who are in STEM careers. Findings revealed that the girls had a positive attitude towards females in STEM than boys (Steinke et al., 2017). Furthermore girls viewed women in science careers as equally good as men (Steinke et al, 2017). The study above argue that young girls perceive STEM careers more attractive when there is female role model who is already within the profession (Steinke, 2017). This indicates a need for female role models in STEM so as to improve young girls' interest in STEM careers.

Additional other internationally studies show that there is a need to build science identity for girls and there is a need to change the masculine nature of STEM fields. For example, Bodnar (2020) conducted a study with a similar interest. The study investigated how gender and race relate to science identity and science aspirations in the United States (Bodnar et al., 2020). The focus cohort was diverse 6th; 7th and 9th grade students (Bodnar et al., 2020). "The results suggest that science identity is strongly tied to aspirations toward a science career regardless of

gender or race(Bodnar et al., 2020).” Therefore, interventions aiming to increase science identities in students who are female and students who are black have the potential of increasing science career aspirations (Bodnar et al., 2020). The culture surrounding masculinity and science weakens the connection between identity and aspirations for girls (Bodnar et al., 2020). Since elementary school students have been shown to already view science as being a field for white men (Wong, 2015), girls in secondary school might already view the field as being exclusive.

A study also reveals a need for intervention to change the masculine nature of STEM fields (Vainionpää et al., 2019).. Findings showed that gendered understanding of IT field and career choices were still prevalent among girls and this explains and supports the educational and occupational segregation (Vainionpää et al., 2019). In addition to changing the masculine nature, there is need for teachers to also play a role in increasing the number of females in STEM.

Teachers have to play a role especially in the learner’s comprehension of the value of STEM fields. Patrick (2016) explored possible differences in STEM self-efficacy by gender. The findings revealed that there is no significant difference in STEM self-efficacy by gender(Patrick & Borrego, 2016). This alludes to the fact that self-confidence to be successful in studying STEM subjects between girls and boys is equal and not a problem (Patrick & Borrego, 2016). The findings instead suggested that teachers at schools need to do more in explaining the usefulness of STEM and how it is interwoven in various facet of life so that there could be an increase in student’s desires to persist in learning STEM content (Patrick & Borrego, 2016).

Additionally, part of literature shows that girls have lower self-efficacy in their ability to be successful in STEM subjects. Seo(2019)study seek to understand the psychological antecedents for STEM career attainment . The study took an intersectional approach and examined racial and gender differences in youth’s math related ability beliefs and their longitudinal relations to STEM careers attainment for 10th graders (Seo et al., 2019). Results showed that female adolescents math self –concept was more negative than male adolescents (Seo et al., 2019). While Black adolescents did not fully garner the advantage of having positive self-concept.

The few related international studies discussed above provide insight about different perceptions girls have of STEM fields however none of the studies have studied Black adolescent girls from low socio-economic status specifically. None of the studies utilized intersectionality looking at three axes as intersecting identities. This study hope to fill in that gap by contributing findings

that show perceptions of girls who are Black and from low socio-economic background utilizing intersectionality.

2.10.2 African studies

In Africa studies insights are similar as those in international studies. Part of literature shows that girls had a positive view towards some STEM fields such as scientist. For example (Nguyen & Riegle-Crumb, 2021) who conducted a study that captures a comprehensive picture of Black student's views of scientists. The study used an intersectional lens and revealed that Black female students held a positive view of scientist (Nguyen & Riegle-Crumb, 2021). The participants of the study held counter –stereotypical perceptions of scientist and these perceptions proved to be important and positive for students who had intentions to pursue STEM careers (Nguyen & Riegle-Crumb, 2021).

Conversly part of literature shows that girls have negative views towards STEM and still view it as a masculine domain. For example Gasant (2011) conducted a study with a similar interest in Mitchel plians . The study examined gender and the perceptions of science education of boy and girl learners in the general education and training (GET) phase of education (Gasant, 2011). The findings confirmed that gender role stereotypes persist in science and science education (Gasant, 2011). Girls are drawn to affective science pursuits whereas boys are firmly rooted to stereotypical perceptions of the masculine image of science and science careers (Gasant, 2011). It is apparent that girls are challenging sex-role stereotypes in science and agitating for gender equity in science education and science careers (Gasant, 2011).

As seen in some study internationally, scholars in Africa also agree that teachers also need to be involved if there is to be a change in the representation of girls in STEM careers. In South Africa a study conducted by Jiyane & Jiyane (2019) revealed that there was a need for information about career choices within the public school library. Moreover Mdlolo (2017) study revealed that teachers in one public school in KwaZulu Natal had limited understanding about gender equity in science education and therefore would not be able to adequately pursue learners especially females towards STEM careers hence the underrepresentation. The study also revealed that these teachers are a product of being socialized in structures which have traditional gender stereotypes , as a result the teachers might continue to encourage boys and girls in different careers as per the understanding of gender roles (Mdlolo, 2017) .On the contrary there is a study that found that learners from rural public schools including females associated STEM subjects with increased

chances of having a decent well-paying Job and therefore had positive attitude towards the subjects than history as a subject (Mqadi, 2020).

Moreover part of literature shows that low self-efficacy is a recurring theme in literature. (Olabode A. Onile-ere et al., 2021) explored the differences in enrolment in STEM related courses between males and females' students in gun state, Nigeria. Findings revealed that males were more likely to enrol in STEM careers. Females reported that they do not have the confidence to take STEM subjects(Olabode A. Onile-ere et al., 2021). Self-efficacy has been reported several times and the common trend in literature is that female learners have low self-confidence to take STEM related courses hence the underrepresentation. Hacıoglu (2021) conducted a similar study about STEM education's influence on career choices. The finding of the study revealed that STEM education has a positive impact on career choices and leads to a positive development of their perception towards STEM careers (Hacıoglu & Gulhan, 2021).

It is evident that some of the findings highlighted by the scholars above show that female perceptions of STEM subjects and challenges are not only attributed to gender but there are other identities which makes these challenges and perception unique to Black females only. It is for this reason that several scholars have proposed intersectionality as an effective theoretical framework to use when conducting research that includes participants with multiple identities that affect their life experiences. Example of such scholars include (Corneille et al., 2019; Gaston Gayles & Smith, 2018; Ireland et al., 2018)

2. 11 THEORETICAL FRAMEWORKS

As noted in the above literature review, Intersectionality is a lens of understanding women underrepresentation in STEM, specifically adolescents' Black girls in public high schools is still a need. Yes, Intersectionality is a popular emerging theoretical framework that scholars are utilizing however the theory has been used predominantly within studies of higher education and the labour market. This is good stride to adequately capture and discuss unique experiences and challenges confronting Black women, especially within the South African context. Other scholars using Intersectionality focus on one axis, for example race or gender. This has long been a trend. Shields (2008) concur and argues that discourses on race, gender and class have taken a singular approach to understanding the experiences of Black women, hence, there is an urgent need for an intersectional approach to research on the challenges confronting Black women because it gets researchers to go beyond the individually informed perspective that we

each inevitably bring to our scholarship and science, again it helps the researchers to refrain from neglecting other identities of oppression which intersect simultaneously and plays a prominent role in shaping the experiences and challenges of Black women (Shields, 2008). In response this study aimed to provide contribution by focusing on three axes namely class, gender and race and also focusing on public high schools and adolescent's cohort.

Intersectionality has traditionally been understood as a Black feminist theory that looks at the various ways in which race, gender and class intersect to oppress and marginalise Black women (Crenshaw, 2013 ; Christie & Collins, 1982) . The term Intersectionality can be traced to legal scholar and feminist Kimberle Crenshaw. She uses the term intersectionality to expose the interlocking axes of oppression such as race, class, gender etc, that connive to amplify the plight of black women (Crenshaw, 2013). Intersectionality is an analytical tool that aims to expose the various dimensions of marginalised bodies (Crenshaw, 2013). It is effective in challenging the hegemonic comprehension of social identities. It is also effective in portraying relation dynamics between power and social identity categories as social construct.

Martiniello (2012) argues that having different social identities categories enables or disables the access people have to power and privilege . What this means is that people have different positionalities and access into systems and opportunities depending on which social identity category they classify with (Martiniello, 2012). For example, most of the participants of this study are classified as Black female learners from low socio-economic class, these multiple identities disable them to access private schools in suburban areas. Private schools are characterised with good education system and exposure to good career opportunities. These arrangement places learners from high socio-economic class who are normally white at a position of privilege. Intersectionality is an effective tool that provides opportunity to analyse the privileged and the unprivileged (Crenshaw, 2013). History plays a dominant role in these positionality, access to structures and lived experiences (Crenshaw, 2013). Steyn (2021) highlights that modern discourses that challenge oppressive dynamics often dismiss transcendent historical injustices as mere memories. Which is ineffective conversely Intersectionality is appropriate and enable the researcher of this study to also show how the racial and gendered effects of Apartheid still play a role in disadvantaging Black women access to STEM fields. Moreover Intersectionality assist in showing scholars gendered inequalities within race and racial inequalities within gender (Nash, 2008). Black men and women have different privileges hence STEM fields have higher number of Black men than women and

white women and Black women have different privileges. For example, specifically Black women are recorded as the least educated and employed.

The way social identity categories were constructed specifically during apartheid set tone for the dichotomy of the privileged from the unprivileged. To this study social identities categories should be viewed as social constructs. Intersectionality is important because it argues that analyses should include multiple identity categories (Dhamoon, 2011) Additionally Intersectionality “ provides a critical perspective that evaluate how categories of social identities inform social positioning”(Longman & De Graeve, 2014).

Cole (2009) argue that understanding of one’s race and gender may affect an individual’s beliefs about what is possible and the opportunities which one could pursue. Common finding in scholarship about Girl’s perception of STEM is that the girls have low self-efficacy in STEM because they do not feel belonging and feel as though they are defying a social norm by being in STEM as it is domain hegemonic understood to be one for males. This then leads to lose of interest for the girls in STEM fields. Transformation of this status quo will require engaging the social identity categories and engaging the power behind the meaning of these categories through society construct.

Bourdieu (2004) argue that the maintains of systems of power relies on the silence of the oppressed as they continue to invest their participation in the system. While Longman and Da Graeve (2014) argue that understanding the dynamic of power and oppression through intersectionality enables scholars to deduce the mode of agency and résistance to structural oppression. Acknowledging intersectional differences also deploys sensitivity to power dynamics and how they can potentially reproduce inequalities if unattended (Longman & De Graeve, 2014).It is for this reason that more scholars should employ intersectionality in studies aimed at understanding gender inequality in the STEM domain.

Although scholars such as Burman (2003) argue against intersectionality because it portrays differences as obstacles that need to be overcome with intent of the universalised state of mutual relatedness. However severally noted in this theoretical framework Intersectionality is an effective framework(Burman, 2003). It enables scholars to generate knowledge of experiences that goes beyond the physical and allows for exposure of the connection between power and differences among people (Steyn et al., 2021)

2.12 Chapter summary

In this chapter a critical review was provided. This was done through discussion of various topics that relates to women in STEM. The review shows how history of women in education, more specifically in STEM education played a crucial role in some of the challenges that exists today related to women in STEM. The review also discussed the purpose of education and the state of public schools in South Africa contemporary to reveal the disjuncture between the aim of education and how things are in education. The review further discussed the representation of women in STEM which revealed that indeed women's numbers are low in STEM. Benefits of women in STEM was further unpacked. The literature review then narrowed the scope of discussion by specifically having discussion that is school context and discussed STEM achievement between girls and boys in South Africa basic education. Family role in females' learners career choice was unpacked to show the role of socialization. The review then highlighted interventions that have been implemented to improve female participation. Legislations were also discussed. The review ended with related studies that were conducted internationally and in Africa. The literature review was followed by a discussion about intersectionality which is the lens that informed this study.

CHAPTER THREE: RESEARCH APPROACH AND DESIGN

3.1 Introduction

This chapter discusses the methodological approach and research design utilized in the study. The chapter will provide firstly the research question; aim and objectives of the study. This will be followed by research strategy and design, population and sampling procedures, research instrumentation, data collection methods, data analysis, trustworthiness and ethical issues considered in the study. The chapter will also include a reflection, highlighting reasons for choosing the above-mentioned methods. Furthermore, challenges encountered more especially with telephonic one-on –one interview schedule. The chapter will also highlight how the researcher had to adopt additionally data collection method to support the challenge with telephone one –on- one interview schedule. The reflection will also reflect on how sanction for this research project was granted, particularly in the mist of Covid-19.

3.2 Research Question

How do Black Adolescent female learners from Bona comprehensive school in Soweto perceive STEM careers in terms of its significance towards economic empowerment?

3.3 Research Aim and objectives

3.3.1 Primary Aim

To explore how Black girls from Bona comprehensive school in Soweto perceive STEM's significance towards economic empowerment.

3.3.2 Secondary Objectives

To explore perceptions of black girls of STEM careers.

To explore the experiences of Black girls in maths and science.

To investigate the challenges experienced by black girls in maths and science.

To examine the learning support programs accorded to black girls within maths and science.

To understand why they chose maths and science.

To elicit recommendations on how women's participation in STEM careers could be improved .

3.4 Methodology

3.4.1 Research strategy

The study employed a qualitative research approach. This is a research strategy that focuses on understanding situations in their uniqueness, as part of a particular context and the interaction there (Creswell, 2009). This strategy is characterized by understanding situations from the participants' perspective and rich description. This strategy was ideal for this research study because the data was collected in a school from school female learners and LO teacher with an intention to hear their perceptions on the importance of STEM fields for female economic development. This approach allowed the participants to share their unique perspectives and subjective realities as argued by Creswell (2009). The researcher gathered rich description from participants by exploring and probing on their experiences; challenges; perceptions and learning programs accorded to them to assist with STEM subjects.

Qualitative research has advantages and disadvantages according (Legard et al., 2003). The advantage of this strategy is that the researcher elicited rich in-depth data from participants because of the nature of this strategy (Legard et al., 2003). Furthermore people are unique, the small sample size might not be adequately representing the larger population, therefore it is of utmost importance for the researcher to be skilled when using this strategy as argued by (Legard et al., 2003).

Furthermore, the research design that was used for the study is the case study design. Yin (2015) defines case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context. The researcher of this study conducted this study within the premises of the chosen high school, namely Bona Comprehensive School. The unit of analysis and the topic of investigation characterize a case study design which is why the researcher found it appropriate to use for this research. The characteristics being the Black female Adolescents perceptions towards STEM careers as the unit of analysis and Bona comprehensive being the context in which learners study STEM subjects. The phenomenon that is being investigated was naturally bounded, this means that there was a limit in terms of who could be interviewed. In this case only Adolescents females from Bona could partake in the research study. Bryman (2016a) defines case study design as a detailed and intensive analysis of a single case. This researcher used a single high school to collect the data. Bona Comprehensive School located at Orlando enabled the researcher to access the population who were eligible for the inclusion criteria of the research study. The requirements

will be highlighted later in this section. Qualitative approach and case study as a research design was appropriate for this study and complementary to Intersectionality theory which is the theoretical framework utilized in this research .

According to Tamela (2020) “most power sites such as literature portrays hegemonic narratives which are often blind to intersectional identities and suffering”. They often analyse one dimension at a time which leads to a great need for intersectionality hence this research study chose intersectionality to adequately report the findings since participants have intersectional identities and sufferings. Furthermore qualitative case study design are useful and complementary approaches of examining intersectionality because they allow the researcher to gather data which is rich and allows for an analyses that offer a particular understanding of intersecting identity category that emerge as lived experiences (Tamela, 2020). Moreover, these methods allow researchers to provide insights of how people’s stories and experiences link to structural power arrangements. Furthermore the scholar argues that intersectional interpretation allows the researcher to search for layers of suppressed meanings from the data.

3.4.2 Population and Sampling

Population refers to all persons and organisations which the research is concerned with, while a sample comprises of elements or subset of a population considered for a study (Strydom, 2011) The population that the study used is the Black adolescents’ female learners at Bona comprehensive school in STEM subjects and one LO teacher at the same school. The sample used was Grade 10 adolescents’ female learners enrolled in one or more subjects within STEM subjects. Nine participants resided at Orlando east and one participant resided at Johannesburg central.

The researcher used purposeful snowball sampling to recruit a sample of ten participants from Bona comprehensive school and additional two Adolescent females who were interviewed for pre-test purposes. Initially the researcher proposed 16 participants however after 10 interviews there was saturation of data and the researcher conducted only ten Interviews. Saturation is point where by the participants are no longer stating new information that can allow the researcher to develop new category (Walker, 2012) . According to Alston & Bowles (2003), the snowball sampling technique is used when participants are not easily accessible or not known. The procedure allowed the researcher to begin the process of selecting participants by identifying one possible participant who shows the required characteristics. The participant then assists and/or

linked the researcher with other candidates having the required characteristics (Alson & Bowles, 2003).

The type of purposeful sampling that was used is snowball sampling. Snowball sampling is a technique whereby the researcher samples a small group of people relevant to the research questions then these sampled participants propose other participants with similar characteristics or experiences relevant to the present research (Merriam & Tisdell, 2015). These participants then suggest others and so on (Merriam, 2015). Purposeful snowball sampling was appropriate and effective for this study especially during Covid -19 as accessing the learners physically was difficult. The aim of purposeful sampling is to sample participants that will help the researcher to discover; understand and gain insights therefore those sampled in the study must be relevant to the research question posed (Guetterman, 2015). The following is the criteria that was used to select the participants.

Participants Inclusion Criteria

- All participants had to be from the African race.
- All participants needed to be female.
- The participants had to be Adolescents (between the ages of 15 and 18).
- All participants had to study at Bona comprehensive high school.
- Participants had to be enrolled in one of the STEM subjects.

In addition to the Adolescents Black females, the researcher recruited one LO teacher as a key informant. The purposive non- probability sampling technique was an additional method used to select the informant. This technique was considered appropriate because it allowed the researcher to select only individual who understood the phenomenon being studied (Merriam, 2015). The informant had experience in teaching and interacting with learners in STEM subjects for an extended period of time. The key Informant has been an educator for over 5 years and was knowledgeable about gender inclusivity in school settings which was those were criteria for a suitable key informant. Gender inclusivity means to be open to everyone and not limited to certain people. Relating to gender, this means that services, establishments, schools, practitioners, government agencies, and other institutions are welcoming of all kids, regardless of their gender identity or expression (Cousins, 2007). The next section will discuss how the data was collected and analysed.

3.4.3 Research Instrument

The researcher was the primary instrument for data collection and data analysis. The researcher was ideal for collecting and analysing data because she can respond and adapt (Merriam, 2015). The advantage of the researcher being a primary instrument is that she is able to expand her understanding through the reading of voice tone (Merriam,2015). The disadvantage would be that the researcher could be bias and that might have an impact on the study (Merriam ,2015).

This research used semi- structured interview to answer the aim and objective of the study. The interviews were designed to elicit information about the experiences of Black adolescents females in STEM subjects and challenges they face within STEM subjects , perceptions they have of STEM careers and learning programs that are given to them to aid with their studies and how helpful they are to assisting them .According to Bryman (2016b) semi structured interview is when a researcher has a list of questions or fairly specific topics to be covered , often referred to an interview guide, but the interviewee has a great deal of leeway in how to reply. Questions may not follow on exactly in the way outlined on the schedule. Questions that are not included in the schedule were asked as the interviewer picks up on things said by interviewees, but, by and large, all the questions asked, and a similar wording was used from interview to interviewee.

There are advantages and disadvantages using a semi-structured interview schedule. One advantage is that it guides the researcher in asking questions and also permits the use of follow up questions, when necessary (Greeff et al., 2011). A semi-structured interview schedule also allowed the participants an opportunity to share their lived experiences in a guided and unrestricted fashion (Greeff, 2011). However, the semi-structured interview schedule also consumed large amounts of time and thus disadvantage participants who have limited time dedicated for the interview (Greeff et al., 2011; Magaldi & Berler, 2020). After the development of the first semi-structured interview schedule for this research, the researcher then pre- tested the research instrument.

