



**EXPLORING PHYSICAL SCIENCE TEACHERS' VIEWS AND UNDERSTANDINGS
ABOUT GENDER EQUITY IN SCIENCE EDUCATION IN HIGH SCHOOLS IN
KWAZULU-NATAL PROVINCE OF SOUTH AFRICA**

By

NOKUTHULA GOODNESS MDLOLO

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School of Education

University of KwaZulu-Natal, Pietermaritzburg

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ABSTRACT

Gender inequity is a violation of basic human rights. Governments and a number of organisations have realised that focussing on the education of females is the most effective approach to eradicate global poverty. While the literature reveals that most gender studies have focussed on learner performance, teacher-learner interactions, post school science education, HIV and violence to achieve equity, this study acknowledges the substantial role science teachers can play in achieving equity in science education.

The objectives of this study were to explore Physical Science teachers' gendered experiences, and their views and beliefs about gender equity in science education. The study adopted a qualitative approach and was located within the interpretive paradigm. Purposive sampling was used to recruit male and female Physical Science teachers in the Umgungundlovu district. Data was collected through semi-structured individual in-depth interviews with six Physical Science teachers. The study draws from feminist theory in an attempt to explain teachers' experiences of gender in their personal and professional lives. Thematic content analysis was used to analyse data from interviews.

The findings revealed that Physical Science teachers understand the concept of gender equity in general, but had little understanding of gender equity issues in science education. However, they believed that women are still under-represented and marginalised in science-related fields, and that gender inequity still exists in science education. Furthermore, the findings indicated that the gender-related experiences of Physical Science teachers emanated from social exchanges (socialisation) as part of families, communities and schools as children, learners and professionals. Gender-related experiences included unfair treatment and unequal access to opportunities and resources from these agents of socialisation. Socialisation plays a huge role in shaping and providing a person with the necessary knowledge and skills to become an active

member within a given community. The findings also indicated that parents and teachers promote gender inequity through their gendered and stereotyped behaviour and roles. This study concluded that there is a need to sensitize Physical Science teachers on gender equity issues in science education, and to equip them with gender-inclusive teaching strategies that would encourage both boys and girls to pursue science-related careers.

Keywords: gender equity, gender equality, science education, gender and science, science teachers and gender.

DECLARATION

Submitted in fulfilment / partial fulfilment of the requirements for the degree of Masters in Education, in the Graduate Programme in the College of Humanities, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

I, Nokuthula Goodness Mdlolo, student number: 208523148, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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_____	_____	_____
Student Name	Date	Signature

<u>Dr Nonhlanhla Mthiyane</u>	_____	_____
Name of Supervisor	Date	Signature

<u>Dr Jaqueline Naidoo</u>	_____	_____
Name of Co-Supervisor	Date	Signature

SPECIAL DEDICATION

This thesis is dedicated to my late father, Mr Bheki Petros Mdlolo who taught me about the importance of education at a very young age. I will be forever grateful for all your teachings. I am deeply indebted to you for teaching me about the meaning of determination and perseverance. Your words of wisdom and encouragement are a true source of inspiration. You have grown, nurtured my inner strength and moulded me into a strong and independent person I am today. I want to thank you with these words:

“Out of nothing, something comes out”

I am certain you would be proud of my academic achievements. (May Your Soul Rest in Peace)

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LIST OF ABBREVIATIONS

AAUW	American Association of University Women
BBBEE	Broad-Based Black Economic Empowerment Framework
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
DBE	Department of Basic Education
DOE	Department of Education
EFA	Education for All
FET	Education and Training
GEM	Girls' Education Movement
GETT	Gender Equity Task Team
GPI	Gender Parity Index
HEMIS	Higher Education Information Management System
HOD	Head of Department
HSRC	Human Sciences Research Council
INSET	In Service Education Training.
LTSM	learner teacher support material
MDG	Millennium Development Goal
NCS	National Senior Certificate
NQF	National Qualifications Framework
PED	Provincial Education Departments
RSA	Republic of South Africa
SET	Science, Engineering and Technology
SGB	school governing body
SMT	Science, Mathematics and Technology
Stats SA	Statistics South Africa
STEM	Science, Technology, Engineering and Mathematics
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Emergency Fund

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

The aim of this chapter is to describe the focus and purpose of the research. Firstly, a description of the background and the context for the study is provided. The rationale and problem statement of the study, the methodological approach and definition of key concepts follows thereafter. The chapter ends with a short summary of the structure of the thesis and the contents of each of the chapters.

1.2 Background and context of the study

“If you educate a man, you educate an individual, but if you educate a woman, you educate a nation,” so says an old adage (Nyamidie, 1999).

In his State of the Nation address in Parliament in 1994, the former President of South Africa Nelson Mandela said that “freedom cannot be achieved unless women have been emancipated from all forms of oppression” (Prinsloo, 2006, p. 305). Gender equality and gender equity are attributes of a democratic nation and of global interest (Moletsane & Reddy, 2011a). In most of the developing countries, gender inequity and inequality in the sciences and Mathematics is prevalent. The United Nations (UN) as an important goal (UNICEF, 2006; UN, 2000) has emphasised gender equality in education. Females’ education is not just a human right but also important for the development and growth of the economy of the country (Oxfam; Klasen, as cited in Shabaya & Konadu-Agyemang, 2004). The economic growth and development of the country depend on the usage of the resources and the capabilities of its citizens. Most organisations and governments have come to realise that investing in the education of women is the best way to eradicate global poverty (Jackson, 2009). Therefore, if women can be educated and empowered, the whole world will change for the better.

As South Africa transformed into a democratic dispensation in 1994, the new Constitution laid the foundations for a democratic society based on equality for all its citizens. The Equality clause in

Section 9(3) in the Constitution of the Republic of South Africa that bans discrimination inspired me to explore Physical Science teachers' views and understandings of gender equity in science education. Gender equality in education is a complex subject and cannot be easily defined, even though it has been discussed in most national and international policies and declarations (Morrell, Epstein, Unterhalter, Bhana, & Moletsane, 2009). South Africa is amongst the countries that prioritises gender equity and equality. In this study, the concepts of 'equity' and 'equality' are used interchangeably because one leads to another, i.e. equity leads to equality. This will be the same for the terms 'inequity' and 'inequality'. This means that in order to achieve equality amongst human beings, there should be equity. These terms are defined in Chapter 2 for a better understanding of the meaning.

In South Africa, gender inequality is a violation of human rights and as a result, there are policies and legislations that aim to ensure gender equality for every individual. Women and girls' rights are protected by the Constitution of the Republic of South Africa of 1996. The South African Schools Act of 1996 is legislation aimed at ensuring that all learners receive respect, education and dignity equally. In addition to the legislation, there are several policy frameworks purporting to promote the participation of women in education, including Mathematics, Science, Engineering and Technology. For example, there is gender machinery that is composed of structures in and outside government whose purpose is to achieve equity for females in all life dimensions (James, Smith, Roodt, Primo, & Evans, 2006). There is also gender policy endorsed by the Cabinet in 2000 for women empowerment and gender equity and National Gender and Race Equity Policy for Science, Engineering and Technology (SET) (James, Smith, Roodt, Primo, & Evans, 2006). The Gender Equity Unit within the Department of Basic Education endeavours to ensure that boys and girls have equal opportunities in basic education; girls remain in schools; girls participate in Physical Science and Mathematics; girls are protected against violence; curriculum is unbiased; and equal advancement in all career fields is promoted (Moloi & Chetty, 2011).

Despite global and South African efforts to achieve gender equality and equity, there is still serious disparity in education between men, women, boys and girls worldwide. One of the leading areas where there is alarming gender inequality is Sciences, Engineering and Technology (SET)

education (Dlodlo & Beyers, 2009; Moletsane & Reddy, 2011a). Although South Africa has made progress in gender equality in education since the attainment of democracy in 1994 (especially in the enrolment of females), in other areas such as Sciences, Engineering and Technology (SET), girls and women continue to be underrepresented and marginalised (Shabaya & Konadu-Agyemang, 2004; Diko, 2007; Dlodlo & Beyers, 2009; Masanja, 2010). Moloi and Chetty (2011) revealed that even though South Africa has made great strides in maintaining the gender balance in education for both boys and girls, there are still gender inequalities in management positions, female participation and learner achievements in schools. Despite the fact that the South African Department of Basic Education (DBE) together with Provincial Education Departments (PED) have developed and implemented a number of policies to promote gender parity at all levels of education, gender equity in Mathematics and Physical Sciences is still not at the expected level. For example, in 2012, of the 122 620 Grade 12 females who wrote NCS Mathematics examinations 60 322 (49%) passed, of the 103 254 males 61 648 (60%) passed; and of 94 279 females who wrote Physical Sciences 55 575 (59%) passed, and out of 84 915 males 54 343 (64%) passed (Moloi & Chetty, 2011). According to Statistics South Africa (Stats SA, 2014), in South Africa females constitute more than half of the population, yet they only represent a fraction of the population of professionals in Science, Technology, Engineering and Mathematics (Greve, 2013). Furthermore, Mlambo-Ngcuka (as cited in Adichie, 2016) states that although women and girls are more than half of the world population, they are affected more by poverty, climate change, food insecurity, lack of health care and economic crises as compared to men and boys. Baird (1997) claims that these imbalances seem to be partly caused by the socialisation of girls by teachers, parents and peers. Moreover, several factors seem to cause these disparities including socio-cultural norms and beliefs (Chikunda, 2010; Morojele, 2013, 2014).