3.4.4 Pre –testing of the research instrument.

A pre-test in qualitative research involves administering the interview to an individual or a group of individuals that have similar characteristics to the target study population and this was done in a way that replicates how data collection session was administrated. The aim of pre-testing was to determine the approximate time that will be taken to conduct the interviews. To check if there

are any problems that can arise in the interviews such as participants not understanding the questions (Legard et al., 2003) The pre-test also assisted the researcher to see if the adolescent female learners comprehended the questions based on the level of English used. If the questions were too abstract, the pre-test aimed to help the researcher to simplify the questions even further. Lastly the pre-test gave the two people that were selected for pre-test a chance to give in input on how and where best these interviews could be improved.

The researcher developed the first semi- structured interview schedule. The schedule was administrated to two participants who were not part of the 10 mentioned above. From the pre-test, it was noted that some questions and topics needed to be refined as they were vague and also did not speak to answering the research question. The schedule was then refined. Secondly the proposed time for each interview was 30-1 hour however from the pre-test it was noted that the interviews will only take 30 minutes. The schedule was administrated telephonically and the researcher had challenges in keeping the participants on the phone for an extended period of time, issues such as network, background noise and interruptions were a challenge hence the researcher saw a need to be quick and short in the asking of questions and discussing the posed topics

3.5 DATA COLLECTION

The data was conducted by administrating one- on – one telephone interviews with Black adolescents' female learners from Bona Comprehensive high school. Interviews were ideal for this study because they enabled the researcher to use direct strategy which involves asking questions (Gill et al., 2014). To ensure the reliability of the data, all the participants were asked same questions and the estimated time for the interviews was 30 minutes after pre-testing however this differed from participant to participant. The researcher recorded the interviews. All participants of the study gave consent to being audio recorded. The parents of the participants also gave permission for the participants to be audio recorded and take part in this study. The challenge as mentioned earlier is that some interviews were interrupted by background noise and network. For 3 interviews the researcher had to follow up on WhatsApp by text to get clarity on some of the information shared by the participants. Conducting interviews through telephone was also limiting in fully reading the nonverbal cues of the participants. All interviews were conducted after school hours which is why it was a bit of a challenge to reach some participants. Most of the participants had responsibilities to attend to upon arrival at home from school.

3.6 DATA ANALYSIS

Thematic analysis was used to analysis the data of this study. The researcher used audio recordings and written WhatsApp texts. Thematic analysis is a method for identifying, analysing and reporting patterns within data (Braun & Clarke, 2006). It minimally organizes and describes the data in rich detail (Braun & Clarke, 2006). The aim of thematic analyses is to describe patterns across qualitative data (Braun & Clarke, 2006). The process of analysing data involved various phases which are elaborated in detail below and in chronological order.

After collecting data, the researcher familiarized and immersed herself with the data. This enabled the researcher to have an in depth understanding of the data (Braun & Clarke, 2006). The process of immersion included repeated reading and reading actively to identify meanings and patterns. While doing this the researcher took notes which were used for coding (Braun & Clarke, 2006). The researcher then transcribes the data. This includes transcribing the data from the audio recorder to a written form. Audios were transcribed in a verbatim form(Braun & Clarke, 2006). As the researcher was transcribing, she adapted an interpretative act whereby she created meaning out of the data that was transcribed as argued by Lapadat and Lindsay (1999).

The second step involved picking of interesting themes, this is known as coding and is significant as it allows the researcher to organise the data into meaningful groups (Braun & Clarke, 2006). The coded data differ from the units of analysis which are often broader (Braun & Clarke, 2006). The researcher coded manually. This included writing notes on the texts the researcher used for analysing, by using highlighters to indicate potential patterns. The researcher also took note of contradictions that existed in the data that departed from the dominant story. These accounts were recorded in the presentation of findings chapter.

The third step began after the researcher have coded. The researcher began searching for themes. The researcher had a long list of different codes that have been identified across the data set. This phase included sorting the different codes into potential themes, and gathering all the relevant coded data extracts within the identified themes, this was when the researcher analysed codes (Braun & Clarke, 2006) .The researcher used visual representation here whereby she named each code and gave a brief description for each code. At the end of this phase the researcher had a collection of 22 themes and subthemes, all drawn out from the data.

The fourth step began when the researcher worked out a set of candidate themes, and it involved the refinement of those themes (Braun & Clarke, 2006). This phase involved two levels. Level one involved reviewing at the level of the coded extracts (Braun & Clarke, 2006). Level two involved a similar process, but in relation to the entire data set (Braun & Clarke, 2006). At this

level, the researcher considered the validity of individual themes in relation to the data set (Braun & Clarke, 2006). The researcher needed to return to reviewing and refining the coding until satisfactory thematic map is produced as argued by Braun & Clarke (2006).

The fifth step involved the researcher conducting and writing a detailed analysis of each theme identifying the core of each theme and developed a short and brief informative name for each theme (Braun & Clarke, 2006). After this process the researcher was able to create an overall narrative. During this process, the researcher then identified if the themes may have sub-themes, then name all themes and sub-themes that emerged from the data according as suggested by Braun & Clarke (2006).

The last step was whereby there was selection of captivating extracts and then relating it back to the analysis. In this step the researcher engaged in the process of answering the research question to be able to produce the research report. The task involves telling the story of the research findings based on the analysis (Braun & Clarke, 2006). In this study, the researcher wrote the report in line with the themes and sub-themes that were established from the analysis. This enabled the researcher to answer the research question.

3.7 TRUSTWORTHINESS OF THE STUDY

The researcher adhered to the following criteria which were crucial for the quality of the study: credibility; transferability; dependability and confirmability.

Credibility

Credibility looks at if the study is believable to readers who are critical (De Wet & Erasmus, 2005). Techniques that were used to ensure credibility of research involved members checking and highlighting the perspectives of participants (Miller, & Creswell, 2010). Credibility of the research ensured maintaining consistency in the analysis of data without being biased (Miller & Creswell, 2010). To ensure this the researcher used reflexivity throughout the research to avoid being biased and to be transparent and sincere as suggested by (Bryan, 2016). The researcher attempted to produce sufficient data that was analysed keeping in mind the contextual influence of data.

Transferability

Transferability involves generalizing the findings of a study to a context and the issue that the research is exploring. In order to obtain transferability, the researcher produced detailed information about the research context; processes and participants as argued by Miller, & Creswell, (2010). The data was reported in detail and accurately.

Dependability

Dependability involved the idea that the research study should be the same across time, researchers and analysis techniques (Pandey & Patnaik, 2014). The dependability of data was checked through inquiry audit (Pandey & Patnaik, 2014). Inquiry audit means data and relevant supporting documents being scrutinised by an external reviewer (Pandey & Patnaik, 2014) The supervisor supervising the researcher did inquiry audit for this research study.

Conformability

Refers to the quality of the results produced by the research in terms of how well they are supported by the research participants and by the events that are independent of the researcher (Pandey & Patnaik, 2014). Conformability was done by referring to literature and findings by other authors in order to confirm and strengthen the researcher's interpretations of the findings.

3.8 ETHICAL CONSIDERATION

According to Neuman (2014) ethical issues in research are dilemmas and conflicts that arise over the best way to conduct research". This is basically concerned with what is acceptable and what is not when conducting research. In ensuring that these dilemmas are minimized, the researcher adhered to the following principals:

Informed consent

Informed consent refers to obtaining permission from research participants; with the provision of necessary knowledge to make an informed decision (Saunders et al., 2015). This process involved disclosing to the participants of what the study is about and the process and making it clear that they are free to withdraw from the study at any time should they feel they want to do so (Barbie & Mouton, 2011).

The researcher provided participants information sheet to the participants, the parents of the participants and the LO teacher. These forms enabled the participants to take part in the research study and understand what the research is about. Furthermore, the participants were provided

with the consent included permission to voice-record the interviews which was handed to the participant to obtain permission to record. Consent forms were provided for the participants and the parents of the participants. Since the research involved participants under the age of 18 years old, the participants were also given assent forms to give permission to be interviewed and recorded.

Confidentiality and anonymity

Confidentiality refers to a condition in which the researcher knows the identity of the research participants, but takes steps to protect that identity from being discovered by others (Saunders et al., 2015). Strategies to achieve this could be through the following. Avoiding mentioning 1. people's names; 2. places; 3. religious or cultural background; 4. occupation; 5. family relationships; and 6. other potentially identifying information (Saunders et al., 2015). Instead of using this identifying detail, the researcher opted to numerically label the participants and ensured not to reveal the ethnic/cultural backgrounds of participants or use codes as argued by (Saunders et al. 2015; Hepworth et al., 2010; Neuman, 2014). In this study only the researcher and her supervisor have access to the raw data.

Participant's anonymity was also ensured in the study. Anonymity is defined as a process where gathered data cannot be linked and/or associated with a particular participant (Rubin & Babbie, 2001). Anonymity is successful when the researcher cannot even begin to link the raw data back to specific participants (Rubin & Babbie, 2001). However, in qualitative studies, it is often a challenge to ensure that participants are completely anonymous. In this study, participants' identifying information such as names and surnames were changed and replaced with codes. For example, Hope Sikhosana was identified as participant number one, meaning any direct quotations excluded any information which might be used to identify/ or single out a particular participant. The participants of this study were not anonymous to the researcher.

Vulnerable population

The study made use of adolescents under the age of 18 years; thus, they were legally deemed children and therefore part of a vulnerable group in South Africa. In research, it is a common practice and understanding that children as participants cannot provide informed consent (Creswell, 2003). As a result, it is therefore important for researchers to take appropriate steps to protect such participants from any harm or exploitation (Creswell, 2003). In the study, various

steps were taken to protect the participants from any harm. This included acquiring parents' or caregivers informed consent for those under 18 years before they could participate in the study.

Application for ethical approval (Wits):

The researcher submitted a proposal to the ethics committee and the committee reviewed the proposal to see whether the human participants will be protected in the duration of the research process. The study was cleared by the Gauteng Department of Education - Research Office and the University of the Witwatersrand Human Ethics Committee, H21/03/25. In addition, permission to conduct the study was sought from the principal of the secondary school.

Avoidance of harm or non-maleficence

According to McLaughlin (2007), in any research study, it is important to consider from the outset whether it is likely that participation may be harmful to respondents, and if so, to take action or adopt a contingency plan. Counselling or debriefing sessions are possible ways that can be used to alleviate emotional distress evoked by the study (McLaughlin, 2007). The researcher explained the study in detail beforehand and allowed the participants and the legal guidance of the participants to decide whether they wish to take part in the study or not. The researcher did not experience any possible danger. No participant experienced emotional distress.

Reflection / Challenges

There were various challenges that the researcher encountered in the process, and these are highlighted below and how they were managed.

Finding a school (site) to conduct the study was a difficult challenge because of the Covid-19 protocols, after approval from the Department of Basic Education (DBE) to conduct the research in any school in Orlando east, the researcher approached several schools around Orlando virtually and only got response from Bona Comprehensive. It was difficult for the researcher to physically approach the schools because of Covid -19, one of the rules from DBE stated that researchers are not allowed to be in the premises of the school. This was in line with combating the spread of Covid-19. Most communication needed to happen virtually as per the DBE Covid-19 protocol. Request for approval was communicated through email and approval was granted virtually by email followed by a formal letter. The school Principal and researcher then arranged and had one meeting to meet and greet and discuss the research and recruitment of the participants. During the meeting all Covid-19 protocol were adhered. The principal of the school was very busy and

produced the formal letter months later despite her verbally agreeing to the commencement of the research. Reaching the Principle for a reminder was a challenge as all communication was virtually and the researcher relied on the principle virtual response. After formal approval, the principle then linked the researcher to the Life Orientation (LO) grade 10 Head of Department (HOD) who then assisted the researcher going forth with accessing participants and all matters related to research.

The LO HOD was assisting the researcher to access the participants. The HOD linked the researcher to a female class representatives of grade 10 classes enrolled in STEM subjects. The researcher telephonically contacted the representative who met the criteria of the study then the representative adolescent females linked the researcher to other participants by sharing contact details of their classmates who also met the selection criteria. All the participants underwent profiling to assess eligibility. The participant's information sheets, consent forms and assent forms were physically shared with the participants. The forms were left with the Principle during the meet and greet meeting and were distributed to the learners to fill in together with their parents. The usage of sanitizer was utilized throughout the process in line with Covid-19 protocol. The challenge with sharing the forms virtually was the need for data to download the forms. Utilizing the above-mentioned method was cost effective.

Communication among the participants and researcher mostly occurred through Phone calls and WhatsApp as that is the platform that most of participants were using. The challenge with phone communication was network, background noise from the participant's side often disrupting the interview. This method was also expensive as much airtime needed to be purchased.

3.9 Chapter Summary

This chapter provided a research question, aims and objectives. This was followed by research approach and design. The research design that was used for the study is the case study design. The unit of analysis and the topic of investigation characterize a case study design which is why the researcher found it appropriate to use for this research. Furthermore, the chapter discussed population and sampling, Research instrument and pre- testing of the instrument. Semi- structured interview was used as instrument to answer the aim and objective of the study. Semi structured interviews were found to be useful because it guides the researcher in asking questions and permits the use of follow up questions, when necessary (Greeff, 2011). This was followed by a discussion of the data collection and analysis methods used in the study. The researcher used one-on – one telephone interviews. Thematic analysis is a method that was used for analysis.

Moreover, the chapter discussed the trustworthiness and ethical consideration of the study. Lastly the chapter highlighted the reflection which discussed challenges encountered in the process and how these were managed.

CHAPTER FOUR: DATA PRESENTATION AND FINDINGS

4.1 Introduction

This chapter presents and discusses the study findings. Participants demographic information will firstly be outlined, descriptive analyses was used to analyse the demographic information. Furthermore, this chapter will present findings. For each objective there will be a table that summarises the themes and some participant's quotes. The table will be followed by an interpretation and discussion of the themes that emanated from the analysis for each objective. This qualitative data was analysed using thematic content analysis method. Quotes used in this section are direct from the participants and supports the identified themes.

4.2 Participants socio-demographic Information

Table 4.1 Participants socio- demographic profile (N- 10)

Demographic Factor	Sub – category	No
Age range	15-18	10
Grade	10	10
Race	Black	10
Gender	Female	10
Housing type	Informal settlement	5
	Township	4
	Town	1
Parents occupational status	Unemployed	3
	Low paying Jobs	4
		3
	Decent. paying Jobs	
STEM subject enrolled in	Technical science	8
	Engineering graphics and design	8
		1
	Physical science	

Table 4.1 summarises participants’ socio- demographic profile. (10) Ten participants participated in the study. All the participants were between the ages of 15-18. All participants were in grade Ten and they were all Black and female. Majority (5) of the participants resides in informal settlement. 4 of them resides in township while 1 lives in town (CBD). Most of the

participants reported that they parents were in low paying Jobs. Three participants reported that they parents were unemployed and 3 reported that they parents were in decent paying Jobs. All the participants taking part in the study were studying towards STEM fields. 8 of the participants had Technical Engineering and construction in their subjects while one participant studied Physical science.

4.3 Perceptions Black female adolescent from a public school have of STEM careers.

The first objective of the study was to explore the perceptions of Black girls from public schools of STEM careers.

Table 4.2 Perceptions Black girls from public schools have of STEM Careers

This table below summarises the main theme, sub themes and participants quote that emanated from the analysis for the first Objective of this study.

Main Theme	Sub- theme	Quotes
Learners' positive views of STEM fields	STEM subjects have employment opportunities	<i>"The area I live in has RDP houses and most people in the area are unemployed. My parents are unemployed. I once did research about engineering subjects as I was looking into which subjects I should take and I noted that engineering have a lot of opportunities. In my neighbourhood there is a lot of young people who are not working and I don't want to be like them. I want to work and help my family."</i> <i>"I love construction Mam, it is all about hard work and I feel like with the skill gained there you will be able to start something and work with your hands even when you cannot find employment."</i>

STEM careers are good especially medicine	<i>"I want to become a doctor because I want to help people."</i> <i>"I intend to be a Doctor so that I can get a good paying Job and help people."</i>
STEM careers pay well	<i>If you have maths and science you stand a good chance to get a Job that is paying well and many Jobs require physical science and maths. This is what I learnt from university prospects. In my community most women are dependent on their partners.</i> <i>I think there is a lot of women are involved in small businesses and are working for themselves and their children. Personally, I think STEM careers have good money, one can earn good money.</i>
STEM fields provide growth and development	<i>"So far it has been good you know, we learn about a lot of new things. I even learnt how to build a wall."</i> <i>"Yes, I think the knowledge provided is stimulating for growth but difficult"</i>
Learners' negative views of STEM careers are not safe STEM fields	<i>"IT pays well and is good. I think again it is not dangerous which is why I love it."</i>

		<i>"I think being a Dr is a safe career. Your life is not at risk in anyway."</i>
Female learners understanding of the cause of female underrepresentation in STEM fields	Girls cannot draw	<i>Transcript 1</i> <i>" I plan to stay because a lot of females prefer to be nurses and Doctors and it is only a few females that are in engineering so I want to take part as I am interested in engineering. I guess because they are not good with working with hands and drawing ."</i> <i>Transcript 2</i> <i>" .. In class we are only 10 girls. Most girls cannot draw which is why they do not choose these subjects."</i>
	Stereotype that STEM is for males	<i>Transcript 5</i> <i>" I think it is because of stereotypes that there is Jobs for males and some females however it is not true and I also had the same perception at some point however ever since I learnt that there is a female who is doing these subjects I was motivated."</i> <i>Transcript 6</i> <i>" They need to explain to us what maths and physical science is about even before we choose the subjects so as</i>

to understand what it entails. That could limit the stereotypes that these subjects are for males only.”

4.3.1 Main theme: Learners view STEM fields positively

Findings show that learners had some positive views about STEM fields. The participants saw STEM subjects as subjects with employment opportunities. The participants expressed that STEM careers were good particularly medicine. Furthermore, the participants understood that STEM careers pay well which was attractive for them. The participants further perceived STEM careers as careers that provide practical growth and development. Part of intersectionality is useful in revealing how social identities inform social positioning and to some extent perceptions. The social position of the participants of this study includes being young females who are Black and live in low-income areas and attend public schools. What this implies is that the current social positioning of the participants is them being disempowered especially financially. What is important for them is seeking opportunities that could positively change their circumstances particularly financially. In a country with high unemployment rate, STEM subjects for them had higher opportunities to secure employment as it provides critical skills and better pay. The findings are discussed in-depth below:

Sub Theme 1 : STEM subjects provide better employment opportunities

Findings revealed that 8/10 participants viewed STEM subjects as subjects that could provide employment opportunities. The participants perceived STEM subjects as subjects that provide skills which are of demand in the work market. Securing good employment after studies was an important factor to consider when selecting subjects for the participants. Majority of the participants have parents who are unemployed and uneducated and live in poor communities. Historically the parents of the participants lived under the apartheid era and had limited access to educational and employment opportunities especially STEM opportunities, this led to struggles in securing good employment that could enable a good life for them and their families however with now better access and opportunities, the participants find it important to utilize the access

and available opportunities to better their socio- economic livelihood and that of their families. Participants viewed STEM Jobs as a path through which they could achieve this objective. The quotes below were captured to support this theme.

Transcript 1

“The area I live in has RDP houses and most people in the area are unemployed. My parents are unemployed. I once did a research about engineering subjects as I was looking into which subjects I should take and I noted that engineering have a lot of opportunities. In my neighbourhood there is a lot of young people who are not working and I don’t want to be like them. I want to work and help my family.”

Transcript 3

“I stay in a shack. Both my parents are unemployed but are very supportive towards me and my studies. I would like to do medicine or something within science. Science careers have more Job opportunities. I think we need to know about science, I think it is important and I want to know more about medicine as well.”

Additionally, two participant added that with skills gained from STEM subjects, one could start their own business and not only rely on companies or organisations for employment. Despite STEM skills being critical and of demand in the work market, employment in South Africa have proven to be unstable given the high unemployment rate which is why most encouragement from social structures such as schools, social media is steering towards building entrepreneurship mind-set amongst young people so as to widen opportunities of employment.

Transcript 7

“Yes there is a lot of opportunities in STEM and again you also will be able to help people in your community. For example in construction you can gain a skill of building and be able to build a roof for your family or start your own small business with that skill and help build around the community.”

Transcript 10

“I love construction Mam, it is all about hard work and I feel like with the skill gained there you will be able to start something and work with your hands even when you cannot find employment.”

Most of the participants agreed that STEM subjects provides better chances of one making an income and that STEM opportunities could better their socio economic livelihood.

Current research indicates that students' self-efficacy, attitudes, and perceptions are what contribute to their positive views of STEM. For instance, Nguyen & Riegler-study Crumb's from 2021 provides a thorough overview of Black students' perceptions of scientists. The study,

which employed an intersectional lens, found that Black female students had favorable perceptions of scientists. The study's participants had anti-stereotypical views of scientists, and these views turned out to be significant and encouraging for students who intended to pursue STEM jobs (Nguyen & Riegle-Crumb, 2021). Additionally, academics like Crisp et al. (2009) contend that the self-efficacy is the basis for social cognitive career theory. This approach emphasizes how students' personal attitudes, beliefs, and experiences affect their thoughts and expectations about their own STEM talents (Badri et al., 2016).

Additionally, literature shows that indeed skills provided by STEM are in demand and can help individuals improve their lives but also equip the individuals to contribute to changes in society. Society has evidently shown that there is great inequalities and social injustices. This implies that there is a need for people who are trained and skilled to be able to tackle challenges that comes with these inequalities and injustices. Scholars such as Westheimer, (2017) argue that education enables individuals to ask critical questions, it exposes them to different perspectives and equip them to challenge injustices. STEM education in particular is important for individuals to be able to compete in this modern world, it increases chances of employability and develops essential 21st century skills (Bybee, 2017).

This study slightly deviates from the above scholars and show that learner's positive attitude towards STEM is not particularly tied to the self-efficacy to successfully perform in STEM but it is tied to the benefits STEM brings to better their lives. Particularly the economic benefit, the ability of STEM to be applied to change their daily lives and the high job prospect the field provides. The findings suggests that for learners who come from low socio-economic background and come from townships which are popularly known for being underdeveloped the focus is not on the ability to perform well in STEM subjects but more on how these careers could change their lives.

Sub theme 2 : STEM careers are good especially medicine.

In addition to participants viewing STEM subjects as subjects that could increase their chances of securing employment, majority of the participants expressed that STEM jobs are good especially medicine because it allows them to help people who are ill. 6/10 participants expressed that they have an interest in pursuing medicine. Despite participants showing interest in a fields that have been historically male dominated and masculine in nature, participants still

expressed an interest of performing a care role in their selected career choice and associating with a career that allows them to help and care for others which are roles typically associated with femininity . Historically nurturing role in occupations have been associated and reserved for females, this has been the socialization in many societies including townships like Soweto where the participants of this study reside. It is evident that gender role socialization still plays a prominent role in influencing some adolescents of this era career selection. In this study participants viewed medicine as a good profession because it is within STEM and is a profession that can enable them to help and care for people in society. The following quotes support this theme:

Transcript 3

“I want to become a doctor because I want to help people.”

Transcript 4

“I see myself one day having my own surgery and being a Dr. Okay so I reside with my grandmother who smokes and drinks. When I was young I would ask at school as too is it good for my grandmother to smoke and drink in her condition. Her condition and behaviour worries me and my wish is for her to live long until I get to be a Dr so I can help her with her condition.”

Transcript 6

“ I was thinking of being a Doctor so that I can help people . I just want to see myself helping people. Alternatively, I would like to be a social worker so I can help people living in poverty because I am also in that condition and it is my wish to help change people’s lives.”

Transcript 8

“I intend to be a Doctor so that I can get a good paying Job and help people.”

Majority of the participants want to become medical Doctors because of the nurturing nature of the job as seen in the last quote some participants also viewed medicine as a good paying Job in addition to its helping nature.

Current research demonstrates that women are increasingly interested in careers in health sciences and medicine, not just in South Africa but around the world. The overall percentage of female doctors has climbed from 29% in 1990 to 46% in 2015, according to data from the Organization for Economic Co-operation and Development, indicating a trend towards higher engagement of women.(Coe et al., 2019). Nevertheless the disparity in participation rates between nations is still evident, indicating that regional social norms and cultural factors have a

significant influence (Coe et al , 2019). Even females from some areas of Soweto are expressing interest in medicine, according to this study's findings.

Furthermore part of literature shows that career choice is linked to personality. (Eccles & Wang, 2016) study revealed that males and females with an altruistic orientation and who perceive STEM careers unhelpful to people will be less likely to choose STEM pathway. The values individuals placed on having jobs associated with people and altruistic concerns that discriminated between individuals who chooses occupations in health , biology , and medical science (HBMS) and those who choose occupations in MPECS (Eccles & Wang, 2016). This study does not find anything related to personality linkage to career choices however Soweto being a community governed by patriarchal gender social norms. This can suggest that females are highly likely to place value on occupations that are helping people oriented as part of female social norm includes nurturing.

Literature shows that there are some scholars who are concern about gender serotypes in education. According to Barka, who was referenced by Gouws (2012), over 65% of African nations are studying the position of female students in classrooms, and some have already changed the curricula to promote positive representations of women. She asserts further that through in-service education training, instructors need access to different teaching strategies that are sensitive to gender(Gouws, 2012). The majority of female students are enrolled in traditionally gendered programs like nursing and social work, while men continue to predominate in science-related programs, reflecting the persistence of gender stereotyping in education (Masanja, 2010).

Subtheme 3 : STEM careers empower women, and facilitates financial independence

As discussed above, STEM careers provide high pay than most professions because of the critical skills it provides. Some participants viewed STEM careers and business skills obtained from STEM subjects as opportunities that could provide economic empowerment and financial Independence for them as women. The participants live in communities where women are the mostly unemployed. Most women in these communities are reliant on their male partners financially which place them in positions of being subjected to social ills such as gender-based violence(Martineau, 1997). Historically women had limited access to education and

employment (Martineau, 1997) In 1994 South Africa committed to bringing transformation. Despite current equity and equality policies within Labour relations to assist women and other vulnerable groups, majority of women in South Africa are still recorded as the most uneducated and unemployed (Maluleka, 2019) . The participant's exposure to women in their communities being unemployed and uneducated has served as influence for them to associate with professions that will change the narrative of Black women in Soweto in relation to employment and financial status.

Transcript 1

"I think just to add now that I understand the term, I want to make my own money. I just want to be Independent. I want to own my own construction business. I always feel bad when I see women reliant on men in my township because someone can die or abuse you and then if you break up with them you end up being stranded , I do not want to be stranded."

Transcript 2

" IT pays well and is good, since I am doing these subjects , I want to pursue it . Women are not economically empowered where I stay. Here most women are abused by they partners, we also have the electricity issue . Women have tried to fight for electricity and men would argue that they would not be ruled by women so they silent women voice despite women having equal right to fight for electricity. "

Transcript 5

"If you have maths and science you stand a good chance to get a Job that is paying well and many Jobs require physical science and maths. This is what I learnt from university prospects. In my community most women are dependent on their partners and do not work."

Despite some participants expressing that most women in the communities are unemployed and reliant on the partners financially, there is one participant who stated that women in her community own small business and are financially Independent and take care of their families which served as motivation to also be an Independent women and she saw STEM as subjects that could provide that opportunity of being financially Independent as a women.

Transcript 4

“I think there is a lot of women who are involved in small businesses and are working for themselves and their children. Personally, I think STEM careers have good money, one can earn good money.”

This finding is congruent with the current literature. Literature shows that indeed women involvement in STEM can have a positive impact in the lives of women financially (Mone, 2013; Silver& Snider, 2014; Sari et al, 2018; Hacioglu, 2017 and Ozcelik, 2017) and participants of this study had knowledge of this hence viewing the domain in positive lens. The most common reason highlighted in scholarship as a reason for women to be in STEM is that the field has potential to provide financial benefits to women. Women disempowerment and challenges in general such as gender-based violence is closely linked to lack of financial independence, this trend is particularly evident in developing countries. Siann & Collaghan (2010) argue that the pattern of female underrepresentation in science is a problem of both developed and underdeveloped countries. In underdeveloped countries it reduces female economic empowerment as they continue to be marginalized in STEM fields. It is for this reason that one of the important reasons for women to be in STEM is to ensure that women can sustain themselves. Several scholars agree that women involvement in STEM is essential for them to be economically empowered (Lessig, 2017; World economic forum, 2017; White& David, 2014; Pols, 2019). Furthermore STEM education have proven to be able to give women higher chances of getting higher paying occupations (Adelakun, O. A., 2015).

Some scholars have found similar findings. For example Mqadi , 2020 study found that learners from rural public schools including females associated STEM subjects with increased chances of having a decent well-paying Job and therefore had positive attitude towards the subjects than history as a subject (Mqadi, 2020). It is also worth noting that public schools and rural schools share similar characteristics. For examples public schools in both contexts often service learners who are from low socio-economic background. There is evidently a need for learners from poor backgrounds to be economically empowered including females.

As seen above good remuneration and financial Independence was important for the participants and majority perceived STEM careers as careers that could provide good pay. Additionally, the participants perceived STEM fields as fields that could provide growth and development.

Sub theme 4 : STEM fields provide growth and development.

Another positive perception participants had of STEM fields is that within STEM you will grow and develop as an aspiring female STEM professional because of the rare knowledge and practical nature that comes with the knowledge and skills provided by the STEM subjects. Majority of females in public school are saturated in theory intense subjects such as History, Tourism studies and commerce, this is due to the stereotype associated with STEM subjects that they are difficult and mostly suitable for males because of hand work and drawing associated with some of the subjects. Most girls cannot draw and do not prefer handwork which is why they shy away from STEM (Eguchi, 2017). Drawing and hand work are tasks typically associated with masculinity (Eguchi, 2017). Participants felt that they chose a rare subject stream as females which provides information and skills that is unique from majority of female peer's choice. The practical skills afforded by the subjects was also a positive attribute and intriguing for participant 9 specifically because she felt that she could use the skills even at home and around the community in a practical manner as a female. The following quotes support this theme:

Transcript 6

"Because they give you knew and rare knowledge. Even though at first it seems difficult, and you do not know the content but eventually if you are interested enough you will know."

Transcript 7

"So far it has been good you know , we learn about a lot of new things . I even learnt how to build a wall."

Transcript 8

"Yes, I think the knowledge provided is stimulating for growth but difficult"

Transcript 9

"These subjects are not only based on theory but also practical. For example with these subjects you can even start your business and help within communities. Even at home, you will be able to help when there is a pipe burst for example by fixing that pipe because you learned from school . So, you grow from these subjects".

As seen in the quotes above the participants felt that with skills gained from STEM they were able to apply the skills practically. Participants viewed the practicality that comes with STEM fields as good and desirable as it is skills that they could be implemented in the daily lives to

better their lives. Furthermore, participants recognised that they are few as females in these subjects and for them associating with subjects that most females shy away from was intriguing and positively challenging. This might be because the females did not feel belonging but had keen interest to challenge and find their positions within these subjects as females and immerse themselves.

Literature shows that indeed STEM provides skills which could develop individuals and equip them to deal with challenges they are confronted with even daily. Many scholars across the globe are all in agreement that that education is important especially STEM education. Glenn (2018) argues that science and technology is important to enable people to develop solutions that could aid in current day challenges. Diverse people need to be trained in STEM for innovation to transpire in different parts of the world for functionality and survival (Bybee , 2010). For example one of the problems the world is currently facing is overpopulation and Glenn, (2018) argue that one of the solutions might be colonising another planet and transporting some people however such innovation will require great expertise in science and technology. This implies that STEM education is important training for survival and development globally.

Additionally literature shows that STEM skills are important for several reasons at a broader scale. STEM skills are important for critical thinking and technology core skills which are important for the 21st century in addition to economic empowerment and therefore women should not be marginalised in these careers but attracted and retained (Hacioglu, 2017 Mone, 2013; Silver& Snider, 2014; Sari et al, 2018; and Ozcelik, 2017). Additionally society has evidently shown that there is great inequalities and social injustices. This implies that there is a need for people who are trained and skilled to be able to tackle challenges that comes with these inequalities and injustices. Scholars such as Westheimer, (2017) argue that education enables individuals to ask critical questions, it exposes them to different perspectives and equip them to challenge injustices. STEM education in particular is important for individuals to be able to compete in this modern world, it increases chances of employability and develops essential 21st century skills (Bybee, 2017). The participants of this study were knowledgeable of what STEM could provide hence they want to associate with the field.

Additionally one of the purposes of education is to enable individuals develop society. Education must promote the growth of an open mind, a scientific perspective on topics, creativity, problem-solving skills, and the capacity to think for oneself, interpret decisions, learn from others, and reject or adopt them in accordance with specific requirements and circumstance (Masanja, 2012).

Education must instil the knowledge and abilities necessary for family life as well as engagement in the growth and upkeep of the community (Masanja, 2010:2). Education in Africa has undoubtedly shown to be flawed and fall short of its goals. This means that the education system needs to be prioritized in order to guarantee that it fosters growth and development. The majority of individuals had favorable opinions of STEM, but some also had unfavorable opinions.

4.3.2 Learners view STEM fields negatively

Knowledge is power and determines social order and peoples understanding of self and how to relate to others and society. Part of intersectionality state that systems of power governing different parts of the world also determine access and opportunities (Longman & De Graeve, 2014). In this case the understanding of women being biologically weak than men indirectly denies them in occupations that are deemed to need physical strength. Females of this study do not perceive themselves as strong enough to successfully conduct work that require hard labour or involves risk. Some participants perceived some careers in STEM as careers that are not suitable for them as females because they perceived themselves as physically weaker than men and also as likely to get hurt in Jobs that involves risk than males (Ceci et al., 2009).

Sub theme : STEM careers are not safe.

For some participants safety was an important factor of consideration in career selection. Despite majority of the participants pursuing technical engineering and construction, the participants wanted to associate with a career that will not endanger they life and expressed a lack of interest in professions like electrical engineering and construction because according to their understanding, those careers were risky to their lives. Often work that requires strength and stamina is typically done by males because of being stereotypically viewed as more physically strong than women (Botha & Cronjé, 2015; Zungu, 2011). Females are often socialized and encouraged to do less laborious work as they are not as physically strong and might injury themselves easily than when compared to men(Botha & Cronjé, 2015). This perception of STEM careers being unsafe for women was a discouraging factor. It is important to note that this understanding of these careers reveal the participant's lack of knowledge about what the careers are about. The following quotes were captured to support this theme:

Transcript 2

“IT pays well and is good. I think again it is not dangerous which is why I love it.”

Transcript 6

“ I think being a Dr is a safe career . Your life is not at risk in anyway.”

Transcript 7

“STEM careers are risky. Construction for example is risky , a brick can fall on you if you are not careful. Some of these careers need you to be diligent and hardworking.”

Transcript 10

“For me I would not want to work with electricity because you might get shocked which is which I would rather be a Dr because at least there I just help people.”

When questioned by the researcher why the participants chose Construction and engineering whilst not having an interest in careers associated with the subjects, the participants expressed that the subjects were not their first choice, when they enrolled in the school, other subject's streams were fully occupied. This stream of subjects was the closest to the subjects they initially wanted in terms of similarity. The quotes below are example of participant's quotes who expressed this:

Transcript 8

“Mhmm, I chose these subjects because... My intention was to choose physical science and geography but unfortunately that stream was full so I opted for this stream and this is how I landed here.”

Transcript 2

“ I did not want to choose these subjects but they forced me into taking these subjects because other schools were full and I had no choice but to choose technical science as at least there is science.”

Transcript 10

“Actually Mam I wasn't going to choose these subjects , I wanted to choose maths and science and when I got to Bona I found that space was full and the only space that was available close to what I want is these subjects . I must say it was hard because there is a lot of people who were moving from these subjects because they were scared as these subjects are hard and I personally cannot draw.”

Participants had both positive and negative views about STEM careers however the positive views outweigh the negative views. These views play a prominent role in the career decision making of the participants and their decision to stay or leave STEM fields. In this particular study most participants intend to stay within STEM because of the positive factors associated with the field however the interest concentration is medicine. Some participants were cognisant of the underrepresentation of females in STEM fields and had certain perspectives about the underrepresentation which will be discussed in the next theme.

4.3.3 Female learners understanding of female underrepresentation in STEM fields.

In this finding we see again how knowledge influence social order as an institution of power. Drawing is one skill that has been typically associated with masculinity. As many girls are socialized into this way of thinking, some girls automatically develop a dislike for drawing and perceive it as a male skill.

Girls cannot draw.

Some participants understood female underrepresentation in STEM especially in engineering Stream as a result of lack of women's self-efficacy to draw. The participant felt that most girls cannot draw which is one of the skills one needs to successfully pass subjects like Technical graphics design and this is one of the subjects that one does in one of the science stream. Which is the stream 80 % of the participants were a part of. Drawing is a skill that is typically considered masculine and most girls do not even attempt drawing and chose to associate with drawing. The follow participant's quotes support this theme.

Transcript 1

"I plan to stay because a lot of females prefer to be nurses and Doctors and it is only a few females that are in engineering so I want to take part as I am interested in engineering. I guess because they are not good with working with hands and drawing ."

Transcript 2

" .. In class we are only 10 girls. Most girls cannot draw which is why they do not choose these subjects."

Transcript 10

".. We went to consult with the teacher, and she encouraged us to stay within these subjects because everything has a start and we will learn how to draw so that is how I stayed in these subjects however most girls do not stay because drawing is hard."

In addition to STEM being viewed as a masculine trait, Participants also viewed STEM fields as a whole as masculine in nature which is why they regarded as fields for males and that is discouraging to most of their females peers hence the underrepresentation.

STEM is for males' stereotype.

Other participants and the LO teacher expressed gender stereotypes associated with STEM fields contributed immensely in the under representation of females in STEM fields. Despite several efforts from the department of education and government as a whole to diversify STEM fields. This was done by placing initiatives directed towards females specifically to support them in their STEM studies and attract them, females from public schools do not benefit much from these initiatives as they do not hear about these opportunities. The communication gap between the government and the public schools seems to defeat the whole purpose hence most girls still do not find interest and confidence in selecting STEM subjects. Furthermore, participants interact with other social institutions like family, church, social media which to some extents are institutions still governed by patriarchal gender stereotypes and seemingly there is still much that needs to be done to eradicate the masculine image associated with these fields. The following quotes supports this finding:

Transcript3

"I think it is us as girls who allow these perceptions to get to us and end up not trusting our ability to do well within STEM."

Transcript 5

"I think it is because of stereotypes that there is Jobs for males and some females however it is not true, and I also had the same perception at some point however ever since I learnt that there is a female who is doing these subjects, I was motivated."

Transcript 6

"They need to explain to us what maths and physical science is about even before we choose the subjects so as to understand what it entails. That could limit the stereotypes that these subjects are for males only."

LO teacher Interview.

“I think most girls choices of subjects is affected by negative stereotypes associated with the subjects. The idea that these subjects are difficult and that construction is for boys.”

This finding is in alignment with existing literature. Literature reveals that gender roles socialization plays a prominent role in females feeling lower sense of belonging and having negative attitudes about the STEM domain. Literature reveals that there is a need for the change in the masculine nature of STEM. In STEM fields , a masculine culture is a social and structural environment that confers a greater sense of belonging and ability to succeed to men than women (Cheryan, 2017). This perception of STEM fields lowers the sense of belonging for females in this careers(Cheryan & Plaut, 2010). Factors that decreases women’s sense of belonging in STEM fields include negative stereotypes, perceived bias and a few role models(Cheryan & Plaut, 2010). The lower one’s sense of belonging in STEM , the less interest one expresses in entering and pursuing these fields (Cheryan & Plaut, 2010).

Additionally another South African study by (Juan et al., 2018) revealed that girls reported lower self-efficacy when compared to boys. The study further states that traditional gender roles and stereotype of STEM being a male profession have negative impact on females self –efficacy in STEM domain (Juan et al ,2018). This suggests a great need to deal with the masculine climate in the STEM domain and create the fields to be more female favourable and friendly. (Vainionpää et al., 2019). study concur and reveals a need for intervention to change the masculine nature of STEM fields There is also an urgent need to deal with how various social institution socialize boys and girls.