In recent years, there has been great concern with regard to the state of gender equity in science education in South Africa. This concern emanated from the Education for All (EFA) goals and Millennium Development Goal 3 to address the issue of gender disparity and women empowerment in education at all levels by 2015. In comparison to other countries, females in South African high schools are less advanced than females in other countries on different aspects such as academic performance and achievement, empowerment and access to equal opportunities

as their male counterparts (Dlodlo & Beyers, 2009). Teachers frequently have different expectations and attitudes towards boys and girls in classrooms on the basis that boys need careers and girls need husbands (Kabeer, 2010). They expect girls to do well in the social sciences and humanities subjects, whereas they expect boys to excel in Physical Sciences and Mathematics. This is what Friedrich, Flunger, Nagengast, Jonkmann, and Trautwein (2015, p.1) refer to this as the “teacher expectancy effect” on learners. On the other hand, students want to please their teachers and they end up excelling in the areas where they know that they will receive positive feedback from their teachers. This results in girls viewing Physical Science, Mathematics and other science fields as masculine and ending up pursuing other careers such as teaching and nursing (Kabeer, 2010). The curriculum also encourages gender inequity in high schools (Kabeer, 2010). The curriculum and pedagogy do not accommodate the girls in the fields of sciences and Mathematics (Brotman & Moore, 2008). Likewise, Moletsane and Reddy (2011a) argue that the Mathematics and science curriculum is not friendly to girls. This means that the science curriculum does not acknowledge girls. The science content, and the way it is designed, is not accommodating to females. For example, few topics focus on feminine activities. Correspondingly, Kabeer (2010) claims that the gender stereotypes in the curriculum depict girls as submissive while portraying boys as strong and ambitious.

Culture and society also promote gender inequities because children are taught at very young age that they are different (Morojele, 2013). Children acquire these social characteristics during socialisation as a member of a community. The social inequities are also reproduced within school interactions (Kabeer, 2010). This results in both boys and girls having different socio-economic goals, including career goals. Physical Science teachers could contribute significantly to addressing the gender inequity in Science education if they have positive views and understanding of gender equity issues in science education.

However, the South African Physical Science teachers’ views and understanding of these gender equity issues appear largely unknown, especially in high schools. Most of the research is conducted on learners, gender, science, learner performance, HIV, and AIDS. For example, Dlodlo and

Beyers (2009) conducted a study on the experiences of South African high school girls in a Fab Lab environment. Monyemore (2012) conducted a study on teachers' views on gender equity in primary schools in Diepkloof, Soweto. Morojele's (2014) study focused on Gender Equitable Schooling: Insights from Rural Teachers' Voice in the Local Context at primary schools. Morrell, Epstein, Bhana, Moletsane, and Unterhalter (2009) conducted a study about gender equality in South African schools during the HIV and AIDS epidemic, to name a few.

1.3 Rationale and problem statement

This research is important to the researcher as a Black female educator because in South Africa and other developing countries, gender inequity still prevails in schools, tertiary institutions and workplaces. As a result, females and women end up being under-represented in science careers and other related fields. As a female educator, gender inequity in science education affected me both personally and professionally. With own experiences of science classrooms, gendered treatment and gender stereotypes which affect both learning and performance of female learners. Masculinities and femininities are reconstructed through the teacher-learner interactions during teaching and learning. It is this differential treatment that is of interest because of its influence throughout my career. This started while I was a learner both in primary and high school and throughout tertiary education. The way I was taught during Physical Sciences and Mathematics lessons as a learner had an impact on my personal and professional life. As females in our class, we used to sit and watch the teacher with the boys doing experiments. Our job was to clean the equipment and copy notes from the board. Even at tertiary level, the same thing continued when the lecturer would rely on male students with the experiments and other difficult tasks. This had affected me in such a way that there are some experiments that I cannot conduct on my own. I am relying on my male colleague and the mobile lab for these experiments.

Personally, I ended up having a low self-esteem and lost self-confidence to continue pursuing my Engineering career. I did not believe that I would cope with my studies because I know that Engineering is a very demanding career, and you need to have a very strong background especially in Mathematics and Physical Sciences. Professionally, as an educator I sometimes use the same methods that were used by my science teachers. I am also expecting boys to perform better than

girls, despite the fact that some girls are doing well. So conducting this research would help me to listen to and understand the views of other Physical Science teachers regarding their experiences of gender equity from childhood, education and the workplace.

James et al. (2006) argue that there is little evidence of teacher education training on gender awareness teaching and how to deliver a curriculum while also delivering a “gender-aware education devoid of sexist notions of what is appropriate behaviour”, including school subjects and careers choices for both boys and girls (p. 21). Schools and teachers are seen as agents who can transform societal practices and beliefs that still promote gender inequities in schools and communities (Monyemore, 2012). Morojele (2013, 2014) argues that learners bring their beliefs about gender into classrooms and schools. They also expect to be treated the same way that their parents treat one another. For example, the father is the head of the family so they believe that a boy is supposed to be treated the same way in the classroom. Female learners and teachers perpetuate gender inequity in schools by allowing male learners the opportunity to lead in classrooms even if female learners are more capable. Moletsane and Reddy (2011a) assert that boys grow up in male dominated environments and as a result, they tend to dominate in the classrooms.

The education system has an important role to play in addressing gender inequity. Physical Science teachers are key stakeholders in the teaching and learning of science and as such, their positive views and understandings of gender equity in science education could be utilised to address gender inequity in this field. On the other hand, if the teachers have negative views and lack understandings of the matter, a lot of effort would be required to change such stereotypes.

This study aims to explore Physical Science teachers’ views, beliefs, experiences and understandings of gender equity in science education through their own lens. Should it be found from the study that teachers are aware and have a significant understanding of gender equity in science education, they could be supported to contribute to addressing gender inequity in science education. For example, training and development could be provided to enable them to change

their teaching practices that perpetuate gender inequities in high schools. Physical Science teachers could also be capacitated to improve their relationships and the way they interact with learners in science classrooms such that they would not have gender bias. This work will also contribute to supporting the relevant policy designers to examine whether the gender equity policies that are in place have any influence on Physical Science teachers in addressing gender equity in science classrooms and in schools in general. In addition, relevant stakeholders could use the knowledge generated to develop strategies, professional development initiatives and intervention programmes that can effectively address the gender issues in science education.

Crotty (2008) and Huang and Fraser (2009) claim that there is little research conducted on teachers and learners' perspectives inside science classrooms and in the school environment. Nevertheless, this seems not to be the problem in South Africa. Research has been conducted on learners and teachers as mentioned earlier. Diko (2007) and Crotty (2008) further advocate that investigating views through the lenses of teachers might provide deeper insights into addressing gender awareness teaching, thus there is a need for further research. The current research on how Physical Science teachers' professional and personal identities intersect with their perspectives is limited (Bianchini, Cavazos, & Helms, 2000).

There is still a need for research to find ways of effective gender awareness teaching in high schools, especially in the sciences. The research on narrative data that focuses on teachers' lived experiences or realities from their own perspectives is under-researched (Essien-Wood, 2010). There is also a need for research on how education leaders can effectively address educators' resistance to and lack of information about gender-inclusive strategies (Crotty, 2008). The literature reviewed indicates that there are few studies that have been conducted in South Africa to explore the views and understanding of teachers about gender equity and equality in education in general. The few studies in South Africa which explored this subject were mostly conducted with primary school teachers. With regard to the views and understanding of South African science teachers about gender equity and equality in the study of science subjects, it appears that very few studies have been conducted. Thus, studies are needed on this subject. In South Africa, the Matric

results are critical in academic and professional careers. Therefore, the lower performance of girls in Mathematics and Physical Science negatively affects their participation in the sciences at tertiary level and in the science-based employment sectors. According to Mayer-Smith, Pedretti and Woodrow (as cited in Dlodlo & Beyers, 2009), good teaching practices and social environments encourage a gender inclusive learning atmosphere. This promotes equal participation between males and females.