According to Cleaver (2002) in all countries and civilizations, gender stereotypes start as soon as we are classified as a boy or a girl at birth. These gender stereotypes describe acceptable behavior. Learning the beliefs, behaviors, standards, and social skills relevant to one's social station is a part of socialization. moreover,(Cleaver & Kimmel, 2002). claims that gender stereotypes exist in all countries and civilizations and start the moment a person is born and classified as either a boy or a girl. These gender stereotypes describe acceptable behavior. Learning the beliefs, behaviors, standards, and social skills relevant to one's social station is a part of socialization. Within a particular community, the girls receive socialization on how to behave as daughters, sisters, friends, wives, and mothers. Within a particular civilization, boys are taught how to

behave as sons, brothers, friends, husbands, and fathers. One technique to develop a culture for a certain population is through socialization.

From the above quotes it is evident that some participants were aware of the under representation in STEM and keen in changing this phenomenon by being part of the STEM fields as they found them to be interesting. Other participants expressed that from interaction with other female students, they observed and noted that gender stereotypes that state that STEM fields are males still play a prominent role in females career selection and it negatively contribute to the number of females in STEM fields because most girls end up not choosing STEM subjects. All the participants as mentioned above were part of the STEM subjects and the next objective discuss how they have come to experience the subjects.

4.4 Experiences of Black Adolescent girls from Bona Comprehensive school in STEM subjects

The second objective was to explore the experiences of Black girls from a public school in maths and science subjects. Overall, the findings for this object reveals that in dealing with the low representation of females in STEM there is a need to also engage teachers and the curriculum and teacher play a prominent role in how the learners experience the subjects. The main themes in response to this objective are captured the table below:

Table 4.3 Experiences of Black girls from a public school in STEM subjects

Main Theme	Participants quotes
Encouragement from teachers is helpful in STEM	<i>“I would say that there are teachers at school who encourage us to study STEM subjects and”</i> <i>“My teacher greatly helped me by encouraging me to stay in these subjects . My friends also helped a lot because we study together for construction.”</i>

Teachers teaching style determine comprehension	<i>“Drawing has been my challenge. The teachers however actually teach well.”</i> <i>“ Okay with pure maths our teacher is very good and teaches well and even provides examples but for Physical science the teacher explains in a way that is un understandable for me. I even need to approach other teacher for me to understand the content.”</i>
STEM subjects are difficult	<i>“At first it was hard and it was difficult to understand but as time went by and I joined study groups , things got better and that helped me.”</i> <i>“I like maths and science but these two are really difficult. I am able to get level 7 in other subjects but for maths and science I always get lower levels.”</i>

4.4.1 Encouragement from teachers

Some participants reported that teachers have played a huge influence in how they have come to experience STEM fields. Participants reported that at some point in their academic journey there was an educator who encouraged them to pursue and retain in STEM subjects because the teacher saw potential and believed that they could successfully perform within these subjects. The following quotes support this theme:

Transcript 3

“I would say that there are teachers at school who encourage us to study STEM subjects and”

Transcript 7

“My teacher greatly helped me by encouraging me to stay in these subjects. My friends also helped a lot because we study together for construction.”

Transcript 8

“... When I was in grade 6, my teachers from rural areas told me that my performance and academic capability enables me to excel in Physical science .”

Transcript 10

“ ... So we went to consult with the teacher and she encouraged us to stay within these subjects because everything has a start and we will learn how to draw so that is how I stayed in these subjects.”

As seen in the quotes above, teachers play a prominent role in how the female learners view themselves within STEM subjects and experience STEM subjects. Additionally, a handful of participants expressed that teacher in STEM actually teach well and they understand how they teach which is encouraging in the STEM studies.

This finding reveals how the learners feel about teacher's role in their studies. Literature also reveals that other scholars have highlighted the important role teachers can play in changing the girl's attitude towards STEM careers by engaging the learners on issues around gender inclusivity (Muralidharan & Sheth, 2016). Additionally, literature shows a gap in teachers' knowledge on gender inclusivity and a need to ensure that teachers training also includes a component of training them to be able to tackle gender issues in schools (Shapard , 2017).

Internationally, part of literature shows that teachers are well vested around issues of gender balance in schools. For example, in Russia teachers are always talking to young women about gender balance in STEM and this positively ignite an interest to pursue STEM, as early as age 10. Girls in Russia and fine land perceived STEM curriculum to be gender neutral. Furthermore the girls clearly understand how these topics are relevant in their lives and the type of Jobs they could enter (Microsoft, 2017). With such a small window of opportunity before interest starts to wane, it's vital for teachers and parents to actively encourage any girl with an early interest in STEM(Microsoft, 2017). This suggestion is consistent among scholars.

Patrick (2016) study concurs. The study explored possible differences in STEM self-efficacy by gender. The findings revealed that there is no significant difference in STEM self-efficacy by gender. This alludes to the fact that self-confidence to be successful in studying STEM subjects

between girls and boys is equal and not a problem. The findings instead suggested that teachers at schools need to do more in explaining the usefulness of STEM and how it is interwoven in various facet of life so that there could be an increase in student's desires to persist in learning STEM content.

Another part of literature related to this finding reveals that there is a need to pay attention to teacher's knowledge and training specifically towards gender inclusivity issues. For example, some scholars highlights that another important factor might be that teachers treat girls and boys differently, for example by having different academic expectations (Buhl-Wiggers et al., 2021; Jones & Dindia, 2004) Some scholars find that girls perform better at school if they have a female teacher, while there is no effect on boys (Muralidharan & Sheth, 2016) or, instead, a positive effect on boys (Hwang & Fitzpatrick, 2021). Other studies, in turn, find that boys perform better if they have a same-sex teacher (Hoffmann & Oreopoulos, 2009). Contrastingly, Shepherd (2017) finds that having a female teacher with a mathematics background is negatively associated with girls' performance in wealthier schools in South Africa, but not in poorer schools. This suggests that the relationship between teacher gender and student gender is highly context specific.

According to a survey on gender equity in the mathematics and science school curriculum that Moletsane and Reddy (2011) conducted with 735 educators from the provinces of Mpumalanga, KwaZulu-Natal, the Eastern Cape, and Gauteng, most teachers are not familiar with national or international strategies and policies that promote girls' participation and gender equity in mathematics and science. Forty percent of teachers said that textbooks are male-oriented, and 77% of these teachers believed that activities should be used to encourage girls' interest and participation in math and science. They also discovered that about 80% of teachers agreed that different teaching strategies were necessary for teaching mathematics and science. This reveals that to deal with the number of girls in STEM, there is a need to also deal with teacher perceptions and knowledge training specifically about gender inclusivity matter in maths and science.

Through early socialization and cultural influences, it has been ingrained in countless generations that men are good in STEM fields while ladies excel in humanities and the arts. These ideas and perspectives give children the impression that certain fields are beyond the scope of what they can achieve given their gender (Sanders et al., 1997). Even though they are unaware of this behavior, teachers continue to promote gender roles. The more they give duties to boys and girls, the more they do this through their gendered behaviors (Diko, 2007) The gender relations in the

educational system, inside the classroom, and later in higher education are also shaped, according to Morojele (2014), by instructors' gender conceptions. By forcing students to adopt gender-specific social behaviors, teachers impose pressure on their learning. Teachers often tend to create gender norms and stereotypes that they are unaware of (Morojele, 2014).

4.4.2 Teachers teaching style determine comprehension level.

According to the participants some teachers teach the participants in a manner that is understandable. Participants reported to be pleased with this as it made their academic journey within STEM easier. Whilst other teachers did not teach well and that made the learners, experience difficult of STEM subjects and ultimately low performance within STEM subjects and lack of interest to further studies within STEM careers. This theme was captured through the following quotes:

Transcript 8

“From my experience teachers do not really give us enough attention and time, most of us do not even understand the way they teach and they are hard to approach. For me even teachers from other schools are better.”

Transcript 6

“ Okay with pure maths our teacher is very good and teaches well and even provides examples but for Physical science the teacher explains in a way that is un understandable for me. I even need to approach other teacher for me to understand the content.”

Transcript 7

“ I think teacher generally teach well. It is just that we as learners do not listen .”

Transcript 5

“ I would say it is the way the teachers teach . I have had an opportunity to be taught by different teachers and there is teachers who have taught me and I actually understood the content. Some teachers cannot teach which is why the content becomes difficult.”

Transcript 3

“I could say that the teachers did not teach well and I could not understand but as I joined study groups and continue listening to the teacher, then things got better. The time I started I could not hear the teacher but social media apps and study groups helped me to better understand the work.”

Part of literature reveals that STEM curriculum is complex and there is a need for teachers to be well trained in delivering the content. For example (Semela, T, 2010) argues that the manner in which pertinent topics are taught in schools is at least partially to blame for students' low interest in science and their generally unfavorable sentiments. Students' attitudes toward an interest in science are thought to be negatively impacted by science curricula, school textbooks, teachers, and their teaching methods because these elements tend to emphasize science's academic, highly intellectual, and abstract nature and present it in a decontextualized way that is removed from daily life (Semela, T, 2010). However, there are other difficulties that teachers face, which make teaching difficult.

According to (Shenilla, 2020) teachers have a challenge with the multiple changes in the curriculum. The teachers reported that there is increased content and less time for preparation and creative pedagogical input (Shenilla, 2020). Teachers reported that the increased complexities mean that teachers have become more of facilitators than educators. This implies that learners do not get quality educational experience (Shenilla, 2020) Furthermore part of literature shows that South Africa also face a major challenge of having teachers who lack skills and ability, particularly in specialist areas such as mathematics and science (Shenilla, 2020). According to Shenilla (2020) results found that there are some South African teachers who scored as low as 10 % in English and as low as 5 % in mathematics.

Additionally part of literature shows that actual teaching and learning time is lower in schools with high concentrations of students from socio- economically disadvantaged homes (Amnesty, 2020). Learners are normally disruptive, and teachers spend most of the time trying to deal with the disruptiveness in classes rather than teaching (Amnesty, 2020). For example, some students steal from each other, violence in classrooms, lack of concentration from students; some students being pregnant all contribute to classroom disruption. The teachers then must deal with the disruption before teaching.

It is evident that it was not only learners efforts and preparations that determines their experiences and success within STEM subjects but also teachers play a prominent role in how learners navigate STEM subjects. Female learners from public schools reported that good teachers with understandable good teaching methods made their academic journey in STEM easier. Most Learners in STEM in public schools specifically throughout the country often reports how challenging STEM subjects are and this was the case even for the majority participants of this study. It is worth noting again that teachers are guided by a designed

structure of how education should be delivered and which education is delivered. As highlighted earlier that part of the curriculum is highly rigorous highlighting a need for intense support especially to learners who are not English speaking at home.

4.4.3 STEM subjects are difficult.

Majority of the Participants reported that STEM subjects are difficult. Most of the students even reported getting low marks at least once in the STEM academic journey because of the challenging nature of these subjects. As mentioned in the theme above, teachers teaching method was very crucial for the participants and the difficulty of the subjects was measured by how well the teachers teaching that particular subject could explain the information. Moreover, it is important to note that the Black female learner have multi intersecting challenges that are confronting them outside academic pressures which further puts pressure on them in addition to academics. For example, residing in low socio-economic environment which are characterised by poverty, poor service delivery from the government, reproductive challenges and safety further exacerbates their difficulty to perform on their academics. The following these came from analysis to support this theme:

Transcript 3

Yeah, I do pass these subjects but with low levels like 3 or 4 because they are not easy. Yoho I fail to even understand the teacher at times however there is my classmate who is very good with maths and I try to get close to her so I can learn from her."

Transcript 1

"Okay some of the drawings within engineering are complex and sometimes the teachers does not explain well and you do not get enough attention from the teacher since everyone does not understand."

Transcript 8

"When I started these subjects, they were very challenging, but I was told you need to focus if you do not understand then you need to ask for help."

Transcript 5

"I like maths and science but these two are really difficult. I can get level 7 in other subjects but for maths and science I always get lower levels."

Transcript 10

“To be honest Mam I am finding these subjects hard. Even my marks are not pleasing. Personally, I pass but I want to be a radio presenter so based on these subjects I can try to be a land surveyor but my passion lies in radio presenting.”

The perceived difficulty of STEM subjects was discouraging for the learners. However one participant expressed that STEM subjects are not difficult, it is important to note that this particular participant has parents whom are educated and in well-paying employment and were supportive in the educational journey of the participant by providing conducive environment and allowing the participant time even at home to focus on her work.

Transcript 9

“No they are not really difficult, they just need you to be determined, perseverance and put in more effort.”

Class evidently plays a role in how learners experience academics. Participant 9 had parents who are in a middle class and her support from her parents and experience in STEM is good and that positively impacted her studies which is different from other participants who had parents in low income Jobs or are unemployment and have to deal with other challenges such as poverty and other social ills identified above.

This finding is different from existing literature. Existing literature reveal another challenge which is also applicable to these participants learning experience. Part of literature shows that most learners in public school have English as their second language and this means that even before tackling the content of different subjects there is a need to learn English as that is not the language spoken at home. Scholars argue that science literacy requires proficiency in science language. Science in particular use sophisticated and complex words (Webb, 2010). This suggests that there is a need to bridge the gap by firstly teaching the learners the language of teaching vocabulary before the learners could efficiently and independently learn science (Webb, 2010). This is especially more applicable to learners who use a different language from English at home as English particularly in South Africa is the mode of learning.

4.5 Challenges of Black Adolescents girls from Bona Comprehensive School in STEM subjects

Objective three aimed To investigate the challenges experienced by black girls in maths and science from public school in STEM subjects. The themes that emanated from the study are in the table below:

Table 4.4 – Challenges of Black girls from a public school in STEM subjects findings

Main Theme	Participant Quote
Electricity Problem	<i>“It has been 3 years now without electricity in this area, I study during the day and use a torch at night .”</i> <i>“.... We also have the electricity issue. Women have tried to fight for electricity....”</i>
Parents unemployed/ Unemployment serving as motivation.	<i>“My parents are unemployed , they are actually dependant on me to assist at home once I am done with my studies . With these subjects I hope to go to university and get a good paying Job.”</i> <i>“ My parents are unemployed however I know that one day when I am a Doctor , I will be able to assist them .”</i>
Lack of provision for academic needs and unconducive environment	<i>“I stay in a shack.”</i> <i>“My mom is unemployed and occasionally works as a domestic worker.”</i>
Lack of resources at the school for STEM practical learning	Transcript 4 <i>“At school there is no labs for practical’s.”</i> Transcript 8 <i>“I thought we were going to be labs mixing chemicals, but we do not have labs in schools.”</i>
Participants limited knowledge about STEM careers	Transcript 7 <i>“IT and this other profession I forgot its name but it has to do with testing chemicals.”</i> Transcript 6 <i>“Well I did not know what these subjects are about even to begin with, I just heard people</i>

	<i>saying that these subjects are difficult. So, I am not sure which career I want. ”</i>
--	---

Overall, the findings show that the challenges learners experience is at a structural level. These challenges are linked to government lack of service delivery; unemployment; poor education; lack of knowledge and issues around poor housing and infrastructure. These are challenges which are context specific. Part of intersectionality allows researchers to reveal inequalities showing the interplay between the privileged and the unprivileged. In this case we see how participants of this study are unprivileged when compared to learners who attend private schools in higher socio-economic areas. This realities automatically disadvantage the learners schooling in this context .

A body of research contends that systematic, structural, organizational, institutional, cultural, and societal hurdles to equity and inclusion are to blame for the persistent underrepresentation of women in science and medicine in terms of recruitment, advancement, and retention. These obstacles must be located and eliminated by raising awareness of the difficulties and employing evidence-based, data-driven strategies that produce measurable goals and results (Coe et al, 2019).

4.5.1 Electricity Problem

9/10 of the participants reside in Orlando and have all experienced challenges with electricity. Load shedding is a crucial problem that is experienced by South Africa as a whole however in some parts of Orlando there is an additional Electrical infrastructure faults that has led to residents living up to 3 years without electricity. Some of the participants resides in informal settlement which is areas characterised by lack of service delivery like electricity and safe shelter .According to some participants, the electricity issue has made it difficult to do school work at home . Some participants expressed that they had limited time to study which is they could only study during the day and others resorted to using torch at night. The following quotes emanate from the analysis which supports this theme:

Transcript 4

“It has been 3 years now without electricity in this area, I study during the day and use a torch at night.”

Transcript 2

“.....We also have the electricity issue. Women have tried to fight for electricity....”

Transcript 5

“Yes, I do have challenges. For example, at home electricity goes every now and then. When I study late my family would be like switch off the light or when I try to work during the day , the young kids are making noise.”

Additionally the Life Orientation teacher expressed that in winter mornings the girls might be mostly vulnerable when it comes to walking to school in the mornings because of the darkness as street lights are normally off due to load shedding.

LO teacher!

....Maybe also the fact that girls are more vulnerable when it comes to walking to school in the mornings as most of them walk given that some areas are not safe and given the rate of violence , crime and sexual abuse in South Africa.”

The electricity problem is a structural and class issue that further worsen the experience of majority of Black girls in public school who are in pursuit of STEM careers. However the participants also express resilience and keenness in overcoming challenges that they are confronted with so as too successfully perform in these subjects.

Literature reveals that load shedding is greatly affecting learners in public schools. Both in school and at home learning (Pillay, 2022). In the school premises learners spend a lot of time moving around classrooms to have lessons in classes with light (Regan, 2023). Furthermore, teachers cannot use projectors and are forced to establish creative ways of delivering content. Furthermore at home learners need to resort to learning with candles and do not have good work environments and light to efficiently do the school work.

4.5.2 Home circumstances

The participants are confronted with challenges from home of having parents who are unemployed and hopeful that their children would one day get good paying Jobs so as to change the situation at home. This reality act as a pressure to perform and succeed for participants. Career decision making for the participants is also influenced by these home circumstances. This theme was captured using the following quotes:

Transcript 4

“My parents are unemployed , they are actually dependant on me to assist at home once I am done with my studies . With these subjects I hope to go to University and get a good paying Job.”

Transcript 1

“ My parents are unemployed however I know that one day when I am an Engineer , I will be able to assist them ...the situation at home pushed me to choose engineering and yes it has money and could lead to me changing the situation at home.....”

However on the counter some participants expressed that despite situation at home being difficult and them experiencing pressure to get good Jobs to help the families, they parents have been supportive and encouraging in the academic journey:

Transcript 5

....My mom would always encourage that I choose subjects that would help me to be well off in life. She would encourage me to do maths because she saw that maths is something that I love “

Transcript 8

“My Dad told me that this career is rare because a lot of people do not want to study for a long time . They just want to study 3 to 4 years.

Transcript 9

“...At home they are supportive especially during exams , they tell me that when it is exams do not do home chaos and invest more in studying.”

Despite living in poverty stricken conditions, both the learners and parents have portrayed a very resilient mindset and keenness for the learners to be successful in STEM subjects. However Poverty remains a challenge that contributes negatively to the learner’s academic journey.

Part of literature shows that poverty often reduces young girls school attendance(Bysiewics, 2018). Molestane (2015) found that South African women experience the following pressures:

The world over, including in SA, violence and discrimination against women and girls is widespread. Sexual and physical abuse against women occurs every day. Males are the ones who subject them to this cruelty. In South Africa, the gendered division of labor and the low wages placed on women's shoulders are some of the causes that contribute to women's poverty. Women bear the brunt of poverty.

4.5.3 Unconducive environment

Infrastructure and parents' unemployment is the first greatest poverty challenge confronting the participants. The learners also do not have conducive working space at home and also parents being unemployed means that they are not in a position to provide for the academic needs of the participants. This experience further worsen the challenges of the learners in their pursuit to STEM. It is evident that participants of this study face class struggles, gender struggles and race struggles simultaneously which is what makes they experience unique from other cohorts .The quotes to support the housing and unemployment challenge are captured below.

Transcript 3

"I stay in a shack."

Transcript 6

"My mom is unemployed and occasionally work as a domestic worker, this affects me in that sometimes she cannot afford to buy me school things like drawing boards."

Transcript 10

"I stay in an informal settlement, there is a lot of shacks."

Furthermore the neighbourhood that these participants reside in are characterised by social ills such as crime, substance abuse and unemployment. There is no much role models for young STEM aspirant learners, the learners are also not involved in recreational activities. The learner are exposed to not good activities which may influence them into abusing substances or getting involved in crime.

Transcript 1

“In my neighbourhood there is a lot of young people who are not working, and I do not want to be like them.”

Transcript 4

“Well, we have a lot of people who are unemployed, there is criminals and substance abusers.”