1.4 Focus of the study

The focus of this study was on Physical Science teachers' views, beliefs, experiences and understandings of gender equity in science education in UMgungundlovu District, KwaZulu-Natal province. In order to engage Physical Sciences teachers, it is of paramount importance to understand their views, experiences, and beliefs about gender equity in science education. Understanding their views is crucial because schools in particular can be spaces where gender inequities can be challenged. Physical Science teachers are key stakeholders in the teaching and learning of sciences. As such, their positive views and understandings of gender equity in science education could be utilised to address gender inequity in this field.

This study aimed to achieve the following objectives:

1. To explore Physical Science teachers' understandings of gender equity in science education.
2. To examine Physical Science teachers' personal and professional experiences of gender equity in science education.
3. To explore Physical Science teachers' views and beliefs about gender equity in science education.

The main objective of the study was to explore the views and understandings of gender equity in science education of Physical Science teachers in high schools from their own lived experiences, both personally and professionally. Another objective of the study was to examine their

perceptions and to understand how their personal and professional experiences influenced their views and beliefs about gender equity in science education.

1.5 Research questions

This study sought to address the main issues emerging from the following questions:

Main research question

What are Physical Science teachers' views, understandings, beliefs and experiences about gender equity in science education in the Umgungundlovu District, KwaZulu-Natal province of South Africa?

Critical questions

1. How do Physical Science teachers understand gender equity in science education?
2. What are Physical Science teachers' personal and professional experiences of gender equity in science education?
3. What are Physical Science teachers' views and beliefs about gender equity in science education?

1.6 Methodological Approach

This study is located within the interpretive paradigm and used a qualitative approach. Data was collected using semi-structured interviews. This study applied the Purposive sampling method. The study has focused on six Physical Science teachers, using individual interviews to explore their views and understandings about gender equity in science education. The methodological approach and research processes are discussed in more detail and depth in Chapter Three.

1.7 The structure of the thesis

Chapter 1: Introduction -The aim of this chapter is to describe the focus and the purpose of the study. Firstly, a description of the background, context, rationale and problem statement and the

focus to the study are presented. Research questions and objectives are stated. This is followed by the methodological approach of the study. The chapter ends with a short summary of the structure of the thesis and the contents of each of the chapters.

Chapter 2: Literature review- In this chapter, previous studies and published work relevant to the current study are critically evaluated. The literature review discusses a number of major aspects, i.e. understanding gender, gender equity, gender equality and education; state of gender equity in science education and science-based careers in South Africa; policies and legislations which address gender in South Africa; influence of socialisation on gender equity; how do schools perpetuate gender inequity; teachers' awareness, views, and understandings of gender issues in science education and the conceptual framework of the study.

Chapter 3: Research methodology- The aim of this chapter is to present a description of the methodology employed in the study. The study employed an interpretive paradigm, a qualitative approach and purposive sampling. Semi-structured interviews were used for data collection. The sample comprised of six Physical Science teachers, two females and four males. The methods of data collection and the rationale behind their selection criteria are described. This is followed by a description of ethical procedures used in the study. Measures used to prevent or reduce bias, and to increase data trustworthiness and credibility are explained. The limitations and the strengths of the study are stated.

Chapter 4: Results and discussion- In this chapter, the research results are presented. The research results are comprised of qualitative data. Qualitative data is analysed systematically; the main steps in the analysis are thematic content analysis to establish patterns, codes and categories; from which themes were then identified. The findings of the study are interpreted, discussed and compared with the findings of previous studies that are related to the current study.

Chapter 5: Summary, Conclusions and Recommendations - In this chapter, the major findings of the study are summarised and presented. The significance and possible implications of the findings of the current study are discussed. Recommendations for policy and practice in the subject of gender equity and equality in science education are suggested. In addition, recommendations for further studies in gender equity are made.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This study focuses on how Physical Sciences teachers understand and view gender equity in science education in Umgungundlovu District, KwaZulu-Natal. The previous chapter described the purpose and focus of this research. Chapter 1 located the research within the context of gender equality and equity in education in South Africa since democracy in 1994. The purpose of this chapter is to review the relevant literature on gender equity issues in general, education and science education in particular. This chapter focuses on gender equality and equity issues in South Africa; and the views and understandings of Physical Science teachers of gender equity issues in science education. This chapter further looks at the gender policies that have been developed and implemented in South Africa. The key issues discussed in this chapter are understanding gender, gender equity, gender equality and education; the state of gender equity in science education and science-based careers; influence of socialisation on gender equity; policies and legislations which address gender in South Africa; teachers' awareness, views, and understandings of gender issues in science education; and the conceptual framework of the study.

2.2. Understanding gender, gender equity, gender equality and education

Connell (2002, p.3) and Connell (2009, p.5) claims that in daily life people usually take “gender for granted”. When a baby is born, he or she is normally born with a specific gender or sex, i.e. a boy or girl. Males and females have many different physical characteristics, which include their genitalia. These differences do not mean that one gender is more important or powerful than the other; they only indicate that males and females are different in terms of their physical characteristics.

Nicholson (1994) asserts that gender is a difficult word to understand or explain within feminism. Gender is described by Jackson and Scott (2002, p.1) as “hierarchical division between women and men embedded in both social institutions and social practices” while Holmes (2008, p. 2)

describes gender as “the ideas and practices that constitute femininity and masculinity.” She further suggests that:

- (i) Gender between women and men is socially constructed, not biologically determined.
- (ii) Gender is learned and practiced every day in relation to norms/rules/scripts (p.134).

In addition, Connell (2002, p.8) defines gender as “the cultural difference of women and men, based on the biological division between male and female”. Similarly, Mda and Mothatha (2000) claim that the socialisation of boys, girls, women and men regulates the way in which they lead their lives. Therefore, gender is socially constructed and created through daily interaction within a given community. Society also perpetuates the social division between men and women because of the characteristics that are associated with masculinity and femininity. Mda and Mothatha (2000) further argue that gender is also culturally constructed and identifies the expected social behaviour between men and women. Mda and Mothatha (2000) agree with Grown, Gupta and Kes (2005, p.30) that gender “defines and differentiates the roles, responsibilities, obligations and social norms of men and women”. Cooper (2011) claims that these social norms allow men extra access to opportunities, freedom and resources to develop their abilities. These socially constructed behaviours determine how people should behave as men or women and are different and ever-changing. People learn these behaviours from birth through social and cultural practices. The socially constructed behaviour includes roles and responsibility, mannerism, conduct, etc. and specific society or community expectations from males and females, respectively. A traditional African society may expect females to put on long dresses, kneel while serving men with food and do most of the household chores, whereas men may be expected to wear long or short trousers, pay lobola for a wife and do much of the hard manual work to secure food, shelter, safety and security for the family.

Moreover, Nicholson (1994) argues that gender describes “social construction having to do with the male/female distinction, including those constructions that separate female bodies from male bodies” (p.79). In addition, Connell (as cited in Cleaver, 2002, p.6) defines gender identity as “activities, traits and values culturally and historically associated with men and women.” Ryle (2015) asserts that there is a difference between gender and sex”. Sex” is defined as the anatomical

and physiological attributes associated with femaleness and maleness. In addition, Mda and Mothatha (2000) and Ryle (2015) state that sex denotes the biological differences between men and women, which do not change. Furthermore, Holmes (2008, p. 2) states that sex refers to “whether a person is considered female or male, based on the kind of body they have”. Under normal circumstances, people are born with either female or male genitalia.

What then is “gender equity?” To secure equity, there should be legislation to ensure equal opportunities for men and women. This should be done to compensate for past prejudices and social discriminations which prevented men and women from exercising their full potential. Equity leads to equality (UNDP, 2000). Equity focuses on equality between women and men, and the fair distribution of benefits of development (UNDP, 2000). Furthermore, the Gender Equity Task Team (GETT) Report (as cited in Mda & Mothatha, 2000, p. 40) describe gender equity as “concerned with the promotion of equal opportunities and fair treatment for men and women in personal, social, cultural, political and economic arena”. Gender equity entails meeting the needs of women and men, girls and boys in order that they might:

- (i) compete in the formal and informal labour market;
- (ii) participate fully in civil society; and
- (iii) fulfil their familial roles adequately without being discriminated against because of their gender (p.40).

In educational contexts, Fennema (1990) defines gender equity as the set of behaviours and knowledge that permits educators to recognise inequality in educational opportunities, to carry out specific interventions that constitute equal educational treatment, and to ensure equal educational outcomes. Moreover, Sahin (2013, p.60) states that gender equity in education means that “males and females have equal opportunities in terms of economic, social, cultural, and political developments”. If gender equity is attained, this will benefit both girls and boys for their future. In addition, Holsinger and Jacob (2009, p.4) explain that equity takes into consideration “the social justice ramifications of education in relation to the fairness, justness, and impartiality of its distribution at all levels or educational subsectors.”