Transcript 5

“Okay I reside in a low socio economic neighbourhood, I live in a very small house however”

From the above theme, it is evident that the participants' journey in STEM subjects confronted with hindrances which might explain some of the reasons for why there are few females who remain in STEM specifically Black females from low socio economic class. In addition to the challenges which are specific to the STEM subjects, the participants are also confronted with class and gender and race related challenges. The next challenge that emanated from the analysis was that the participants do not have access to resources and that negatively contributes to the learning journey of the participants.

(Pillay, 2022) Argues, that learners who reside in informal settlements encounter several challenges in their learning. Some of these challenges include being bullied for their background, experiencing challenges with doing school work at home, having to go to school in hunger, having inadequate learning materials. Having to do their school work in neighbourhoods where there is noise and disruptions as the area is often overcrowded.

4.5.4 Lack of resources from the school

Some participants expressed that they expected to work in labs for their practical learning however that is not transpiring because the school does not have functional resources like science labs and computer labs. Furthermore the participant's parents as mentioned above had difficulty in buying stations like drawing boards and big rulers for the participants which is essential stationary needed for learning, again the school does not always provide academic stationary for learners. The following these emanated from the analysis.

Transcript 4

“At school there is no labs for practicals.”

Transcript 8

“I taught we were going to be labs mixing chemicals but we do not have labs in schools.”

Transcript 10

“...Honestly if it was not for my teachers giving us drawing boards, I was going to be in trouble. My mom tried to get me one but it was not the one required at school, even the rulers that we use, it is hard to ask my mom at home to buy me these things. So it makes the learning difficult as these resources are important and needed and even in class teachers think we are not serious when we do not have rulers and boards and teachers end up chasing us out and that really affects learning.”

Transcript 2

“I will be starting to use computer at University if I make it there.”

From the above theme it is evident that there is a great need for Public schools to be provided with resources and have infrastructure and equipment's that will assist with the practical learning of STEM subjects. The last challenge that emanated from the analysis is that Participants had limited knowledge about careers available within STEM. Most participants were familiar with only medicine. This could to some extent explain the skew gender balance within STEM workforce in some profession over the others.

Literature demonstrates how the girls' lack of resources severely hinders them in their academic endeavors. It's crucial to get real-world experience and hands-on training. The more hands-on experiences a girl has while in school, whether in or out of the classroom, the greater her interest in STEM will be. Another important factor is creativity in the classroom. Girls who are interested in STEM are excited by the opportunity to select their own projects or participate in field trips where STEM is brought to life (Microsoft, 2017).

4.5.5 Participants limited knowledge about STEM careers.

Majority of the participants understood the positive benefits associated with being in STEM fields however most of them had limited knowledge on which careers within STEM they could follow. This is due to the fact that there is no career expo that students have attended. The school also does not have information about these careers. Most of the students rely on the internet however even accessing the internet is not easy as most of these students come from

improvised background and can rarely afford to purchase data. The following quotes support this theme:

Transcript 7

“IT and this other profession I forgot its name, but it has to do with testing chemicals.”

Transcript 6

“Well I did not know what these subjects are about even to begin with , I just heard people saying that these subjects are difficult. So I am not sure which career I want.”

Transcript 8

“I know medicine only; I do not know much about others.”

“Well I do not know really about STEM pay , I do not know much about the careers.”

Transcript 10

“... Electrical what what and those that fix train wheels. I actually do not know the names....”

Worth mentioning is that one participant had a very good knowledge about STEM career opportunities which are available. However this particular participants had both parents whom are well educated and in good Jobs which was different from the rest of the participants . This participant also had an opportunity to be taken to a career expo by her mother which gave her more knowledge of these careers. Some of the careers the learner was interested in pursuing are as follows :

Transcript 9

“ Achitecture; Minning engineering , urban and regional planning or Biomedical science.”

This finding highlights a challenge for the participants as there is a need for them to know more about the careers and what they entail. Part of literature shows that girls become more interested in STEM once they're able to conceive what they can do with these subjects, how they can be applied to real-life situations and how relevant they might be relevant to their future(Microsoft, 2017).

Parents educational and employment status plays a role in the learners' knowledge and exposure of opportunities available to them. In this theme we note the class inequality that exists which influence the learners career knowledge and ultimately they retention in STEM fields. The majority of the participants parents are supportive of their children education however do not know the career opportunities available for they children and therefore cannot assist, additionally because of not having good financial means, it is difficult for the parents to

take their children to career expos. The next objective presents and discusses the participants learning support programs.

4.6 Objective four: Learning support programs accorded to Black girls from public schools within STEM subjects

The final objective focused on exploring learning programs that are accorded to Black girls from public schools within STEM subjects.

Table 4.5 – Learning support programs accorded to Black girls from public schools within STEM subjects finding

Main theme	Sub theme	Participants quotes
Extra assistances with studies	Study groups / tutor	<i>Transcript 8</i> <i>“I actually started improving when I joined a study group. My marks really picked, and I was happy about my performance.”</i> <i>Transcript 7</i> <i>“ Yes I have an app in my phone, here is a lady in grade 12 who helps me and my father as well.”</i>
	Extra classes	<i>Transcript 4</i> <i>“Yes, we had extra lessons and also we had a group that was held here at home where we study together and help each other.”</i> <i>Transcript 6</i> <i>“It has been difficult. I was assisted by the fact that I attend extra lessons otherwise it has been difficult.” For maths I got 60% and for physical science I got 50% and I would say I</i>

	<i>am grateful to my maths teacher for giving us extra lessons and releasing us late.”</i>
--	--

4.6.1 Extra assistance with studies

Majority of the participants expressed that as hard as STEM subjects are, but one can be successful when there is extra help. Extra help with studies assisted the participants to cope with the demands of the STEM subjects.

Part of literature argues that extra lessons and tutors in secondary schools are highly effective. Often time the learning time in classrooms in schools is not much to adequately cater for all the needs of all learners individually. Learners are different and have different learning needs and for them to successfully perform there is a need to have other people outside classroom who can assist with the learning or more time learning (Selamat et al., 2012).

Study groups / tutor

Some participants expressed that they grade improved and they started coping with the demands of STEM subjects after joining a study group or having a tutor from someone who has done these subjects helping them after school hours. It is unfortunate that during Covid-19 it was hard for the participants to meet and study together . As highlighted above many participants cannot afford to pay private tutors however they rely on older peers around the community to assist them with the studies, during covid-19 it was hard to even go approach senior peers because of the restrictions implemented during this time. Most parts of the world during this time were moving to virtual interactions. However, in townships like Orlando not everyone can afford data, so interaction was hard and, in this case, greatly impacted on the learning of learners. The following quotes emanated from the analysis.

Transcript 8

“ I actually started improving when I joined a study group. My marks really picked and I was happy about my performance.”

Transcript 7

“Yes I have an app in my phone, here is a lady in grade 12 who helps me and my father as well.”

Transcript 2

“Where I stay , my landlord did these subjects so he helps me with drawing.”

Extra lessons

Other participants expressed that they were part of extra lessons which helped them to cope with the demands of STEM subjects. The following quotes supported this sub themes:

Transcript 1

“.... I have my own extra classes which I take for maths, engineering and technical science.

“Extra classes are very helpful because I get ahead in class. You find that the teacher is doing a topic which I have already covered so it does help.”

Transcript 4

“Yes, we had extra lessons and also we had a group that was held here at home where we study together and help each other.”

Transcript 6

“It has been difficult. I was assisted by the fact that I attend extra lessons otherwise it has been difficult.” For maths I got 60% and for physical science I got 50% and I would say I am grateful to my maths teacher for giving us extra lessons and releasing us late.”

Most of the assistance that participants have is assistance that was outsourced outside school. It is important to note that given that most of the participants come from impoverished background, outsourcing outside help might come with costs which might make it hard for some participants to consistently attend or access that particular assistance. Having assistance of extra lessons for all the subjects with the school for free could lessen the financial burden. The last objective explored motivation the Black girls selected STEM subjects

Part of literature shows that teachers are overwhelmed with the number of learners that they have to teach , this highlights that there is a need for extra assistance. Additionally the content is also difficult and that suggests a need for extra assistance which tutors and extra classes could come in handy. Bad education system in Africa is not a new problem. After Independence era many African countries recognised the important role that science education in particular play in the socio- economic development of any country. Much effort was placed in expanding educational facilities which was good however it compromised the quality of science education (Ogunniyi, 2017). What this implies is that there were now many schools and many people

started attending school however the number of teachers allocated in various facilities did not increase. This meant that teachers now have to teach a large group of learners which to a great extent compromised the quality of education to the learners (Ogunniyi, 2017). Overcrowded classes often have challenges such as disruptions. Learners often also have unique needs and in overcrowded classes teachers cannot identify and intervene effectively to all learners needs.

In United states STEM curriculum as part of a way to increase participation and quality was reformed to be more rigours with an intention to foster higher level skills. In an era where STEM skills have become critical and in high demand, there is a need for training to be intensive and of high quality. However, this attempts were less effective for learners from low income backgrounds because they have other issues to deal with. For example designing the course to be harder increases failure and lack of interest thus this intervention unintentionally maintain inequalities (Eisenhart et al., 2015). For curriculum intervention reform to be effective there is also a need to take into account of other issues that learners are confronted with which directly have an influence in the schoolwork. A holistic intervention possibly might be effective and increase the number of female participations in STEM.

4.7 Objective five: Reasons/motivation the Black girls selected STEM subjects

This objective aimed to understand the reason /motivation the Black girl's selected STEM subjects. The Main themes and some of the participants quotes are recorded in the table below

Table 4.6 – Resons/motivations the Black girls selected STEM subjects findings

Main theme	Participants quotes
Senior peers served as motivation and inspiration for the participants	<i>Transcript 3</i> <i>"I have an older sister who studied the same subjects I am doing now, and she inspires me so much."</i> <i>Transcript 4</i> <i>"My neighbour did these subjects and really motivates me; he is currently at University."</i>
Personal Interest	<i>Transcript 1</i>

	<i>"I would say my school helped me in knowing more about technology and</i>
	<i>engineering. I did not know about it but as time went by I developed an interest as I could see that there is some common things between me and these subjects. I am good at hand working and these subjects need someone who can work with hands . I am also hard working."</i> <i>Transcript 6</i> <i>"I would love to be a scientist which is why I chose these subjects."</i>
Social media Influence	<i>Transcript 3</i> <i>I think mostly it is social media and not my family. In social media I see a lot of posts talking about science and the careers that are various and mostly available including science.</i> <i>Transcript 9</i> <i>"Then they should also put more information on the internet especially social media platform that are used by teenagers so that we can see and be interested because that is where we spend most of our time, on social media."</i>
Careers Interest	<i>" ...Mam I think for me I would not work in STEM because it is something I am not interested in . I actually would love to be a radio presenter."</i> <i>" I chose Maths and science because I want to be a Doctor and being a Doctor requires you to do Maths I envision myself working in a hospital setting</i>

4.7.1 Senior peers served as motivation and inspiration for the participants.

Majority of the participants expressed that they have someone whom they know who did these subjects who served as motivation and inspired them to choose these subjects. It is evident that role models role was effective in attracting Black females into STEM subjects. As highlighted earlier most students do not have exposure and knowledge of what STEM subjects are really about and careers available when one is studying these subjects. Moreover the stereotypes associated with these subjects leads to the subjects being less attractive or desirable to pursue for the participants. The role of having a role model was significant in providing inspiration and confidence for some participants to pursue STEM subjects. The following quotes were used to support this theme:

Transcript 3

“I have an older sister who studied the same subjects I am doing now, and she inspires me so much.”

Transcript 4

“My neighbour did these subjects and really motivates me; he is currently at University.”

Transcript 5

“Yes I would say she is my role model because she got 6 distinctions at school so I am following her footsteps. She is a critical thinker and thinks out of the box so besides the fact that she does mechanical engineering , she is my role model.”

Transcript 10

“When it comes to help Mam , there are these girls which are doing third year at University, they were doing these subjects that I am doing and they really help me with knowledge. These girls are twins, they help me but often they have a lot of work.”

Majority of the participants who are part of STEM have someone whom they know who once did these subjects and helped, knowledge and inspiration to the participants. It is evident from this theme that STEM subjects became attractive to the girls when there is someone they know who has done these subjects before. Some participants expressed that STEM they are in STEM fields because it is a personal or career interest.

This finding is in line with literature. Part of literature emphasise the importance of having specifically female role models in STEM. For example, Microsoft (2017) reveals that lack of female role models in STEM fields is the biggest contributing factor to the decline of females in STEM fields. This implies that there is still much work to be done to change the masculine image in the STEM fields and investing in changes that are appealing, comfortable and attractive for females. One way to achieve this is through visible role models who are specifically females (Microsoft, 2017). This is a common trend in literature. Girls find STEM careers more interesting after the role-model sessions, especially ones that include female role models who are successful in STEM and have broken the glass ceiling (Makarova, aeschlimann & Herzog, 2019).

Additionally, there is various international studied that have explored girls in STEM fields. The perceptions, experiences and challenges. Part of literature shows that girls perceive STEM to be more attractive when there is women. For example Steinke et al, ((2017) conducted a study with a similar interest, the study examined middle age girls and boys attitude towards women who are in STEM careers. Findings revealed that the girls had a positive attitude towards females in STEM than boys (Steinke et at ., 2017) . Furthermore girls viewed women in science careers as equally good as men (Steinke et al, 2017) . The study above argue that young girls perceive STEM careers more attractive when there is female role model who is already within the profession. This indicates a need for female role models in STEM to improve young girls' interest in STEM careers.

4.7.2 Personal Interest

Some of the participants chose STEM fields because it was a personal interest . From young age they have always been interested in activities that are in line with STEM fields and being part of these fields was an alignment to what they personal Interested in . The following quotes support this theme.

Transcript 1

“ I would say my school helped me in knowing more about technology and engineering. I did not know about it but as time went by I developed an interest as I could see that there is some common things between me and these subjects. I am good at hand working and these subjects need someone who can work with hands . I am also hard working. ”

Transcript 4

“Okay so I reside with my grandmother who smokes and drinks . When I was young I would ask at school as too is it good for my grandmother to smoke and drink in her condition. Her condition and behaviour worries me and my wish is for her to live long until I get to be a Dr so I can help her with her condition.

Transcript 5

“Okay growing up I have always loved fixing things and watching shows which show people building things from scratch and I would be like this is what I would do one day and again there is someone who once told me about mechanical engineering and told me what it’s about and I could tell that she is happy with her choice”.

Transcript 9

“Mhm so the only subject I knew was EGD and I knew that you could do them in FET then when I arrived at Bona Comprehensive high school , I was given a list and I saw these combination of subjects and I was so interested and I chose them.

Other participants expressed that they chose these subjects because it was a career interest. They had an interest in STEM careers.

Transcript 3

“I want to become a doctor. I need the subjects for the career that I want to do which is medicine.”

Transcript 6

“I would love to be a scientist which is why I chose these subjects.”

Transcript 7

“My wish is to work in a Job that deals with technology. Like dealing with computers or construction. I actually want to learn how to hack, I want to know everything that has to do with computers.”

From the above theme it is evident that most of the participants had attraction towards STEM. In addition to personal and career interest, social media seems to be a strong influence in the participants choosing to be part of STEM subjects.

4.7.3 social media as a strong Influence

According to some participants social media has played a prominent role in exposing them to STEM fields and influencing them to choose these subjects. The participants of this study are adolescents and most of them spend most time on social media. Information consumed from social media greatly influenced their lives. The following quotes supports this theme “

Transcript 1

“I can say family and social media, because I once did research about engineering subjects as I was looking into these subjects I should take and I noted that engineering have a lot of opportunities and also interviewed a person on Facebook who was doing these subjects at Wits University then I got interested.”

Transcript 3

I think mostly it is social media and not my family. In social media I see a lot of posts talking about science and the careers that are various and mostly available including science.

Transcript 9

“Then they should also put more information on the internet especially social media platform that are used by teenagers so that we can see and be interested because that is where we spend most of our time, on social media.”

It is evident that social media is a strong influence platform and could be used to positively influence female adolescents which information that could help with their retention in STEM fields. The last these outline careers that participants showed Interest in within STEM.

It almost seems like society's storyteller is the television and the media in general. based on Cultivation Theory. The main tenet of the cultivation hypothesis is that people are more inclined to accept the social reality depicted on television if they spend more time "living" in that society. (Javed, 2015).

The media is one form of medium that has a significant impact on society. The media has the power to alter how individuals view the world, how they perceive gender roles, and even how they perceive reality. The way that women in STEM are portrayed in the media is crucial because it has the power to either reinforce or dispel stereotype(Javed, 2015).

4.7.4 Career Interest

Findings show that 40 % of the participants are interested in Medicine. 30% in Engineering. 20 % in Information technology and 1 participant in not interested in STEM.

Table 4.7 – Career Interests

Transcript no	Career Interest
1	“I chose these subjects because I am interested in engineering.”
2	“ STEM careers are good and I am thinking of doing IT since I am doing these subjects.”
3	“ I want to become a Doctor.”
4	“ I chose Maths and science because I want to be a Doctor and being a Doctor requires you to do Maths I envision myself working in a hospital setting.
5	“...I want to do mechanical engineering and I have always been a top student at school in maths and science.”
6	“ I was thinking of being a Doctor .”
7	“ My wish is to work in job that deals with technology. Like dealing with computer or construction.”
8	“I would love to pursue medicine.”

9	“...Between aeronautical engineering, civil engineering or mechanical engineering.”
10	“...Mam I think for me I would not work in STEM because it is something I am not interested in . I actually would love to be a radio presenter.”

It is evident that majority of the participants have an interest in STEM however it is concentrated in Medicine and IT. These are the most common careers known which are good however there is a need for more exposure to the participants of other available STEM careers.

Conversely 1 participant expressed that she is not interested in STEM careers and is more interested in being a radio presenter. It is worth noting that the participant does believe that she has capability to successfully complete her STEM studies however, she is still not interested in pursuing a STEM career

“Personally I pass but I want to be a radio presenter so based on these subjects I can try to be a land surveyor but my passion lies in radio presenting”.

This finding, slightly deviate from literature. While part of literature reveals that females shy away from STEM subjects in high school and interest in STEM careers, this finding reveals that the females are interested in some STEM careers despite its difficult and their perceived ability because of the benefits associated with STEM careers. (Zhao & Perez-Felkner, 2022) conducted a study, which also found similar data. The study explored the link between perceived abilities or academic interest in learners from high school in science and maths by gender and race. The findings revealed that while both mathematics and science perceived ability positively influence STEM major selection, academic interest in these subjects is a weaker predictor (Zhao & Perez-Felkner, 2022). Moreover, across a series of analyses, we observe a significant gender gap—whereby women are less than half as likely to select STEM major (Zhao & Perez-Felkner, 2022). This suggest that there are other factors that girls consider when deciding on academic interest and career interest apart from maths and science perceived ability.

Additionally, this finding adds to literature and is in alignment with existing literature. Socializations play important roles in careers females choose. Rariya (2014) agree that socialization of girls and boys means that they have different life experiences which play out in

education system, both within the school classroom and later in higher education and career selection. An example is that girls might be more inclined to choosing nurturing careers because that is what they believe their gender role allows them to be while boys tend to choose STEM related professions as the nature of these professions are more masculine and fitting to what it means to be a boy (Rarieya,2014).

This chapter presented the findings against the objectives that were set for the study. For each objective, a summary table of themes that emanated from the data was presented. Key supporting quotes were also added in the table. This was followed by explanation and literature integration.

CHAPTER FIVE

MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of main findings

This last chapter provides a summary of the main findings, conclusions and recommendations emanating from this study. The study explored the Perceptions of Black Adolescents female enrolled at Bona Comprehensive School.

It is evident that some of the findings highlighted by the scholars above show that female perceptions of STEM subjects and challenges are not only attributed to gender but there are other identities which makes these challenges and perception unique to Black females only. It is for this reason that several scholars have proposed intersectionality as an effective theoretical framework to use when conducting research that includes participants with multiple identities that affect their life experiences. Example of such scholars include Gaston Gayles et al (2018), Ireland (2018) and Corneille et al , 2019 .