On the other hand, gender equality means that both men and women benefit from the same results equally (UNDP, 2000). No one is left behind or aside because of his or her gender. It means that men and women enjoy equal human rights and equal opportunities to utilise their full potential to contribute effectively to the development of the economy, politics and the nation as a whole. It also means the equal sharing of values and the tolerance of the different social roles which they play within societies (UNDP, 2000). Moreover, Holsinger and Jacob (2009, p.4) define equality as “the state of being equal in terms of quantity, rank, status, value, or degree”. However, in this study the terms gender equity and gender equality are used interchangeably to refer to the same concept.

Over the past three decades, research studies have been conducted to address gender equity issues in several socio-economic spheres, including education (Gilbert, 2001; Brotman & Moore, 2008). This work was started by liberal feminists who thought that the rights of females should be equal to the rights of their male counterparts. This resulted in the development and implementation of policies and intervention programmes to address gender inequalities in all spheres of life, including education. Since the adoption of the eight Millennium Development Goals (MDGs) by the United Nations (2000) and as is stipulated in the Education for All goals (UNESCO, 2000), all countries which are affiliated to the UN have prioritised gender equality for both males and females. However, achieving gender equity has been elusive globally, especially in developing regions of the world, including the African continent.

Over the past thirty years, both developed and developing countries have shown progress in educating women. Stromquist (2008) maintains that, whilst women have made gains in education in terms of parity at all levels of schooling in most countries, there are still differences in economic and political power between men and women. Jackson (2009) states that women globally are also behind men in enjoying basic human rights. Despite the fact that no country has achieved gender equity fully, some countries have done well in closing the gender gap, for example the Nordic countries and Western European countries. On the other hand, females in African countries are still faced with discrimination with regard to access to education compared to males. For example, in the study on gender in education in Africa with special reference to Ghana, Zimbabwe and

Kenya, Shabaya and Konadu-Agyemang (2004) found that females' illiteracy rates were high as compared to their male counterparts. In the same way, Masanja (2010) affirms that education statistics indicate that women in sub-Saharan African countries continue to be underrepresented in Science, Mathematics and Technology education. In South Africa, James et al. (2006) maintain that although the South African government has implemented gender policies, there is a lot more that needs to be done to bring more girls and women into the science fields. This indicates that girls and women continue to lag behind boys and men in science related fields. Likewise, Rarieya, Sanger, and Moolman (2014) claim that schools continue to be contexts for gender inequities and inequalities experienced by both male and female learners.

The challenges of gender inequity which affects the whole world, and especially the developing regions as described above, is prevalent in most of the socio-economical spheres, including education, which is one of the most critical and essential socio-economic spheres. Education has great benefits for women, such as empowering equality in gender through dominion and by giving dignity to girls. Education contributes to knowledge, increasing women's abilities to face outside challenges and boost confidence thus relinquish subordinate positions to men (Kabeer as cited in Cooper, 2011). Within the education sphere, gender equity levels vary according to disciplines, the science-based disciplines, especially the Natural Sciences, sciences, Technology, Engineering and Mathematics (STEM) subjects are the most affected by gender inequity as reviewed in the next section.

2.3. The state of gender equity in science education and science-based careers in South Africa

2.3.1. South African education under apartheid and inequality

The Dutch settlers through religious education (Behr & MacMillan, 1966) laid the roots and foundation of the educational system in South Africa. Christie (1985) argues that the education system was divided along the lines of race and class. The best available education was given to Whites. The apartheid system in South Africa contributed severely to inequity in education in general. Christie (1985) asserts that the apartheid system left the SA education system with

inequalities. Dr Hendrik Verwoerd introduced the Bantu Education in parliament in 1953 with the following words:

“If the native in South Africa is being taught to expect to lead his adult life under the policy of equal rights, he is making a big mistake. The native must not be subject to a school system which draws him away from his own community, and misleads him by showing him the green pastures of European society in which he is not allowed to graze” (cited in Rose & Tunmer, 1975, p.266)

Christie (1985) further states that this was the birth of the apartheid era in South Africa, which led to racial segregation and inequalities in education. This apartheid legacy in education prepared children in:

“Different ways for the positions they were expected to occupy in social, economic and political life under apartheid. In each department, the curriculum played a powerful role in reinforcing inequality. What, how and whether children were taught differed according to the roles they were expected to play in the wider society” (Department of Education, 2002a, p. 4).

Kallaway (2002) agrees with Holsinger and Jacob (2009) that the education for the majority of Black children had always been different from White children’s education in terms of equity and equality”. Apartheid education was a social as well as economic fact of everyday life for all South Africans” (p.2). Schools for Black pupils were under resourced and their teachers were not well trained as compared to White, Indian and Coloured teachers. Female teachers under apartheid were not paid salaries equivalent to their male counterparts. They were also not offered management positions because of their gender. Morrell et al. (2009) maintain that gender inequity and inequality was one of the attributes of the apartheid education. The curriculum for Black children focused more on agriculture and history. In history, Black children were taught versions that focused more on their subordinate positions and roles. Even the number of girls who attended and finished high school did not equal that of boys (Unterhalter, as cited in Morrell et al., 2009). Kallaway (as cited in Morrell et al., 2009) asserts that the skills that were attained by learners were determined by race under apartheid education. Therefore, the apartheid legacy made a contribution to gender inequality in education, particularly for black women and girls.

This study was driven by MDG 3 which aims to “promote gender equality and empowerment of women” (Kabeer, 2005, p.13). In the Country Report 2013, Statistics South Africa stated that the South African government had performed adequately in general in obtaining MDG 3 even though it still faced a number of challenges that impeded gender equality in other aspects since 1994. Cooper (2011) critiques that Millennium Development Goal 3 concentrates on gender equality with access to education instead of focusing on equal participation. Most of the targets for 2015 have been achieved in SA. The Millennium Development Goals, Country Report 2013 revealed that in South Africa, the Gender Parity Index (GPI) in secondary and tertiary education had been achieved. This achievement shows that South Africa had addressed the issue of gender enrolment rates in the education system. In addition, the ratio of literate and unemployed females to males had been achieved. In the next section, the trends in enrolments and performance of both boys and girls in primary and secondary schools are compared. This is followed by the participation of females in science, Technology, Engineering and Mathematics education and science related-careers.

2.3.2. Comparative trends in the enrolments and academic performance of boys and girls in primary and secondary schools of South Africa

In South Africa, science education begins at primary school level where learners are taught Mathematics, Natural Sciences and Technology from Grades R to nine. Between Grades ten to twelve, learners are taught Physical Sciences, Life Sciences and Mathematics. Even though learners begin to interact with Mathematics and Physical Science at Further Education and Training (FET) level, it is at higher education level where they decide about their careers (Tacsir, Grazzi, & Castillo, 2014).

Moloi and Chetty (2011) reported that there was generally a gender balance in school enrolment in South African primary schools (Grade 6) in the years 2000 and 2007. This is encouraging because this indicates an achievement in efforts to maintain gender equality in education in South Africa. Moloi and Chetty (2011) also reported on the academic performance of primary school (Grade 6) boys and girls in the same years (2000 and 2007). The authors concluded that girls generally performed better than boys in Mathematics.

In 2013, the South African Department of Basic Education published a National Senior Certification Examination Technical report for the period 2010 to 2013. Table 2.1 shows the performance of girls and boys in Mathematics and Physical Sciences in the National Senior Certificate examinations during 2010 to 2013 (South African Department of Basic Education, 2013) extracted from the report. The table shows that in the period 2010 to 2013, generally more girls wrote Mathematics and Physical Sciences Matric examinations than boys. On the other hand, boys performed better than girls in the same subjects during the same period (Table 2.1). Therefore, there were gender inequalities in terms of enrolments and performance in Mathematics and Physical Sciences. In general, more girls write science subjects as compared to the number of boys who write science subjects during the Matric examination. On the other hand, there are still inequalities in terms of performance, because boys are performing better than girls in the Matric examinations in both Mathematics and Physical Sciences.