5.2 Perceptions of adolescent females from Bona Comprehensive have of STEM Careers

Findings revealed that participants had positive and negative views regarding STEM careers however predominantly the views are positive. Adolescents' females perceived STEM careers as careers with employment opportunities. Securing employment was a crucial factor when it comes to deciding on which career path to follow hence all the participants are enrolled in STEM subjects because they believed it increase their chances of being marketable and hired. It is important to also note that participants come from dire home situation and in communities where youth is unemployed and most of them aspire to change those circumstances and also create a better life for themselves and perceive STEM as a path that could possibly help them attain their aspirations. It was interesting that within STEM most of the participants found medical science mostly attractive, the reasons presented by the participants was that medical science is safe and has a nurturing element which is why the female adolescents found that particular segment of STEM attractive. The participants also appreciated the fact that STEM careers provide good remuneration when compared to other fields and this was important. Lastly the female Adolescents associated the practical nature of STEM with personal and professional growth and development. For example some participants highlighted how they able to use the building skill gained from construction studies to help around at home physically.

On the contrary participants also had some negative views regarding STEM careers. Participants expressed that in as much as the subjects were practical in nature and that was good however, they felt that some career within STEM were not safe for them particularly because they were female. Example of these included electrical engineering and construction studies. Girls also had very low self-efficacy in their ability to draw which is one of the skills requires to do well in one of the STEM subject they were enrolled in . Particularly EGD subject and lastly most girls also were not fully comfortable with being in STEM because of the hegemonic understanding that STEM careers are suitable for males as opposed to females.

From the above findings it is evident that there is an intersection of gender, race and class identities influencing the participants understanding of self in relation to STEM careers. Participants had a clear understanding of their socio- economic status and most of them were exposed to youth in their communities whom are unemployed and without formal education. This reality for the participants created resilience and a need to work hard and change their circumstances. This prompt a need for institutional transformation in the South African schooling system to help aid the females realise their aspiration and this change should also be in line with the Gender equality aspiration within the STEM domain. Particularly there is a need for the learners to be provided with mentorship, extra lessons, study material ,individual support and exposure to STEM careers as recommended by the participants so as to successes within STEM.

Furthermore South African educational system and society is largely governed by western ideologies of gender. The system and society at large still holds hegemonic gender paradigms based on polarized dualisms. This idea and construct of gender is socialized through generation and generation. Learners in schools still find themselves having to make decisions based on masculinity and femininity depending on the gender category. This also applies to career selection and was evident in the interpretations of the findings. Firstly most females as mentioned identified with nurturing hence majority felt the need to associate with medical science. Most females also associated drawing as a skill for males and were hesitant to even try and lastly most still viewed many STEM careers as masculine. There is a need for South African education system to be Africanised specifically for the LO and history syllabus to have discussion of gender and roles associated to gender in line with decolonization and transforming the gender construct and patriarchal understanding of the categories. African scholars like Ifi Amadiume argue that biological sex did not always correspond to ideological gender in African societies. “Moreover , because gender systems were relatively flexible , it was not unusual for women to play “ male “

role in terms of power and authority over others because roles were not rigidly masculinized or feminized and no stigma was attached to breaking gender rules.”

5.3 Experiences of Black Female Adolescent from Bona Comprehensive School in STEM subjects

Most Participants reported that what influenced them to retain in STEM subjects is having a teacher who encouraged them and affirmed their ability to be successful in completing STEM studies. Most females have fear of STEM subjects because the dominant understanding of STEM subjects being difficult and fear of failure. Participants trusted and found courage in having a teacher who believed in them. The encouragement increased the adolescents’ self-efficacy, participants that this was more felt when the encouragement came from a female teacher.

Whilst there was teachers who had this positive influence on learners self-efficacy, participants also reported that there were some teachers whose teaching style was not good because they failed to comprehend the teachers teachings, some participants highlighted that for them teachers from other schools who occasionally came to teach were more elaborative and had effective teaching methods which enabled the learners to better comprehend the learning material in STEM. Lastly participants reported that STEM subjects are difficult, they mentioned that the nature of STEM subjects was hard and this is the dominant discourse around STEM subjects in many parts of South Africa however it was noted that 1 of the participant held a different view, the participant experienced STEM to be manageable and not difficult. The researcher however noted that this particular participant had different identity from the other participants, while majority of the participants were from low-socio economic class and had parents whom are unemployed this particular participant had parents who were in well-paying Jobs and afforded to better support the participant in her educational journey by outsourcing external educational assistance.

Themes that emanated for this objective evidently exposed the need for competent and more teachers in STEM subjects especially maths and science. Learners in STEM subjects need much attention from teacher as these subjects are labelled to be demanding and hard. For this to happen there is a need for the department of education to deploy more teachers in public schools who specialized in Maths and science. This will lead to less classes and more individual focus on learners and ability to identify how each learner learns best and try to develop learning techniques that accommodate all learners. Having large class rooms is not effective for all learners and place learners in public school at a disadvantage compared to learners in public schools who have less

crowded classes and are able to have the educators attention on a one on one basis. This again expose class in equality and the need to address it for the learners to have a good learning journey which will increase the chances of accessing and qualifying for higher education institutions and ultimately occupying a position in the STEM workforce.

5.4 Challenges of Black adolescents girls from Bona comprehensive school in STEM subjects

Results revealed that the challenges they experiences were mostly outside school but directly and greatly affected they academic journey in all subjects and mostly in STEM as already most participants found STEM subjects to be difficult subjects. Participants expressed that there was an electricity problem in Orlando, both load shedding and faulty infrastructure which lead to them having to resort to using candles when they work from home, additionally It made the Adolescent girls to not feel safe while walking to school in the mornings especially in winter when streets are dark.

Finding also revealed a contradiction of experience that co-existed simultaneously. Most participants expressed that having parents who are unemployed was hard as often there is a number of things in which parents cannot provide for them, both at home and school however that circumstance in as much as it posed a challenge, it also served as a motivation for them to work hard at school in order to change the situation at home. Moreover, the situation at home for some participants was the reason they selected specifically STEM subjects because they believe these subjects have better chances of providing good Job security.

Some participants reported residing in informal settlements which are characterised by social ills such as crime and teenage pregnancy and substance abuse. The participants reported that working on school work at home was hard as the environment is not conducive. Often such areas are overpopulated. Moreover, there is many youth people who are unemployed and involved in crime, abuse substances and teenage/youth pregnancy, there girls expressed the need for role models to inspire them, more specifically role models of females who are in STEM career pursuit or STEM employment.

The participants also expressed that within the school premises there is a need for resources. Lack of resources in public schools made their learning journey difficult. The participants expressed a need for labs within the school to assist with practical learning and also provision of material such as learning boards for subjects like drawing and construction as most parents at home could

not provide these materials for the learners. It was also evident that participants had limited knowledge of STEM careers, this revealed a need for exposure of careers available in STEM which the learners could pursue.

It is also noted that themes that emerged for this objective shows a link on how the intersection of race, gender and class links to institutional injustices and how the position Black females from public schools are in disadvantaged them in their journey to success as per the famous saying that “Education is the key to success”. The school that these participants are enrolled in is located at Orlando a township saturated by public schools, these are schools which are easily accessible to the residents. These schools are low funded as they are fee free and often as mentioned there is lack of resources. Compared to Private schools, it is key to note that learners from public schools are already disadvantaged by virtue of being in public schools and all challenged associated with these schools. This institutional arrangement of geography and the type of schooling systems and services delivery accessible in the area disadvantage learners who resides in low socio-economic areas when compared to learners in private schools in middle and high socio-economic areas. This perpetuates racial inequalities in education and labour market.

5.5 Learning support programs accorded to Black Adolescent girls in Bona Comprehensive within STEM subjects.

Findings revealed that there is limited academic support provided to female learners in STEM subjects. Most participants had to be proactive in searching for extra assistance to aid their learning. Most participants formed study groups and attended extra lessons which are sometimes provided by the school. Participants who could afford, utilized external tutors. Some accessed senior peers whom they know to assist them however there is still a great need for formal extra academic assistance for the participants especially for STEM subjects. In light of the intersecting challenges and suffering that Black female adolescents are subjected too, there is a great need for additional support.

5.6 Reasons / Motivation the Black girls selected STEM subjects

Findings revealed that the following were the reasons why the Adolescents Black girls selected STEM subjects. Some expressed that they heard about the subject from a senior peer whom they know and developed an interest and decided to also pursue the subjects. Other participants expressed that they heard about the subjects from social media and gained an interest which is why they decided to follow these subjects. Other participants expressed that they chose these

subjects because it aligned with their personal interest or career Interest. Most participants mostly were attracted to medicine within STEM careers because of the nurturing element that the profession has.

Power institutions such as media and social media plays a prominent role in influencing young people in all spheres of the life. Whilst there are attempts to portray women in different light, there is so much more that still needs to be done in order to change the masculine image of STEM fields so as to attract more females in STEM.

5.7 Recommendations given by Adolescents Black girls on how the school could better support their studies

All the participants were probed on what recommendations they could give which could better aid them learning. The first recommendation was directed to the STEM sector. The participants expressed that invitation of females especially Black females who are practicing in STEM careers to come and give motivational talks could really be inspirational for them. The other recommendation was directed to the Department of education. The participants expressed the need to be provided with resources for practical learning, example of resources included drawing boards for drawing and construction, labs within the school premise where they can practice since these subjects are not only theory based but also practical in nature. Furthermore, the participants expressed that even buying uniform was not easy and would appreciate support in that regard as well as uniform is expensive and most parents of the participants are not working. The participants also expressed that they need career information sessions about available careers in STEM because this is something that they lacked or Universities to come and talk about tertiary qualifications that they could pursue within STEM. Lastly the participants expressed a great need for more teachers to be employed in STEM subjects, this is due to the fact that available teachers were overworked and it was hard getting an individual attention from the teacher. The participants firmly believed that when there are more teachers, they would be able to attend to them individually and that could better help them in STEM studies.

Additionally, the LO teacher who was the key informant of this study added that provision of sanitary towels would be advantageous to the Adolescent girls and also maybe having a security guard who could be in the school street in the mornings and in the unsafe open area so as to ensure the safety of girls to some extent.

5.8 Conclusion

In line with the equity programme that is aimed at bringing about gender equality in STEM fields which are fields that have been historically male dominated, it was important for the study to have the voice of the often-overlooked cohort which is the Black females from public schools in Soweto in STEM subjects. Since 1994 there has been significant efforts in place directed at better supporting females in schools however there is still some gaps and a need for an intersectional insight when drafting and implementing aid specifically directed at Black female learners. These females are still confronted with experiences that are directly linked to their intersectional identities and suffering. Subtle forms of Racial, Class and gendered oppression still exists and there is a need to dismantle these by having policies which are inclusive of how to also deal with these challenges which ultimately affects the female learners.

There is also a need for educators who are aware of these intersectional suffering so has to better know how to best interact with the Black female learners.

5.9 Recommendation for department of education; STEM sector; department of Higher education and department of infrastructure

Table 5.1- Recommendations

Department of education	STEM sector	Department of higher education	Department of infrastructure
• Provision of resources to aid with practical learning. • Deployment of more STEM educators	• Mentorship from females who are established within the STEM field in South African public schools for young girls.	• Come to public high schools to offer career expo events so as to aid learners in public schools about available careers within	• Ensure that schools have their own electricity lines. • Provision of generators.

who are competent. • Provision of sanitary pads • Deployment of security guards for safety.		STEM domain.	
---	--	--------------	--

5.10 Recommendation for future studies

- There is a need for more studies that utilize intersectionality as a framework or methodology when investigating underrepresentation of women in STEM.
- There is a need for more studies to focus on Adolescent girls when investigating women underrepresentation in STEM as this is the time most learners are selecting their career choice.
- There is a need for more studies that investigate women STEM underrepresentation utilizing a larger sample size.

Reference List

- Adelakun, O. A., O., J. I. (2015). Strategies for enhancing female participation in technical, vocational education and training (TVET) in Nigeria. *Dvances in Social Sciences Research Journal*, 2(4), 110–120.
- Akala, B., & Divala, J. (2016). Gender equity tensions in South Africa's post-apartheid higher education: In defence of differentiation. *South African Journal of Higher Education*, 30(1), 1–16.
- Alcott, B., & Rose, P. (2015). Schools and learning in rural India and Pakistan: Who goes where, and how much are they learning? *Prospects*, 45, 345–363.
- Allmendinger, P. (2016). *Neoliberal spatial governance*. Routledge.
- Alston, M., & Bowles, W. (2003). *Research for caring professions: An introduction to methods*.
- Annamma, S. A., Anyon, Y., Joseph, N. M., Farrar, J., Greer, E., Downing, B., & Simmons, J. (2019). Black girls and school discipline: The complexities of being overrepresented and understudied. *Urban Education*, 54(2), 211–242.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science Aspirations, Capital, and Family Habitus: How Families Shape Children's Engagement and Identification with Science. *American Educational Research Journal*, 49(5), 881–908. <https://doi.org/10.3102/0002831211433290>
- Ardington, C., & Gasealahwe, B. (2012). *Health: Analysis of the NIDS Wave 1 and 2 Datasets*. <http://localhost:8080/handle/11090/173>
- Badri, M., Alnuaimi, A., Mohaidat, J., Al Rashedi, A., Yang, G., & Al Mazroui, K. (2016). My science class and expected career choices—A structural equation model of determinants involving Abu Dhabi high school students. *International Journal of STEM Education*, 3(1), 12. <https://doi.org/10.1186/s40594-016-0045-0>
- Bariham, I., Saviour, A., & Edmond, A. (2017). Education Inequality with Emphasis on School Dropout among Girls in Basic Schools: A Case Study of Tamale Metropolis in Northern Ghana. *Global Journal of Arts, Humanities and Social Scinces*, 5, 8, 24.
- Barwell, R. (2015). *Mathematics education and language diversity*. Springer Science+Business Media, LLC.
- Bass, M., Gonzalez, L. J., Colip, L., Sharon, N., & Conklin, J. (2018). Rethinking gender: The nonbinary approach. *American Journal of Health-System Pharmacy*, 75(22), 1821–1823.
- Bhasin, K. (2006). *What is Patriarchy. Gender Basics*.
- Björkman-Nyqvist, M. (2013). Income shocks and gender gaps in education: Evidence from Uganda. *Journal of Development Economics*, 105, 237–253.
- Bodnar, K., Hofkens, T. L., Wang, M.-T., & Schunn, C. D. (2020). Science identity predicts science career aspiration across gender and race, but especially for boys. *International Journal of Gender, Science and Technology*, 12(1), 32–45.
- Botha, D., & Cronjé, F. (2015). Women in mining: A conceptual framework for gender issues in the South African mining sector. *South African Journal of Labour Relations*, 39(1), 10–37.
- Bourdieu, P. (2004). Structures and the habitus. *Material Culture: Critical Concepts in the Social Sciences*, 1(part 1), 116–177.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. *School Science and Mathematics*, 112(1), 3–11.
- Bryman, A. (2016a). *Social research methods*. Oxford university press.
- Bryman, A. (2016b). *Social research methods*. Oxford university press.
- Buhl-Wiggers, J., Jones, S., & Thornton, R. (2021). Boys lagging: Unpacking gender differences in academic achievement across East Africa. *International Journal of Educational Development*, 83, 102382.
- Bunyi, G. W. (2003). *Interventions that increase enrolment of women in African tertiary institutions*. 23–25.
- Burgess, T., & Mensah, F. M. (2022). “He Probably Won’t Go to College”: Using Storytelling to Illustrate How Black Boys Use Their Science Knowledge to Challenge Deficit-Based Teacher Dispositions. In *Young, Gifted and Missing* (Vol. 25, pp. 37–51). Emerald Publishing Limited.
- Burman, E. (2003). From difference to intersectionality: Challenges and resources. *European Journal of Psychotherapy & Counselling*, 6(4), 293–308.
- Burnet, J. E. (2011). Women have found respect: Gender quotas, symbolic representation, and female empowerment in Rwanda. *Politics & Gender*, 7(3), 303–334.
- Bybee, R. W. (2010). What is STEM education? *Science*, 329(5995), 996–996.
- Bysiewicz, B. (2018, July 14). *Importance of Girls’ Education Around the World*. The Borgen Project. <https://borgenproject.org/importance-of-girls-education/>
- Cantillon, S., Moore, E., & Teasdale, N. (2021). COVID-19 and the Pivotal role of Grandparents: Childcare and income Support in the UK and South Africa. *Feminist Economics*, 27(1–2), 188–202. <https://doi.org/10.1080/13545701.2020.1860246>
- Carnoy, M., & Chisholm, L. (2008). *Towards understanding student academic performance in South Africa: A pilot study of grade 6 mathematics lessons in Gauteng province*.
- Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women’s underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin*, 135(2), 218.
- Chabaya, O., Rembe, S., & Wadesango, N. (2009). The persistence of gender inequality in Zimbabwe: Factors that impede the advancement of women into leadership positions in primary schools. *South African Journal of Education*, 29(2), 235–251.
- Chalim, S., & Anwas, E. O. M. (2018). Peran Orangtua dan Guru dalam Membangun Internet sebagai Sumber Pembelajaran. *Jurnal Penyuluhan*, 14(1), 33–42. <https://doi.org/10.25015/penyuluhan.v14i1.19558>
- Charles Simkins, P., Stephen Rule, D., & Bernstein, A. (2007). *Doubling for Growth Addressing the Maths and Science Challenge in South Africa’s Schools*.

- Cheryan. (2017). *Why are some STEM fields more gender balanced than others?* <https://psycnet.apa.org/fulltext/2016-48466-001.html>
- Cheryan, S., & Plaut, V. C. (2010). Explaining Underrepresentation: A Theory of Precluded Interest. *Sex Roles*, 63(7–8), 475–488. <https://doi.org/10.1007/s11199-010-9835-x>
- Chisholm, L. (2005). The making of South Africa's national curriculum statement. *Journal of Curriculum Studies*, 37(2), 193–208.
- Christie, P., & Collins, C. (1982). Bantu education: Apartheid ideology or labour reproduction? *Comparative Education*, 18(1), 59–75.
- Cleaver, F., & Kimmel, M. (2002). *Masculinities matter! Men, gender and development*. Zed Books.
- Coe, I. R., Wiley, R., & Bekker, L.-G. (2019). Organisational best practices towards gender equality in science and medicine. *The Lancet*, 393(10171), 587–593.
- Cole, M. (2009). Critical race theory comes to the UK: A Marxist response. *Ethnicities*, 9(2), 246–269.
- Corneille, M., Lee, A., Allen, S., Cannady, J., & Guess, A. (2019). Barriers to the advancement of women of color faculty in STEM: The need for promoting equity using an intersectional framework. *Equality, Diversity and Inclusion: An International Journal*, 38(3), 328–348.
- Cousins, A. (2007). Gender inclusivity in secondary chemistry: A study of male and female participation in secondary school chemistry. *International Journal of Science Education*, 29(6), 711–730.
- Crenshaw, K. W. (2013). Mapping the margins: Intersectionality, identity politics, and violence against women of color. In *The public nature of private violence* (pp. 93–118). Routledge.
- Creswell, J. W. (2003). A framework for design. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 2003, 9–11.
- Creswell, J. W. (2009). Mapping the field of mixed methods research. *Journal of Mixed Methods Research*, 3(2), 95–108.
- David, E. J. R. (2013). *Internalized oppression: The psychology of marginalized groups*. Springer Publishing Company.
- Davis, K. L. (2003). Teaching for gender equity in physical education: A review of the literature. *Women in Sport and Physical Activity Journal*, 12(2), 55–81.
- De Wet, J., & Erasmus, Z. (2005). Towards rigour in qualitative analysis. *Qualitative Research Journal*, 5(1), 27–40.
- Dhamoon, R. K. (2011). Considerations on mainstreaming intersectionality. *Political Research Quarterly*, 64(1), 230–243.
- Diko, N. (2007). Changes and continuities: Implementation of gender equality in a South African high school. *Africa Today*, 54(1), 107–116.
- Dlodlo, N., & Beyers, R. N. (2009). *Experiences of South African high school girls in a fab lab environment*.
- Duflo, E. (2012). Women Empowerment and Economic Development. *Journal of Economic Literature*, 50(4), 1051–1079. <https://doi.org/10.1257/jel.50.4.1051>

- Eccles, J. S., & Wang, M.-T. (2016). What motivates females and males to pursue careers in mathematics and science? *International Journal of Behavioral Development*, 40(2), 100–106. <https://doi.org/10.1177/0165025415616201>
- Eckstein, K. (2012). *How to measure gender equality*. 7th European Conference on Gender Equality in Higher Education. Bergen.
- Eguchi, A. (2017). Bringing robotics in classrooms. *Robotics in STEM Education: Redesigning the Learning Experience*, 3–31.
- Eisenhart, M., Weis, L., Allen, C. D., Cipollone, K., Stich, A., & Dominguez, R. (2015). High school opportunities for STEM: Comparing inclusive STEM-focused and comprehensive high schools in two US cities. *Journal of Research in Science Teaching*, 52(6), 763–789.
- Farmer, H. S., Wardrop, J. L., Anderson, M. Z., & Risinger, R. (1995). Women's career choices: Focus on science, math, and technology careers. *Journal of Counseling Psychology*, 42(2), 155.
- Fiske, E. B., & Ladd, H. F. (2004). Balancing public and private resources for basic education: School fees in post-apartheid South Africa. *Changing Class: Education and Social Change in Post-Apartheid South Africa*, 57–88.
- Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of Mathematics Interest in Adolescence: Influences of Gender, Family, and School Context. *Journal of Research on Adolescence*, 20(2), 507–537. <https://doi.org/10.1111/j.1532-7795.2010.00645.x>
- Gaitskell, D. (1979). 'Christian compounds for girls': Church hostels for African women in Johannesburg, 1907–1970. *Journal of Southern African Studies*, 6(1), 44–69.
- Garson, P. (1996). *Empowering the marginalised*.
- Gasant, M. (2011). *Gender and perceptions of science and science education: A case study in mitchells plain*.
- Gasennelwe, P. (2019). *Understanding the township property market. The case of Orlando east, diepkloof and orlando west, Soweto*.
- Gaston Gayles, J., & Smith, K. N. (2018). Advancing theoretical frameworks for intersectional research on women in STEM. *New Directions for Institutional Research*, 2018(179), 27–43.
- Ghebru, S., & Ogunniyi, M. (2017). Pre-service science teachers' understanding of argumentation. *African Journal of Research in Mathematics, Science and Technology Education*, 21(1), 49–60.
- Gierl, M. J., Bisanz, J., Bisanz, G. L., & Boughton, K. A. (2003). Identifying content and cognitive skills that produce gender differences in mathematics: A demonstration of the multidimensionality based DIF analysis paradigm. *Journal of Educational Measurement*, 40(4), 281–306.
- Gilbert, J. (2001). Science and its 'other': Looking underneath 'woman' and 'science' for new directions in research on gender and science education. *Gender and Education*, 13(3), 291–305.
- Gill, B., Borden, B. C., & Hallgren, K. (2014). A conceptual framework for data-driven decision making. *Final Report of Research Conducted by Mathematica Policy Research, Princeton, Submitted to Bill & Melinda Gates Foundation, Seattle, WA*.