Table 2.1. Performance of girls and boys in Mathematics and Physical Sciences in the National Senior Certificate examinations during 2010 to 2013 (SA DBE, 2013)

Year	Performance	Mathematics			Physical Sciences		
		Female	Male	Total	Female	Male	Total
2010	Total wrote	142 990	120 044	263 034	106 746	98 618	205 364
	Number who achieve a pass	62 197	62 552	124 749	48 763	49 497	98 260
	% who achieved a pass	43.5	52.1	47.4	45.7	50.2	47.8
2011	Total wrote	119 645	104 990	224 635	92 984	87 601	180 585
	Number who achieve a pass	50 158	53 875	104 033	46 683	49 758	96 441
	% who achieved a pass	41.9	51.3	46.3	50.2	56.8	53.4
2012	Total wrote	122 620	103 254	225 874	94 279	84 915	179 194
	Number who achieve a pass	60 322	61 648	121 970	55 575	54 343	119 918
	% who achieved a pass	49.2	59.7	54.0	58.9	64.0	61.3
2013	Total wrote	132 784	108 725	241 509	97 995	86 388	184 383
	Number who achieve a pass	72 069	70 597	142 666	64 376	59 830	124 206
	% who achieved a pass	54.3	64.9	59.1	65.7	69.3	67.4

South African primary and secondary schools as statistics shows that in terms of enrolments there are no concerns about gender inequality against girls overall and in Mathematics and Physical Sciences. The enrolments actually show that gender inequality is in favour of girls (see Table 2.1). While, as stated earlier, it is pleasing to note that girls overall performed better than boys at primary school levels (Grade 6) during 2000 and 2007, it is disappointing to see that the performance of girls was lower than that of boys in the Matric Mathematics and Physical Sciences examinations between 2010 and 2013. In 2013, out of 142 666 learners who wrote the Mathematics examination only 54.3 % females achieved pass rates as compared to 64.9% of their male counterparts. of the 124 206 learners who wrote Physical Sciences, only 65.75% of females achieved the pass rate as compared to 69.3% of males. These trends from Table 2.1 indicate that in general, boys have performed better than girls in National Senior Certificate Examinations in both Mathematics and Physical Sciences almost every year. There are various reasons put forward for girls' poor performance in matric examinations. These include the poor quality of learning experiences which affect their learning achievements (Moletsane, as cited in Rarieya et al., 2014). The positive views and understanding of Physical Science teachers about gender equity may influence learner performance and participation in science education. Teachers could be used as role models and agents to encourage and motivate learners into taking and participating in science subjects.

2.3.3. Female participation in Science, Engineering and Technology education and careers

Shabaya, and Konadu-Agyemang (2004) maintain that unequal access to education between males and females seems to be prevalent in the developing world. Nevertheless, females in Africa appears to “suffer more discrimination” regarding access to education (p.395). Science education should be equally accessible to both males and females. However, females lag behind in STEM subjects (Moletsane & Reddy, 2011a). Since the current democratic South African government took over from the apartheid government in 1994, much has been expected in terms of equity and equality in all spheres of life including education. South African education has undergone substantial restructuring since 1994. Holsinger and Jacob (2009) assert that the possibility of South African education reaching the parity between Blacks and Whites is very bleak. Fiske and Ladd (2005, p.

ix) affirm that “the new government inherited a system designed to further the goals of apartheid, one that lavished human and financial resources on schools serving white students while systematically starving those with African, Coloured and Indian learners”. Another reason is that South Africa faces a HIV and AIDS pandemic. South Africa has to balance between the two, achieving equality in education and trying to address and eradicate the HIV crisis. Most of the South African children are losing parents who are supposed to support and take care of them financially because of HIV and AIDS. Such affected become child-headed families which make it very difficult for them to balance schooling and the parenting for younger siblings. Most of these learners live in poverty and they cannot afford expensive and well-equipped schooling. The learners who will be able to enjoy the similar and equal benefits with White learners are those learners whose parents can financially afford to enrol them in former White schools and private schools.

Dlodlo and Beyers (2009) maintain that there are a number of programmes and initiatives that have been implemented globally to attract females into Science, Engineering and Technology careers. Gilbert (2001); Dlodlo and Beyers (2009) state that even though more females are participating in science than previously, gender issues in science education have not been resolved yet. Worldwide, women have been found to be highly underrepresented in Science, Engineering and Technology. Moletsane and Reddy (2011) contend that the under-representation of females in STEM fields and the promotion of gender equity and equality is not only a South African problem, but also an international concern and priority. Moreover, Clark Blickenstaff*, (2005); Haynes (2008); Chikunda (2010); Tacsir, Grazzi, & Castillo, (2014); and Legewie and Diprete (2012) state that females are underrepresented in Science, Technology, Engineering and Mathematics (STEM) in most careers around the world. Furthermore, Rop (1998); Brickhouse, Lowery & Shultz (2000); and Brotman and Moore (2008) maintain that females are isolated and marginalised in science education.

In trying to address this problem, other countries have implemented a number of interventions, for example Affirmative Action and legislation policies (Bunyi, 2003; Siann & Callaghan, 2001). In most countries, the focus is now on candidates' participation in tertiary Science, Technology,

Engineering and Mathematics education. Langen and Dekkers (2005) assert that this is due to the under-representation of females and global economic competition. Tacsir, Grazzi, and Castillo, (2014) argue that gender equality in science-based careers is a matter of fairness. According to the European Commission (as cited in Tacsir et al., 2014), in order to achieve gender equality, the recruitment of the most talented candidates is required, irrespective of gender. In 1970, the percentage of Japanese women enrolled in undergraduate science programmes was 2.3 % and by 2004, this percentage had not changed (Scantlebury, Barker, Sugi, Yoshida, & Uysal, 2007).

Similarly, Mody and Brinard (as cited in Dlodlo & Beyers, 2009) maintain that in most African, Middle East and Asian countries, females are grossly under-represented in Science, Engineering and Technology careers. In Africa and other parts of the world, males continue to dominate in science careers. For example, in Botswana and Zimbabwe females constitute only 39% and 30% at pre-university level (Clegg, as cited in Chikunda, 2010). In 2004, the female percentage at higher education level in Zimbabwe who enrolled in Engineering was only 5%, whereas in other science fields this was 31% (ibid). Conversely, Chikunda (2010) argues that the situation in South Africa is not similar. There is a slight difference in terms of the enrolment of females in Engineering courses and other science degrees. Although gender disparities still exist in Engineering, Mathematics and Physical Sciences in favour of males in tertiary institutions; at secondary level the gap less is visible (Clegg, as cited in Chikunda, 2010). According to Light and Durndell (as cited in Siann & Callaghan, 2001), females in school are more likely to choose languages as compared to science subjects. According to Shabaya and Konadu-Agyemang (2004, p. 395) African women and girls experience vast prejudice “in terms of access to education”.

In South Africa and other countries, there remains a challenge in increasing the number of females in higher education institutions. Higher education institutions have created equity plans, employment equity and transformation committees at all levels yet gender inequity still prevails. This is because educators have put more focus on getting the numbers right instead of focusing on cultural transformation (Ruiters, 2008). Similarly, Davis (2003) asserts that despite much effort that has been made to bring about changes in science classrooms, gender equity in science education is still not at the level that is expected. Mlambo (2011) asserts that societal practices and

institutional structures keep females away from this sector. Moletsane (as cited in Rarieya, et al., 2014) states that girls receive poor educational experiences in high schools; hence they perform poorly in the Matric examination. These students end up being unable to get good marks, which in turn hinder their ability to secure places in tertiary institutions (Bunyi, 2003). Female students also compete with their male counterparts for very limited places at the Universities, which are primarily secured by male students. Likewise, Diko (2004) argues that females still dominate fields that are perceived to be feminine.

From the information that was provided by Higher Education Information Management System (HEMIS) for South Africa, Data Profile 2012 shows that in all the 23 universities in South Africa, male students still dominate in Science, Engineering and Technology (SET). Out of 186 203 students enrolled in SET, females only represent 38% (70 839) and males 62% (115 364) in SA universities. According to Ruiters (2008), most women tend to study traditionally feminised disciplines such as Business, Management, Law, Education, Health Sciences, Humanities and Social Sciences in Higher Education Institutions. Therefore, this highlights that in South Africa, females in their post school education do not pursue careers in SET at the universities.

It is widely known that future economic growth in any country and global competition depends on progress in the STEM fields. Van der Linde, Van der Waal and Wilkinson (1994) claimed that schools in developing countries (including SA) do not provide sufficient numbers of students in science-related disciplines. Dlodlo and Beyers (2009) and Moletsane and Reddy (2011) claim that in South Africa, there is a shortage of women skills in the Science, Engineering and Technology sectors. If there are skills gaps in the country, the growth and the development of the economy is affected. According to Tacsir, Grazzi, and Castillo, (2014), insufficient supply of trained graduates in STEM careers compromise the future of society. If women are not fully trained and equipped in this sector, this does not impact negatively only on them but the society as well. In South African higher education institutions, the ratio of female to male students was 1:4 in 2010. This means that of four students the three were male students and one female student at higher education level. This highlights that there is still gender imbalance in STEM fields in tertiary institutions. In SA in 2009, only 40% of researchers in STEM were women. The percentage of females in Physical

Sciences is very low (Diale, Buchner, Buthelezi, Gledhill, Grayson & Kgabi, 2009). According to Ellis (2008), out of four published scientists, only one of them is a woman and three are men. This is an indication that South Africa has a serious problem in gender equality in science education.

In the workplace, gender imbalances persist especially in SET fields. The South African economy is threatened by these inequalities in this sector. A research study conducted by the Human Sciences Research Council (HSRC) on women's participation in industrial Science, Engineering and Technology in 16 companies regarding gender representation revealed that women were underrepresented in the Science, Engineering and Technology sectors. The factors pronounced to prohibit women's participation in Science, Technology and Engineering are the working environment, gender stereotypes, male image of science, lack of strong female role models and a lack of gender equity policy in the workplaces (Moletsane, & Reddy, 2011a). Other reasons that hinder their success in science education is that teachers, parents and their peers do not expect girls to excel in this field.

2.4. Policies and legislations which address gender in South Africa

South Africa is a signatory to the different international bodies that address gender discrimination, such as the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) and others. Since it took over in 1994, the South African government has done a great deal in trying to heal the scars of the past that resulted from apartheid legislation, policies, and practices, especially prejudices against women. These past laws favoured men, especially White men (Mathur-Helm, 2005). According to United Nations Children's Emergency Fund (UNICEF) (2006), women and girls are regarded as people with low social profiles in South African communities. Women or girls also find themselves under the authority and control of men, faced with gender-based violence, sexual harassment and high level of HIV and AIDS infections from this inferiority. UNICEF (2006) claim that girls and women are socialised to become home keepers and child bearers. When they do well in Mathematics and science related subjects, they are not motivated to pursue science related careers (UNICEF, 2006). The South African government has formulated and implemented a number of legislations, policies and laws, which encourage gender balance between male and females. These policies are reviewed below:

The Constitution is the foundation of all institutions of South African society, including education. Chapter 2 of the Constitution is a Bill of Rights which enumerates the civil, political, economic, social and cultural human rights of the citizens of South Africa. Most of the human rights apply to all people of South Africa. The Constitution of the Republic of South Africa was formulated based on equality and equity, rights, freedoms and dignity for its citizens. According to the Constitution, no human being shall experience any form of discrimination because of his or her gender and race. With regard to education, every citizen has the right to education and according to the Constitution, the government should ensure that every individual is able to progress and has access to higher education. Learners are protected by the South African Schools Act 84 of 1996 that states that schools must provide learners with educational needs without unfair discrimination of any form. The government has given school governing bodies the authority to develop policies to enable them to implement gender equality policies effectively (Diko, 2007). This then should form the basis for the need to ensure gender equity and equality in schools, and the important role played by teachers in ensuring gender equity. This brings to the fore the need for this study to Gaine insight into teachers' understanding, experiences, and views about gender equity in education, especially in science education, considering the low levels of scientists and the need to encourage more learners, particularly girls to study science.

The Employment Equity Act of 1998 prohibits unfair discrimination against employees with relation to their sex and gender. According to the Act, employees should receive fair treatment and be given equal opportunities in employment. Women are still given lesser opportunities in the workforce as in South Africa, there is still a gender gap in employment. According to the Employment Equity Act 55 of 1998, every employer is obliged to implement affirmative action in order to achieve employment equity. Everybody must be given equal employment opportunities without any form of unfair discrimination.

The data from Statistics South Africa (2014) shows that the employment rate for men is higher than the employment rate for females. There are approximately 84, 4% males employed as

compared 73,3% females with tertiary education. Employees with matric 59,6% are males and 44,2% are females. Employees without matric 38,8% are males and 26,7% are females (Stats SA, 2014). These statistics highlight that there are more males in employment than their female counterparts. Table 2.2 shows employed people by gender, occupation and population.

Table 2.2. Employed people by gender, occupation, and population (adapted from Stats SA Q4:2014)

Race	Employed women (%)			Employed men (%)		
	Skilled	Semi-skilled	Low skilled	Skilled	Semi-skilled	Low skilled
White	56,6	42,1	1,3	60,4	35,7	3,9
Indian/Asian	44,8	53,1	2,1	46,5	47,7	5,8
Coloured	20,1	51,8	28,1	19,0	45,0	27,0
Black African	17,1	40,5	42,4	14,7	58,7	26,6

Note: 'Skilled' includes manager, professional and technician occupations; 'semi-skilled' includes clerk, sales and services, skilled agriculture, craft and related trade and plant and machine operator occupations; 'low-skilled' includes elementary and domestic worker occupations.

Table 2.2 shows the statistics of employment by occupation, population group and sex for Quarter 4 of the year 2014 as reported by Statistics South Africa (Stats SA, 2014). The table shows that regardless of gender, White and Indian/Asian population groups are more dominant in skilled occupations relative to Black African and Coloured population groups. Table 2.2 shows that the white population group dominates the skilled occupations, irrespective of gender. Irrespective of population group, there was a small percentage difference between men and women in the skilled occupations, for example, 17.1% Black African women compared to 14.7% Black African men. It is noteworthy that, whilst among the Whites, Indians and Coloureds there was a small percentage difference between women and men who were in semi-skilled occupations, in the Black African population there was a larger percentage of men (58.7%) in semi-skilled occupations compared to women (40.5%). The most important statistics in relation to the current study is that there was a much larger percentage of Black African women (42.4%) in low skilled occupations compared to

Black African men (26.6%). Generally, most of the skilled occupations require Science, Mathematics, Engineering and Technology education at high school and tertiary levels, and therefore the dominance of Black African women in low skilled occupations suggests that there is a much higher percentage of Black African women who have no education in these subjects compared to their counterparts (Black African men). Thus, Black African women are the most under-represented in the Science, Mathematics, Engineering and Technology sectors.

The cabinet of RSA adopted the National Policy Framework for Women's Empowerment and Gender Equity or "Gender Policy", 2000. The Gender Policy framework outlines South Africa's vision for gender equality and sets out how it intends realising its gender goals. The policy framework aims to place gender issues at the centre of the transformation process within all structures, institutions, procedures, practices and programmes of government, its agencies and parastatals, civil society and the private sector (James et al., 2006). The "Gender Policy" encourages equal access of both males and females to goods and services. The National Gender and Race Equity Policy for Science, Engineering and Technology (SET) addresses SET for women which will also benefit women living in poverty (James et al., 2006). These policies stipulate that a legislative framework should be established for women empowerment and equal participation and representation. The Broad-Based Black Economic Empowerment Framework (BBBEE) Act focuses on the economic empowerment of black people and women (James, et al., 2006). The study conducted by Mathur-Helm (2005) examined whether SA has successfully employed women as professional equals after implementing affirmative action policies revealed that women are still not accepted as professional equals. Until organisations are well sensitised about women empowerment and gender equity, government initiatives on gender will never be fully successful.

2.5. Influence of socialisation on gender equity

The focus of this study is on Physical Science teachers' perceptions about gender equity. Therefore, the question of how they construct their views, beliefs, understandings and identities is of paramount importance. Ryle (2015) maintains that from a biosocial point of view, the study of

gender recognises that most of our experiences and beliefs with regard to gender are socially constructed. Holmes (2008, p.3) describes the process through which people are taught how to behave in a given society as “socialisation”. Socialisation is one of the main contributors of gender inequities and inequalities. In societies, males and females undergo socialisation process differently.

2.5.1. Gender and socialisation

Despite the fact that most of us believe that people are now equal, girls, boys, men and women still live in societies that are structured in ways that still benefit and favour males over females in terms of opportunities, access to resources and power. Holmes (2008, p.3) wrote:

“We live within a patriarchy, a society largely controlled by men and in which men usually have a greater share of the rewards (both in terms of wealth and status) available”.

Chisholm and September (2005, p.147) noted the following pressures faced by South African women: Women and girls in every part of the world including SA, are faced with discrimination and violence. Daily, women are victims of physical and sexual violence. They experience these types of violence from males. Women carry the heavier burden of poverty; in South Africa, gendered division of labour, low paid jobs given to women are amongst other factors contributing to women’s poverty (*ibid*).

The apartheid policies and gender discrimination had negative impact on the health status of women. Women carry a disproportionate burden of the scourge of HIV/AIDS; and other opportunistic diseases. Women still have the status of minors in marriages and society, despite laws to the contrary. According to Mlambo-Ngcuka (as cited in Adichie, 2016), every year, 15 million girls marry before the age of 18. In schools, girls continue to be discriminated against in the classroom. In some cases, girls continue to be sexually exploited by male teachers and male learners. Girls continue to be the first to be removed from school as a result of financial pressures. In households whenever there are financial constraints, women are the ones who suffer because their education is not seen as important as males’ education. Girls are regarded as people who will leave homes for marriages.