- Gouws, A. (2012). Social welfare and religion in Paarl through the lens of a feminist ethic of care. *Welfare, Religion and Gender in Post-Apartheid South Africa: Constructing a South-North Dialogue*, 269–284.
- Greeff, P., Roos, V., Vorster, C., & Van Romburgh, J. (2011). Applying mixed methods to assess the value of forensic interviewing from a person-centred approach. *Acta Criminologica: African Journal of Criminology & Victimology*, 24(2), 94–111.
- Guetterman, T. (2015). *Descriptions of sampling practices within five approaches to qualitative research in education and the health sciences*.
- HACIOĞLU, Y., & GÜLHAN, F. (2021). The effects of STEM education on the students' critical thinking skills and STEM perceptions. *Journal of Education in Science Environment and Health*, 7(2), 139–155.
- HACIOĞLU, Y., YAMAK, H., & KAVAK, N. (2017). The opinions of prospective science teachers regarding STEM education: The engineering design-based science education. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 37(2), 649–684.
- Hakura, M. D., Hussain, M. M., Newiak, M. M., Thakoor, V., & Yang, M. F. (2016). *Inequality, gender gaps and economic growth: Comparative evidence for sub-Saharan Africa*. International Monetary Fund.
- Hanna, G., & De Villiers, M. (2012). *Proof and proving in mathematics education: The 19th ICMI study*. Springer Nature.
- Hawkins, R. L., & Kim, E. J. (2012). The socio-economic empowerment assessment: Addressing poverty and economic distress in clients. *Clinical Social Work Journal*, 40, 194–202.
- Hoffmann, F., & Oreopoulos, P. (2009). A professor like me the influence of instructor gender on college achievement. *Journal of Human Resources*, 44(2), 479–494.
- Hwang, N., & Fitzpatrick, B. (2021). Student–teacher gender matching and academic achievement. *AERA Open*, 7, 23328584211040056.
- Idahosa, G. E., & Mkhize, Z. (2021). Intersectional Experiences of Black South African Female Doctoral Students in STEM: Participation, Success and Retention. *Agenda*, 35(2), 110–122. <https://doi.org/10.1080/10130950.2021.1919533>
- Ikechukwu-Ilomuanya, A. B., Iwuagwu, L. C., & Obidoa, M. A. (2020). SOCIO-ECONOMIC STATUS AND PEER PRESSURE AS PREDICTORS OF FEMALE STUDENT'S DROPOUT OF SECONDARY SCHOOL IN KOGI-EAST SENATORIAL DISTRICT OF KOGI STATE. *Journal of the Nigerian Council of Educational Psychologists*, 12(1).
- Ireland, D. T., Freeman, K. E., Winston-Proctor, C. E., DeLaine, K. D., McDonald Lowe, S., & Woodson, K. M. (2018). (Un) hidden figures: A synthesis of research examining the intersectional experiences of Black women and girls in STEM education. *Review of Research in Education*, 42(1), 226–254.
- Isdale, K., Reddy, V., Juan, A., & Arends, F. (2017). *TIMSS 2015 Grade 5 national report: Understanding mathematics achievement amongst Grade 5 learners in South Africa: Nurturing green shoots*.
- Javed, A. (2015). *The Media, the Women and STEM Fields*.
- Jewkes, R., Morrell, R., & Christofides, N. (2009). Empowering teenagers to prevent pregnancy: Lessons from South Africa. *Culture, Health & Sexuality*. <https://doi.org/10.1080/13691050902846452>

- Jiyane, N., & Jiyane, G. (2019). The role of the school library in the career choices of grade 12 female learners: A case study of a rural secondary school in KwaZulu-Natal, South Africa. *Innovation: Journal of Appropriate Librarianship and Information Work in Southern Africa*, 2019(59), 56–75.
- Jones, S. M., & Dindia, K. (2004). A meta-analytic perspective on sex equity in the classroom. *Review of Educational Research*, 74(4), 443–471.
- Juan, A., Hannan, S., & Namome, C. (2018). I believe I can do science: Self-efficacy and science achievement of Grade 9 students in South Africa. *South African Journal of Science*, 114(7–8), 48–54.
- Kahn, S., & Ginther, D. (2017). *Women and STEM* (No. w23525; p. w23525). National Bureau of Economic Research. <https://doi.org/10.3386/w23525>
- Kallaway, P. (1984). *Apartheid and education: The education of black South Africans*. Ravan Press of South Africa.
- Karatopouzis, A., Voinov, A. A., Kubiszewski, I., Taghikhah, F., Costanza, R., & Kenny, D. (2022). Estimating the Genuine Progress Indicator before and during the COVID pandemic in Australia. *Ecological Indicators*, 141, 109025. <https://doi.org/10.1016/j.ecolind.2022.109025>
- Ketenci, T., Leroux, A., & Renken, M. (2020). Beyond Student Factors: A Study of the Impact on STEM Career Attainment. *Journal for STEM Education Research*, 3(3), 368–386. <https://doi.org/10.1007/s41979-020-00037-9>
- Khuluvhe, M., & Negogogo, V. (2021). *Gender parity in post-school education and training opportunities*.
- Klosters, D. (2017). *World economic forum annual meeting 2017*.
- Kornegay, E. (2021). *National gender policy framework for women's empowerment and gender equality*. The office on the status of women.
- Langen, A. van, & Dekkers, H. (2005). Cross-national differences in participating in tertiary science, technology, engineering and mathematics education. *Comparative Education*, 41(3), 329–350.
- Lapadat, J. C., & Lindsay, A. C. (1999). Transcription in research and practice: From standardization of technique to interpretive positionings. *Qualitative Inquiry*, 5(1), 64–86.
- Legard, R., Keegan, & Ward. (2003). *A guide for social science research students and researchers*. Sage.
- Leibowitz, B., & Bozalek, V. (2014). Access to higher education in South Africa. *Widening Participation and Lifelong Learning*, 16(1), 91–109.
- Lesseig, K., Slavitt, D., & Nelson, T. H. (2017). Jumping on the STEM bandwagon: How middle grades students and teachers can benefit from STEM experiences. *Middle School Journal*, 48(3), 15–24. <https://doi.org/10.1080/00940771.2017.1297663>
- Letseka, M., Bantwini, B., & King-McKenzie, E. (2012). Public-union sector politics and the crisis of education in South Africa. *Creative Education*, 3(07), 1197.
- Lockheed, M., & Gorman, K. (1989). *Socio-cultural factors affecting science learning and attitudes*.
- Longman, C., & De Graeve, K. (2014). From happy to critical diversity: Intersectionality as a paradigm for gender and diversity research. *DiGeSt. Journal of Diversity and Gender Studies*, 1(1), 33–39.
- Madlala, N. (Director). (2022, May 12). No electricity for nine months in Orlando east, soweto. In *ENCA*.

- Magaldi, D., & Berler, M. (2020). Semi-structured interviews. *Encyclopedia of Personality and Individual Differences*, 4825–4830.
- Makarova, E., Aeschlimann, B., & Herzog, W. (2019). *The gender gap in STEM fields: The impact of the gender stereotype of math and science on secondary students' career aspirations*. 60.
- Makunga, N. (2020). We need more women in STEM careers. *Mail & Gaurdian*.
- Maluleka. (2019). *The marginalised group indicator* (No. 03-19-05). Statistic South Africa.
- Maluleka, R. (2021). *Work Programme 2021/2022*. Statistic South Africa.
- Martineau, R. (1997). Women and education in South Africa: Factors influencing women's educational progress and their entry into traditionally male-dominated fields. *Journal of Negro Education*, 383–395.
- Martiniello, G. (2012). *The accumulation of dispossession and resistance in Northern Uganda*. 17–19.
- Masanja, V. (2010). *Increasing women's participation in science, mathematics and technology education and employment in africa*.
- Master, A., & Meltzoff, A. N. (2016). Building bridges between psychological science and education: Cultural stereotypes, STEM, and equity. *Prospects*, 46(2), 215–234.
- Mathur-Helm, B. (2005). Equal opportunity and affirmative action for South African women: A benefit or barrier? *Women in Management Review*, 20(1), 56–71.
- Mazama, A., & Lundy, G. (2015). African American homeschooling and the quest for a quality education. *Education and Urban Society*, 47(2), 160–181.
- Mbedzi. (2018). *Bona comprehensive school, orlando soweto Johannesburg Information*.
- McLaughlin, H. (2007). Ethical issues in the involvement of young service users in research. *Ethics and Social Welfare*, 1(2), 176–193.
- Mdlolo, N. G. (2017). *Exploring physical science teachers' views and understandings about gender equity in science education in high schools in KwaZulu-Natal Province of South Africa*. [Thesis]. <https://researchspace.ukzn.ac.za/handle/10413/14483>
- Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.
- Metz, S. (2018). *Editor's Corner: Understanding STEM*.
- Microsoft. (2017). *Microsoft 2017 women in SCIENCE TECHNOLOGY - Google Search*. https://www.google.com/search?q=Microsoft+2017+women+in+SCIENCE+TECHNOLOGY+&ei=fHzWY7qyE4W68gKOiKlw&ved=0ahUKEwi64P_n-Oz8AhUFnVwKHQ6ECAYQ4dUDCA8&uact=5&oq=Microsoft+2017+women+in+SCIENCE+TECHNOLOGY+&gs_lcp=Cgxnd3Mtd2l6LXNlcuAQAZoKCAAQRxDWBBCwAzoNCAAQjwEQ6gIQtAIYAToNCC4QjwEQ6gIQtAIYAToFCAAQkQI6CwguEIMBELEDEIAEOggILhCxAXCDAToICAAQgAQQsQM6CwgAEIAEELEDEIMBOggIABCxAXCDAToLCC4QgAQQsQM6CwgAEIEM6CwguELEDEIMBENQCOg4ILhCABBCxAXDHARDRAzoECAAQZoKCC4QsQM6CwgEQQzoHCC4Q1AIQZoHCAAQsQM6CwgEQQzoNCC4QsQM6CwgEQ1AIQZoNCC4QsQM6CwgEQ0QM6CwgEQQzoNCAAQgAQQsQM6CwgEQCjoKCAAQgAQQsQM6CwgEQFCAAQgAQ6BgAEBYQHjoJCAAQFhAeEPEEOgQIIRAVOgcIIRCgARAKSgQIQRgASgQIRhgAUK8FWOTVAWCO2wFoBXABeAWAAeghiAHg-AGSAQ0yLTlyLjlxLjMuOS00mAEAoAEBSAEKyAEIwAEB2gEECAEYCg&scient=gws-wiz-serp

- Miller, C. C. (2015). The search for the best estimate of the transgender population. *The New York Times*, 6.
- Mlambo, Y. A. (2021). 10 Black African Women in Engineering Higher Education in South Africa. *May Effect Greater Gender Equity in STEM at a Global Level.*—David M. Post, Professor of Education at Pennsylvania State University and Past-President of Comparative and International Education Society, USA “A Talented Group of Emerging Scholars Have Spearheaded a Timely Contribu, 158.
- Mojapelo, J. (2019). THE DETERIORATING STATE OF MUNICIPAL FINANCES POINTS TO AN URGENT NEED FOR PROFESSIONALISATION. *Accountancy SA, Journal, Electronic*, 28–29.
- Moletsane, R., Mitchell, C., & Lewin, T. (2015). Gender violence, teenage pregnancy and gender equity policy in South Africa: Privileging the voices of women and girls through participatory visual methods. In *Gender Violence in Poverty Contexts*. Routledge.
- Morojele, P. (2014). Towards gender equitable schooling: Insights from rural teachers’ voice in the local context. *Studies of Tribes and Tribals*, 12(1), 103–111.
- Morris, S. M. (2012). Black Girls Are from the Future: Afrofuturist Feminism in Octavia E. Butler’s “Fledgling”. *Women’s Studies Quarterly*, 40(3/4), 146–166.
- Morrison, B. B., Quinn, B., Bradley, S., Buffardi, K., Harrington, B., Hu, H. H., Kallia, M., McNeill, F., Ola, O., & Parker, M. C. (2021). *Chronicling the Evidence for Broadening Participation*. 601–602.
- Mphambukeli, T. N. (2019). Social justice in planning: Access to adequate drinking water and contested belonging in emerging communities of Mangaung in post-apartheid South Africa. *African Renaissance*, 16(Special 2), 51.
- Mqadi, N. (2020). *Experiences of the teaching and learning of history in a context of rurality: A case study of a South African rural high school*.
- Mugaga, R., & Akumu, T. (2010). School dropout rates for teenage girls worrying education. *Observer*.
- Muhammad, G. E. (2012). Creating spaces for Black adolescent girls to “write it out!” *Journal of Adolescent & Adult Literacy*, 56(3), 203–211.
- Muralidharan, K., & Sheth, K. (2016). Bridging education gender gaps in developing countries: The role of female teachers. *Journal of Human Resources*, 51(2), 269–297.
- Musetsho, M., Isac, N., & Dobrin, C. (2021). Gender Inequalities in the Workplace: Case Study of South Africa. *Management and Economics Review*, 6(1), 70–81.
- Mutarubukwa, P. A., & Mazana, M. Y. (2017). *Stigmatization Among Female Students in Natural Science Related Courses: A Case of Technical and Vocational Education Training Institutions in Tanzania*.
- Mvulane, S., & Dlabzana, M. (2021). *Setting a 25 year vision and agenda to advance women’s equality ; growth and development*.
- Nash, J. C. (2008). Re-thinking intersectionality. *Feminist Review*, 89(1), 1–15.
- Neuman, D. (2014). Qualitative research in educational communications and technology: A brief introduction to principles and procedures. *Journal of Computing in Higher Education*, 26, 69–86.
- Nguyen, U., & Riegle-Crumb, C. (2021). Who is a scientist? The relationship between counter-stereotypical beliefs about scientists and the STEM major intentions of Black and Latinx male and

female students. *International Journal of STEM Education*, 8(1), 28. <https://doi.org/10.1186/s40594-021-00288-x>

OECD. (2017). *The Pursuit of Gender Equality: An Uphill Battle*. Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/social-issues-migration-health/the-pursuit-of-gender-equality_9789264281318-en

Olabode A. Onile-ere, Oghenevwairhe P. Efekemo, & Angela O. Eni. (2021). Science, technology, engineering and mathematics enrollment patterns and factors influencing the choice to study science among female secondary students in Nigeria. *African Journals of Reproductive Health*, 25(5), 95.

Pandey, S. C., & Patnaik, S. (2014). Establishing reliability and validity in qualitative inquiry: A critical examination. *Jharkhand Journal of Development and Management Studies*, 12(1), 5743–5753.

Patrick, A., & Borrego, M. (2016). *A Review of the Literature Relevant to Engineering Identity*. American Society for Engineering Education Annual Conference,

PCAST. (2010). Prepare and inspire: K-12 Education in STEM (science, technology, engineering and mathematics). *Presidents Council of Advisors on Science and Technology*.

Pereznieto, P., & Taylor, G. (2014). A review of approaches and methods to measure economic empowerment of women and girls. *Gender & Development*, 22(2), 233–251.

Pillay, K. (2022). *Load shedding continues to disrupt education during the school holidays*.

Plasman, J. S., Gottfried, M., & Williams, D. (2021). Following in their Footsteps: The Relationship Between Parent STEM Occupation and Student STEM Coursetaking in High School. *Journal for STEM Education Research*, 4(1), 27–46. <https://doi.org/10.1007/s41979-020-00040-0>

Pols, T. (2019). *STEM Education: Science, Technology, Engineering , Maths for South African underprivileged schools*.

Preda, C. (2015). *Report on the Annual Report on Human Rights and Democracy in the World 2014 and the European Union's policy on the matter*. European Parliament.

R Moletsen, V. R. (2011). *Women's participation in industrial science, engineering and technology*. Human science research council.

Rankin, Y. A., & Thomas, J. O. (2020). *The intersectional experiences of Black women in computing*. 199–205.

Rarieya, J., Sanger, N., & Moolman, B. (2014). *Gender inequalities in education in South Africa*.

Rattan, A., Savani, K., Komarraju, M., Morrison, M. M., Boggs, C., & Ambady, N. (2018). Meta-lay theories of scientific potential drive underrepresented students' sense of belonging to science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology*, 115(1), 54–75. <https://doi.org/10.1037/pspi0000130>

Regan, V. (2023). *State of darkness: Eskom's ability to provide power is steadily worsening, CSIR stats show*.

Rubin, A., & Babbie, E. (2001). *Research methods for social work* Belmont. CA: Wadsworth.

Rudduck, J., & Flutter, J. (2000). Pupil participation and pupil perspective: 'carving a new order of experience'. *Cambridge Journal of Education*, 30(1), 75–89.