Weitz (1977) and Holmes (2008) claim that social structures, parents, peers, education system and social media are the key agents of socialisation. Socialisation refers to the effects that social relationships and interaction with people in society, teachers, parents and peers have on children (Baird, 2007). Correspondingly, Holmes (2008) agrees with Ryle (2015) that socialisation is the way in which people learn how to become members of the group, this includes humanity. Kimmel and Holler (2000) concurs with Ryle (2015) that the socialisation process begins soon after a person is born “and continues throughout our lives to the very end,” as we continue learning how to adjust to changes and new groups (p.109). Moreover, Cleaver (2002) asserts that gender stereotypes begin from the time we are born and identified as either a girl or a boy in all societies and cultures. These gender stereotypes explain how one is expected to behave. Socialisation includes learning the values, behaviours, norms, and social skills appropriate to one’s social status. The girls are socialised how to become daughters, sisters, friends, wives, and mothers within a given community. Boys are taught how to become sons, brothers, friends, husbands, and fathers within a given society. Socialisation is a way of attaining culture for a particular group of people. Personality also develops from the socialisation of a person. Good socialisation can lead to consistency and good behaviour within a given society. The following model shows the agents of socialisation within a society.



Figure 2.1 Model showing agents of socialisation (Source: Premed HQ Agents of Socialisation)

Ryle (2015) describes the people, groups and institutions who socialise children as “agents of socialisation” (p.118). Thorne (1993) maintains that the socialisation process moves only in one direction and that parents and adults socialise children, teachers socialise learners. This means that the powerless get socialised and the powerful socialise. Therefore, power becomes central to the relations. There are a number of factors that can affect an individual’s socialisation process. The amount of impact that each of the agents has on an individual will depend on the situation, the individual’s experiences, and the individual’s stage of life. These ‘agents’ of socialisation are discussed in detail on how they contribute to gender inequalities. Ryle further claims that the family, religion and school play significant roles in the process of gender socialisation. The family, peers, religion, government, media, work, ethnic background and clubs/social groups and school are grouped and discussed in section 2.4.2 under society as agent of socialisation.

2.5.2. Society as agent of socialisation

Joseph (2011, p. 10) contends that our views and beliefs about gender are “strongly influenced by our cultural beliefs which are enacted in our social interactions”. His study on boys’ perceptions

on gender in a Pietermaritzburg high school found that cultural values and beliefs were a reflection of their earlier socialisation and that these had clearly impacted on their perceptions of gender, gender equality and sexism. Moreover, Ridgeway and Correll (2004, p. 512) describe these cultural beliefs as “hegemonic cultural beliefs”. Ryle (2015) affirms that all theories of gender socialisation concur that interaction with the society is the central mechanism through which socialisation takes place. Dietz (1998, p. 425) claims that human beings “make sense of the world around them by using the meanings that the members of the society have come to share”. The family, peers, religion, government, media, work, ethnic background and clubs/social groups will be discussed under society because this is where the socialisation process begins. Socialisation can be understood according to a number of theories, namely the social learning, cognitive-development, gender schema and psychoanalytic theories (Ryle, 2015). Rewarding children according to sex typed behaviours achieves this. For example, boys are told that boys do not cry, but that it is all right for a girl to cry. Cleaver (2002) maintains that this socialisation leads to boys fear that they would be labelled like girls, thus they become aggressive, strong, dominating and controlling others.

Children learn through imitating people around them regardless of whether they will be rewarded or not. They also learn their roles through playing or imitating actors (in social media). Cleaver (2002) affirms that the media also has an impact on children since the way they portray gender stereotypes can influence gender identities. Playing during childhood becomes a substantial component of the socialisation process. It is during this stage of socialisation that boys and girls develop masculine and feminine traits (Dietz, 1998). Ryle (2015) states that social learning theorists argue that children tend to copy, imitate the same sex individuals, and form a strong bond with the same sex parent. De Loache and Gottlieb (as cited in Ryle, 2015) claim that more value is given to male than female new born in most of the societies around the world. In certain cultures, males carry on the family name because females are likely to take on their husband’s name when they get married. Boys are socialised to take care of their parents when they get older, even practicing rituals and religious activities. For example, in Nguni culture a woman is not allowed to slaughter a goat and burn incense for ancestors, only males do these practices. All these gender preferences play a huge role in the socialisation of male and female children. According to United Nations (2000), girls experience high level of abuse and neglect because of the preferences that

are awarded to boys. Cornwall (1988) agrees with Himmelfarb (1979, p. 478) that “parents socialise their children by channelling them into other groups or experiences (such as schools and marriage). [This] will reinforce (have an additive influence on) what was learned at home and will channel them further into similar adult activities”. This suggests that human beings develop a religious worldview through early childhood religious socialisation.

2.5.3. Gender and division of labour

Ryle (2015) describes the division of labour as the distribution of tasks needed for the care and the running of a household. Kimmel, Hearn and Connell (2004) and Connell (2005) assert that domestic labour is divided unequally between males and females. Coltrane (as cited in Kimmel, et al., 2004) claims that women historically were given more domestic work as compared to males. Connell (2006) states that in many societies and cultures, certain females and some males perform duties for example, hunting is for men and females fetch wood and water. In other cultures, for example Zulu culture, it is the duty of women to prepare the body of a deceased and provide the mourners with food while men prepare the grave. Females look after children and males do underground mining. Females are often assigned roles requiring tenderness and care. Women are also trained in domestic work to prepare them for marriage. The connection between gender and occupation can be found in teaching, for example a tough male deputy principal and a tender female drama teacher. This is also seen in the allocation of workload among teachers, where females are given “domestic science, language, and literature teaching, and men in sciences, Mathematics and industrial arts” (Connell, 1996, p. 213). This is also visible when teachers assign tasks to learners. For example, a teacher will ask a strong boy in the classroom to move a table or carry a large and heavy box and give easy tasks to females. All tasks that are given by teachers, parents and community members are sex differentiated.

2.5.4. Hegemonic masculinity

Weitz (1977) maintains that the outcome of gender socialisation is the differentiation of men and women. Gauntlet (2002, p. 9) defines masculinity as “the state of being a man” whereas femininity

is not defined as the state of being a woman. Instead, femininity is seen as a “stereotype of a woman’s role from the past”. The older ideas and definition of masculinity held the view of the “male sex role”, which was linked with power, authority, dominance, bravery and heroism (Connell, 1996). Sweetman (1997) asserts that gender inequality in the home where men possess more authority in decision-making has resulted in domestic violence experienced by women. Research on masculinity has resulted in various views of masculinity, including those briefly described by Connell (1996, p.208) below:

- Multiple masculinities: Different cultures, and different periods of history, construct masculinity differently.
- Hierarchy and Hegemony: There are different classes of masculinity, some masculinities are more honoured than others are, and others may be dishonoured. The form of masculinity that is culturally dominant in a given setting is called *hegemonic masculinity*. Hegemonic masculinity positions itself in opposition to women and takes its status in relation to other forms of subordinate masculinities (Joseph, 2011, p.15).
- Active Construction: Masculinities do not exist prior to social behaviour; rather masculinities come into existence as people act and socialise.
- Masculinities are dynamic: It has been found that masculinities are subject to change due to various environmental and socio-cultural factors, and in the course of time.

Ruiters (2008, p. 232) asserts, “Male characters are overwhelmingly in the majority and the larger number of representations ensures that male characters are foregrounded as heroes”. This heroic character places them in the position of being leaders of groups and act in public spaces. In addition, Connell (2000, p.29) explains, “Masculinities are configurations of practice within gender relations, a structure that includes large-scale institutions and economic relations as well as face to face relationships and sexuality”.

2.5.5. Gender and power

Ryle (2015, p.461) contends that power is the “ability of some actors to influence the behaviour of others, whether through the use of persuasion, authority, or coercion”. There are different types

of power, for example, Ryle (2015) defines coercive power as the “ability to impose one’s will by force, threats or deceits” and authority as “the power that comes from a position in an organisation or institution that is widely regarded as legitimate” (p.462). Power can be good and bad. It all depends on whether it is used in a positive or negative way. Other power, such as authority, could be utilised for a smooth running of a society. For example, the power that is posed by parents over children and teachers over learners is a good power. The power that can lead to inequalities within institutions and society is a bad power. Men still possess more power within societies as compared to women. This is witnessed in law enforcement, ruling government, salary negotiations even with the word of God. In other parts of the world and societies, women possess the power to do these things but they not have as much opportunities as male counterparts to exercise the power (Ryle, 2015).

These power relations involve authority, supervision domination among teachers and harassment and controlling resources among learners (Connell, 1996). Supervision, authority and patterns of dominance are associated with masculinities. In management and supervision, men occupy positions in the education system. Power relations among children are seen over resources and within sports facilities where boys take control over space. They (boys) like to disturb girls during play time in the playground. They also want to occupy spaces that are reserved for girls. Even in classrooms, boys like to occupy the physical space of the classroom because they have power over girls.