- Ruiters, M. (2008). Gender and inflation targeting in South Africa: Brief feminist notes. *Agenda*, 22(78), 4–12.
- Sanders, W. L., Wright, S. P., & Horn, S. P. (1997). Teacher and classroom context effects on student achievement: Implications for teacher evaluation. *Journal of Personnel Evaluation in Education*, 11, 57–67.
- Saunders, B., Kitzinger, J., & Kitzinger, C. (2015). Anonymising interview data: Challenges and compromise in practice. *Qualitative Research*, 15(5), 616–632.
- Selamat, A., Esa, A., Salleh, B. M., & Baba, I. (2012). Extra classes effectiveness in smart secondary school, Johore, Malaysia. *Asian Social Science*, 8(1), 111–118.
- Semela, T. (2010). Who is joining physics and why? Factors influencing the choice of physics among Ethiopian university students. *International Journal of Environmental and Science Education*, 5(3), 319–340.
- Seo, E., Shen, Y., & Alfaro, E. C. (2019). Adolescents' Beliefs about Math Ability and Their Relations to STEM Career Attainment: Joint Consideration of Race/ethnicity and Gender. *Journal of Youth and Adolescence*, 48(2), 306–325. <https://doi.org/10.1007/s10964-018-0911-9>
- Shenilla. (2020, February). South Africa: Broken and unequal education perpetuating poverty and inequality. *Amnesty Internationals*.
- Shepherd, D. L. (2017). Gender, self-concept and mathematics and science performance of South African Grade 9 students. *Stellenbosch. South Africa*.
- Shields, S. A. (2008). Gender: An intersectionality perspective. *Sex Roles*, 59, 301–311.
- Shirdel, K., Fakhri, M. K., & Mirzaeyan, B. (2018). The structural model of educational self-regulation based on learning strategies and attributional styles by the mediator of achievement motivation among secondary high school students in Sari in 2017-2018. *International Clinical Neuroscience Journal*, 5(3), 92.
- Siann, G., & Callaghan, M. (2001). Choices and barriers: Factors influencing women's choice of higher education in science, engineering and technology. *Journal of Further and Higher Education*, 25(1), 85–95.
- Siriwardhane, P., & Khan, T. (2021a). The gendered nature of the risk factors of the COVID-19 pandemic and gender equality: A literature review from a vulnerability perspective. *Sustainability*, 13(23), 13375.
- Siriwardhane, P., & Khan, T. (2021b). The Gendered Nature of the Risk Factors of the COVID-19 Pandemic and Gender Equality: A Literature Review from a Vulnerability Perspective. *Sustainability*, 13(23), Article 23. <https://doi.org/10.3390/su132313375>
- Spaull, N., & Makaluza, N. (2019). Girls Do Better: The pro-female gender gap in learning outcomes in South Africa 1995–2018. *Agenda*, 33(4), 11–28.
- Steinke, J. (2017). Adolescent girls' STEM identity formation and media images of STEM professionals: Considering the influence of contextual cues. *Frontiers in Psychology*, 716.
- Steyn, M., Burnett, S., & Ndzwayiba, N. (2021). *Differences at Work: Practicing Critical Diversity Literacy*. Common Ground Research Networks.
- Strydom, P. (2011). *Contemporary critical theory and methodology*. Routledge.

- Sultana, A. (2010). Patriarchy and women's subordination: A theoretical analysis. *Arts Faculty Journal*, 1–18.
- Tamale, S. (2020). *Decolonization and Afro-feminism*. Journal of Contemporary African Studies.
- Tinker, I. (1990). *Persistent inequalities: Women and world development*.
- UNICEF. (2006). *The state of the world's children 2007: Women and children: The double dividend of gender equality* (Vol. 7). Unicef.
- UNICEF. (2021, June 1). *UNICEF Annual Report 2020*. <https://www.unicef.org/reports/unicef-annual-report-2020>
- Unterhalter, E., Wolpe, H., & Botha, T. (1992). *Education in a future South Africa: Policy issues for transformation*. Africa Research and Publications.
- Vainionpää, F., Kinnula, M., Iivari, N., & Molin-Juustila, T. (2019). *GIRLS'CHOICE-WHY WON'T THEY PICK IT?*
- Valla, J. M., & Williams, W. (2012). INCREASING ACHIEVEMENT AND HIGHER-EDUCATION REPRESENTATION OF UNDER-REPRESENTED GROUPS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS FIELDS: A REVIEW OF CURRENT K-12 INTERVENTION PROGRAMS. *Journal of Women and Minorities in Science and Engineering*, 18(1).
<https://doi.org/10.1615/JWomenMinorScienEng.2012002908>
- Van Broekhuizen, H., & Spaull, N. (2017). The 'Martha Effect': The compounding female advantage in South African higher education. *Stellenbosch: Stellenbosch Economic Working Papers*.
- Walker, J. L. (2012). Research column. The use of saturation in qualitative research. *Canadian Journal of Cardiovascular Nursing*, 22(2).
- Webb, P. (2010). Response—Science Education: Learn by Listening. *Science*, 329(5993), 749–749.
- Westheimer, J. (2017). Education that matters. *Canadian Journal of Education/Revue Canadienne de l'éducation*, 40(2), 1–15.
- Wiebe, E., Unfried, A., & Faber, M. (2018). The Relationship of STEM Attitudes and Career Interest. *EURASIA Journal of Mathematics, Science and Technology Education*, 14(10).
https://digitalcommons.csumb.edu/math_fac/3
- Wilder, G. Z., & Powell, K. (1989). *Sex differences in test performance: A survey of literature*.
- Wong, B. (2015). Careers “From” but not “in” science: Why are aspirations to be a scientist challenging for minority ethnic students? *Journal of Research in Science Teaching*, 52(7), 979–1002.
- Writer, S. (2020). *Call for SAs 50 most inspiring women in STEM*.
- Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford publications.
- Zawistowska, A. (2017). *Gender differences in high-stakes maths testing. Findings from Poland*.
- Zhao, T., & Perez-Felkner, L. (2022). Perceived abilities or academic interests? Longitudinal high school science and mathematics effects on postsecondary STEM outcomes by gender and race. *International Journal of STEM Education*, 9(1), 42. <https://doi.org/10.1186/s40594-022-00356-w>

Zungu, L. (2011). *Women in the South African mining industry: An occupational health and safety perspective*.

Zuze, T. L., & Beku, U. (2019). Gender inequalities in south African schools: New complexities. *South African Schooling: The Enigma of Inequality: A Study of the Present Situation and Future Possibilities*, 225–241.

APPENDIX A



Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Sikhosana

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: H21/03/25

PROJECT TITLE

Exploring the perceptions of adolescents Black female learners in public schools of STEM careers in terms of its significance towards individual economic empowerment, A case study of a High school in Soweto , South Africa

INVESTIGATOR(S)

Ms H Sikhosana

SCHOOL/DEPARTMENT

Human and Community Development/

DATE CONSIDERED

19 March 2021

DECISION OF THE COMMITTEE

Approved
Risk Level: Low

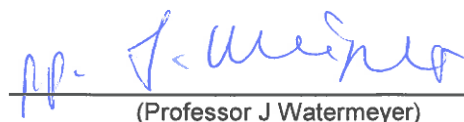
EXPIRY DATE

30 January 2025

DATE

14 April 2022

CHAIRPERSON


(Professor J Watermeyer)

cc: Supervisor : Dr T Nkomo

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I agree to completion of a regular progress report. For Minimal and Low studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**


Signature

_____/_____/_____
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES



BONA COMPREHENSIVE SCHOOL

5603 Mediate Street, Orlando East 1604

Tel: (010) 023 3872 / Fax (011) 935 1609

Email : bona_compschool@gmail.com

Principal: Ms. M.G. Mokumo

Vision

To provide quality education which promotes a dynamic citizen for Socio-economic development and to provide access to quality life-long learning opportunities.

Prof Thobeka Nkomo

Student Supervisor: Social Work

School of Human and Community Development

Wits University

Permission to conduct research at Bona Comprehensive School

Ms Hope Sikhosana, student number 1380367 has been granted permission to conduct her research study at our school with adolescents' Black Female learners in Science, Technology and Mathematics subjects. Provided the university has granted her permission to conduct this study.

Should any queries emerge, please feel free to contact our office

Yours in Tlrisano

M.G. Mokumo

Principal

Date 13 April 2022

BONA COMP SCHOOL

Box 60, Orlando 1604
Tel: 011 935 2641 Mobile: 082 583 3511

2022-04-13

bona_compschool@gmail.com
"LESEDI KHANYA"
Gauteng Department of Education

APPENDIX C

RESEARCHER NAME: HOPE SIKHOSANA



LEARNERS PARTICIPANT INFORMATION SHEET

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

Research interview participation request

Good day,

My name is Hope Sikhosana and I am a post graduate student registered for the degree MA in Social Work at the University of the Witwatersrand. As part of the requirements for the degree, I am conducting research regarding perceptions of adolescent's Black female learners of STEM careers. It is hoped that the study could share insight on the experiences; challenges and perceptions Black female learners have or experience in maths and science.

Furthermore, the study would shed some light on the effectiveness of the learning programs accorded to learners to help them with maths and science according to their perspective. By understanding these the department of education could establish interventions that truly talk to what Black female learners struggle with and possibly increase the number of females in STEM careers and ultimately increase the number of women who will be economically empowered.

As a Black female learner in a high school located at Soweto you are ideally positioned to contribute to my study. I therefore invite you to participate in my study. If you accept my invitation your

participation would be entirely voluntary, and you are free to withdraw at anytime without penalty. There are no consequences or personal benefits of participating in the study. If you agree to take part, I will arrange to interview you through a telephone interview. The interview will last approximately one hour. If you choose to participate, you may withdraw from the study at any time and you may also refuse to answer any question that you feel uncomfortable with answering. If you decide to participate, I will ask your permission to record the interview. No-one other than the researcher and the supervisor will have access to the phone calls recording. The recordings will be sent to my personal computer which only myself have access too, and will be deleted from the phone used to record. The recordings in my computer will be kept for a period of two years following any publications or for six years if no publication emanate from the study. A copy of your interview transcript without any identifying information will be stored permanently in the locked cupboard and may be used for future research.

Please be assured that personal particulars such as your name and age will be kept confidential and no identifying information will be included in the final research report. The results of the research may also be used for academic purposes (including books, journals and conference proceedings) and a summary of findings will be made available to participants, on request.

Please contact me on (+ 277 3 6146274) or ([1389367 @students.wits.ac.za](mailto:1389367@students.wits.ac.za)), or my supervisor, (Prof Thobeka Nkomo) or ([thobeka.nkomo @wits.ac.za](mailto:thobeka.nkomo@wits.ac.za)) if you have any questions regarding my study. We shall answer them to the best of our ability. If you have any complaints about the study, please contact Human Research Ethics Committee (Non- Medical) Contact details: Chairperson: Jasper. Knight @wits.ac.za or (Tel 011717-6508) or Shaun. Schoeman @wits.ac.za (tel – 011717-1408)

Thank you for taking the time to consider participating in the study. Yours

Sincerely

APPENDIX D

RESEARCHER NAME: HOPE SIKHOSANA



PARENTS PARTICIPANT INFORMATION SHEET

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

Research interview participation request

Good day,

My name is Hope Sikhosana and I am a post graduate student registered for the degree MA in Social Work at the University of the Witwatersrand. As part of the requirements for the degree, I am conducting research regarding perceptions of adolescent's Black female learners of STEM careers. It is hoped that the study could share insight on the experiences; challenges and perceptions Black female learners have or experience in maths and science. Furthermore, the study would shed some light on the effectiveness of the learning programs accorded to learners to help them with maths and science according to their perspective. By understanding these the department of education could establish interventions that truly talk to what Black female learners struggle with and possibly increase the number of females in STEM careers and ultimately increase the number of women who will be economically empowered.

As a parent of a Black female learner at Bona Comprehensive high school, your child is ideally positioned to contribute to my study. I therefore would like to invite your child to participate in my study. If you accept my invitation your child participation would be entirely voluntary, and your child is free to withdraw at any time without penalty. There are no consequences or personal benefits of participating in the study. If you agree to allow your

child to take part, I will arrange to interview your child through a telephone interview. The interview will last approximately one hour. If you choose to allow your child to participate, your child may withdraw from the study at any time and may also refuse to answer any question that they feel uncomfortable with answering. If you decide to allow your child to participate, I will ask your child's permission to record the interview. No-one other than the researcher and the supervisor will have access to the phone calls recording. The recordings will be sent to my personal computer which only myself have access to, and will be deleted from the phone used to record. The recordings in my computer will be kept for a period of two years following any publications or for six years if no publication emanate from the study. A copy of your interview transcript without any identifying information will be stored permanently in the locked cupboard and may be used for future research.

Please be assured that personal particulars such as your child's name and age will be kept confidential and no identifying information will be included in the final research report. The results of the research may also be used for academic purposes (including books, journals and conference proceedings) and a summary of findings will be made available to participants, on request.

Please contact me on (+ 277 3 6146274) or ([1389367 @students.wits.ac.za](mailto:1389367@students.wits.ac.za)), or my supervisor, (Prof Thobeka Nkomo) or ([thobeka.nkomo @wits.ac.za](mailto:thobeka.nkomo@wits.ac.za)) if you have any questions regarding my study. We shall answer them to the best of our ability. If you have any complaints about the study, please contact Human Research Ethics Committee (Non- Medical) Contact details: Chairperson: Jasper. Knight @wits.ac.za or (Tel 011717-6508) or Shaun. Schoeman @wits.ac.za (tel – 011717-1408)

Thank you for taking the time to consider participating in the study.

Yours Sincerely

Hope Sikhosana

APPENDIX E

RESEARCHER NAME: HOPE SIKHOSANA



SOCIAL WORK
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)



LO TEACHER PARTICIPANT INFORMATION SHEET

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

Research interview participation request

Good day,

My name is Hope Sikhosana and I am a post graduate student registered for the degree MA in Social Work at the University of the Witwatersrand. As part of the requirements for the degree, I am conducting research regarding perceptions of adolescent's Black female learners of STEM careers. It is hoped that the study could share insight on the experiences; challenges and perceptions Black female learners have or experience in maths and science. Furthermore, the study would shed some light on the effectiveness of the learning programs accorded to learners to help them with maths and science according to their perspective. By understanding these the department of education could establish interventions that truly talk to what Black female learners struggle with and possibly increase the number of females in STEM careers and ultimately increase the number of women who will be economically empowered.

As a Life Orientation teacher at Bona Comprehensive high school , you are ideally positioned to contribute to my study. I therefore would like to invite you to participate in my study. If you accept my invitation your participation would be entirely voluntary, and you are free to withdraw at any time without penalty. There are no consequences or personal benefits of participating in the study. If you agree to take part, I will arrange to interview you through

a telephone interview. The interview will last approximately one hour. If you choose to participate, you may withdraw from the study at any time and may also refuse to answer any question that you feel uncomfortable with answering. If you decide to agree to participate, I will ask your permission to record the interview. No-one other than the researcher and the supervisor will have access to the phone calls recording. The recordings will be sent to my personal computer which only myself have access too, and will be deleted from the phone used to record. The recordings in my computer will be kept for a period of two years following any publications or for six years if no publication emanate from the study. A copy of your interview transcript without any identifying information will be stored permanently in the secure private personal computer and may be used for future research.

Please be assured that personal particulars such as your name and age will be kept confidential and no identifying information will be included in the final research report. The results of the research may also be used for academic purposes (including books, journals and conference proceedings) and a summary of findings will be made available to participants, on request.

Please contact me on (+ 277 3 6146274) or ([1389367 @students.wits.ac.za](mailto:1389367@students.wits.ac.za)), or my supervisor, (Prof Thobeka Nkomo) or ([thobeka.nkomo @wits.ac.za](mailto:thobeka.nkomo@wits.ac.za)) if you have any questions regarding my study . We shall answer them to the best of our ability. If you have any complaints about the study, please contact Human Research Ethics Committee (Non- Medical) Contact details: Chairperson: Jasper. Knight @wits.ac.za or (Tel 011717-6508) or Shaun. Schoeman @wits.ac.za (tel – 011717-1408)

Thank you for taking the time to consider participating in the study.

Yours Sincerely

Hope Sikhosana

APPENDIX F

RESEARCHER NAME : HOPE SIKHOSANA



SOCIAL WORK
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)



CONSENT FORM FOR PARENTS : PARTICIPTION IN THE STUDY

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

I hereby consent to allow my child to participate in the research study and consent to recording of the interview .The purpose and procedures of the study have been explained to me. I understand that:

- My child's participation in this study is voluntary and he/she may withdraw from the study without being disadvantaged in any way.
- My child may choose not to answer any specific questions asked if he/she do not wish to do so.
- There are no foreseeable benefits or particular risks associated with participation in this study.
- My child's identity will be kept strictly confidential, and any information that may identify him/her will be removed from the interview transcript.
- A copy of my child's interview transcript without any identifying information will be stored permanently in a locked cupboard and may be used for future research.
- I understand that my child's responses will be used in the write up of an Masters research report and may also be presented in conferences, published in book chapters, journal articles or books.

Name of Parent : _____

Signature:

Date: _____

Researcher signature:

Date:

APPENDIX G

RESEACHER NAME: HOPE SIKHOSANA



SOCIAL WORK
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)



ASSENT FORM FOR PARTICIPTION IN THE STUDY

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

I hereby consent to participate in the research study. The purpose and procedures of the study have been explained to me. I understand that:

- My participation in this study is voluntary and I may withdraw from the study without being disadvantaged in any way.
- I may choose not to answer any specific questions asked if I do not wish to do so.
- There are no foreseeable benefits or risks associated with participation in this study.
- My identity will be kept strictly confidential, and any information that may identify me, will be removed from the interview transcript.
- A copy of my interview transcript without any identifying information will be stored permanently in a locked cupboard and may be used for future research.
- I understand that my responses will be used in the write up of an honours research report and may also be presented in conferences, published in book chapters, journal articles or books.

Name of Participant: _____

Signature

Date: _____

Researcher signature:

Date:

APPENDIX H

RESEARCHER NAME: HOPE SIKHOSANA



SOCIAL WORK
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)



CONSENT FORM FOR LO TEACHER: PARTICIPTION IN THE STUDY

Exploring the perceptions of adolescent's Black female learners in public school of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto

I hereby consent to participate in the research study and consent to recording of the interview. The purpose and procedures of the study have been explained to me. I understand that:

- My participation in this study is voluntary and I may withdraw from the study without being disadvantaged in any way.
- I may choose not to answer any specific questions asked if he/she do not wish to do so.
- There are no foreseeable benefits or particular risks associated with participation in this study.
- My identity will be kept strictly confidential, and any information that may identify him/her will be removed from the interview transcript.
- A copy of my interview transcript without any identifying information will be stored permanently in a locked cupboard and may be used for future research.
- I understand that my child's responses will be used in the write up of an Masters research report and may also be presented in conferences, published in book chapters, journal articles or books.

Name of Teacher : _____

Signature:

Date: _____

Researcher Signature:

Date:

Appendix I

PROPOSED INTERVIEW SCHEDULE FOR LEARNERS

Exploring the perception of adolescent's Black female learners in public schools of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto.

Demographic information

- Age:
 - Gender:
 - Ethnicity:
 - Religion:
 - Grade:
 - School:
1. Why did you choose to do maths and science?
 2. What is your opinion of STEM careers and why?
 3. What career do you want to follow and why?
 4. What has been your challenges in maths and science?
 5. Is there any extra help that you get to help you with maths and science? If yes to what extend is the help effective?
 6. Do you feel disadvantaged in any way by being a female in maths and science?
 7. What recommendations would you give to your school to help you to survive in maths and science?
 8. What do you think is the reason that contribute to a few numbers of girls in maths and science careers and subjects?
 9. Do you think STEM careers pay good money, elaborate your answer?
 10. Do you think you being in one of them might help you to be economically empowered, elaborate on your answer?
 11. Do you have any questions regarding the study?

Thank you for taking part.

Appendix J

PROPOSED INTERVIEW SCHEDULE FOR TEACHER

Exploring the perception of adolescent's Black female learners in public schools of STEM careers in terms of its significance towards individual economic empowerment, Johannesburg, a case study of a high school in Soweto.

Demographic information

- Age:
 - Gender:
 - Ethnicity:
 - Religion:
 - Grade you teach:
 - School:
1. What do you think about the number of female learners within maths and science ?
 2. What are some of the observed challenges that females learners within the school face?
 3. Do you think maths and science careers have a potential to economically empower Black females ? Elaborate on your response.
 4. What do you think is the reason behind most females choosing not to go for maths and science?
 5. What do you think are some of the social factors that contribute to the female learners choice or choosing to go for maths and science or not?
 6. Do you think the school/department is doing enough to assist female learners within Maths and science ?
 7. Do you think the LO syllabus should be inclusive of content that encourages females to go for maths and science given our history of gender inequality within these fields? Please elaborate on your answer
 8. What recommendations would you give to the school to help female learners within maths and science?

Thank you for taking part.