2.6. How do schools perpetuate gender inequity?

Devine (2003, p.1) argues that “schools are constructed, administered and shaped by adults for children. As social institutions they play a central role in the construction of children’s perception of themselves, of the social world and of their place within it”. According to Apple Bourdieu Bowles and Gintis Lynch (as cited in Devine, 2003, p. 4) “schooling is perceived as an important tool used by the bourgeoisie to ensure hegemonic dominance and studies of school focus on the communication of beliefs, practices etc. that serve to reproduce inequalities based on gender, social class and ethnicity that exist in the broader society”. Connell (1998) maintains that schools are often blamed for all social problems including employment; it is less surprising that they should be blamed about gender issues. However, he further warned that schools are not the only

institutions that perpetuate gender problems, families also influence gender. The things that we consider as normal or we take for granted from home are the ones that promote and encourage gender inequities in schools. For example, the way in which parents socialise their children from childhood, such as buying different toys. Children grow up believing that girls should become mothers or caregivers when they grow up, and boys are trained to become mechanics and strong community members. Girls do what their mothers are doing and boys do what their fathers do. At home, boys are always given harder tasks that train them to become stronger (Morojele, 2013). This continues even in schools, where teachers give boys harder tasks such as fixing and connecting equipment. This gender differentiation shows girls that they are weak and that boys are tough and strong. Acker and David (1994) claims that at a later stage of schooling, the “pathways through the system begin to diverge” (p.90).

The perception that boys are good in STEM subjects and girls in humanities/arts careers has been handed down countless generations through early socialisation and cultural influences. These views and beliefs create notions among children that there are fields that they cannot excel in because of their gender (Sanders, 1997). Teachers continue to promote gender roles even though they are not aware of this practice. They do this through their gendered behaviours more, especially when they assign tasks to boys and girls (Diko, 2007). Moreover, Morojele (2014) argues that teachers’ gender constructions shape the gender relations in the education system, inside the classroom and later in higher education. Teachers put pressure on learners by socializing them through social behaviours of being a girl or a boy. This tendency for teachers results in constructing femininities and masculinities that they are unaware of (Morojele, 2013).

According to Connell (1996, p.213), “gender is embedded in the institutional arrangements by which school functions.” Through school practices, the institutional arrangements reconstruct femininities and masculinities, males and females in terms of power and labour divisions (Kimmel, Hearn & Connell, 2004). Acker and Oatley (1993, p. 258) affirm that “timetabling of subjects, assessment procedures, teacher expectations and behaviour, peer pressures, unequal funding, and stereotyped textbooks” are some of the school factors which contribute to gender inequity. Baird (1997); Acker and Oatley (1993); Stromquist (2008) revealed other factors that contribute to

females' underrepresentation are the different treatment and expectations that teachers hold of boys and girls. According to Becker; Kelly; Measor et al., (as cited in Acker & Oatley 1993), boys receive more time and attention from teachers. Seating arrangements in classrooms also promote gender separation for example same sex grouping or same sex pairs. Connell (1996) asserts that schools have their own way of bringing in symbolisation from society and culture through their uniform and dress code, informal and formal language codes etc. In schools, learners are expected to perform gender conformity by their teachers and peers. For example, girls are expected to wear particular clothing, handle themselves in certain manners and they are always expected to be submissive to their elders and male counterparts. Morojele (2014) believes that these gender constructions infuse the "inequitable gender relations" (p.104). He further maintains that an important symbolic structure in education is "gendering of knowledge, the defining of certain areas of the curriculum as masculine and others as feminine" (p.241).

According to Barka (as cited in Gouws, 2012), about 65% of African countries are conducting studies on the female learners' situation in schools and some have already revised the curricula in schools to present positive women images. She further maintains that teachers require other alternative methods of teaching that are sensitive to gender through in-Service Education Training. The gender stereotyping still continues in education with most females studying the gendered programmes such as nursing and social work, whereas males continue to dominate science-related programmes (Masanja, 2010).

Diko (2007) reported that in South Africa, female teachers continue to accept their roles as women. Diko (2007) contends that women in schools are still generally divided according to feminine roles. For example, in school committees, women are assigned to catering and social committees. Male teachers still dominate and women's voices end up being ignored even if women occupy leadership positions. Gouws (2012) indicates that being a 'change agent' is not an easy task. She further asserts that in the male dominated institutional culture, change do not happen overnight; therefore, she calls for a very strong feminist solidarity in institutions.

2.6.1. Teachers' awareness, views and understandings of gender issues in science education

Crotty (2008) states that while a lot of research has been conducted internationally on gender issues and science education, most of the research studies in science education address gender in relation to post-high school. Very little research has been done on the views of female teachers and girls at high school level. Similarly, Essien-Wood (2010) argues that regardless of the high rate of success of African American females in sciences, research has given very little attention to their experiences in science and Technology. Their experiences of gender issues are only presented with other areas such as race, ethnicity and gender groups (Essien-Wood, 2010). Investigating their views and perspectives in this fashion complicates the challenges which these females face. This research approach might not provide insights of their viewpoints, thus making it difficult to address the issues of gender and science education.

In the USA, Strickland (2006) reported on a study that investigated high school teachers' practical knowledge of gender in social, professional and school settings. The study revealed that the teachers had an early perception of gender in their lives and an understanding of the influence of gender in the schools in which they taught.

Studies conducted in some African countries indicated that only a minority of science teachers have some understanding and awareness of gender equity issues in the teaching and learning practices. However, the majority of the science teachers believe that the teaching and learning of science is not influenced by the gender of the learner. For example, a study conducted in Zimbabwe by Chikunda (2010) on the level of gender awareness of science teachers, found that few of the science teachers had a significant level of gender awareness in their teaching practices. Most of these teachers believed that science was a "factual, or objective discipline that was not affected by people's background, culture, attitudes or gender" (Chikunda, 2010, p. 110). This highlights that very little is done by higher education institutions in Zimbabwe to familiarise science teachers on gender issues. The researcher therefore recommended teacher development initiatives for practicing teachers as well as including gender in the teacher education curriculum (Chikunda, 2010). Morojele (2013) reported that the Basotho cultural and superstitious fabric and family dynamics, which are male-dominated, were being exploited by Lesotho teachers to promote gender inequalities in schools, which favoured and praised the male learners. Thus, Lesotho teachers'

understanding of gender equity issues is based on the socio-cultural fabric of the society in which they live.

In South Africa, it seems there are limited studies on the views and understandings of high school science teachers about gender equity in science education. The studies found in the literature were on the views, perspectives and understandings of South African primary school teachers about gender issues in education in general. Monyemore (2012) reported on a study that investigated teachers' views on gender equity in primary schools in Soweto. Monyemore (2012) contends that teachers have little understanding of gender issues; however, they need more understanding of gender related issues inside the classroom and in school in general. A permeation model for gender equity awareness is recommended so that all teachers reflect on their practices (Monyemore, 2012). In South Africa, teachers view gender in terms of different characteristics which they attach to males and females through socialisation and culture (Morojele, 2014). In other words, the teacher-student interactions are strongly influenced by cultural and societal discourses. In South Africa, Black African customs give men more authority as household heads, therefore in the classrooms females think that males should dominate as they relate school girl-boy power relations with mother-father power relationship in which the fathers have much more power than the mothers in the running of the home. Even teachers give more attention and positive reinforcement to boys. The study conducted on gender equitable schooling by Morojele (2014) in three rural primary schools in KwaZulu-Natal found that the majority of teachers believed that learners are socialised into gender traits from their homes. Teachers also believed that learners are brought up differently in isiZulu traditions and culture as boys and girls.

A survey that was administered by Moletsane and Reddy (2011) to 735 educators from Mpumalanga, KwaZulu-Natal, Eastern Cape and Gauteng provinces on gender equality in the Mathematics and science school curriculum revealed that most teachers were unfamiliar with national or international strategies and policies that encourage girls' participation and gender equity in Mathematics and science. They found that about 80% of teachers agreed that there was a necessity for different teaching strategies for teaching Mathematics and science; 40%, of teachers

revealed that textbooks are male orientated; and 77% of these teachers were of the view that there should be activities used to promote girls' interest and participation in Mathematics and science (Moletsane, & Reddy, 2011). These teachers' views and understandings about gender equity issues in science education should then form the basis for the need to discourage gender inequity in schools. Teachers are regarded as social transformation agents and this bring the need of this study, which is to Gaine their perceptions about gender equity, specifically in science education.

2.7. Conceptual framework

The conceptual framework guiding this study is comprised of two components. Firstly, understanding the meaning of gender and gender equality/equity in education using the four approaches presented by Morrel et al. (2009); and secondly, analysis of the views, experiences and beliefs of teachers about gender equity in science education using the feminist interpretations of the theory of social constructionism, as described and used by Morojele (2013; 2014). The reason for using the two components of conceptual framework was that there would be a limitation of using one component for analysing the understanding of the meaning of gender, views, beliefs and experiences of gender equity of Physical Science teacher in science education. For example, it was not going to be possible to analyse the understanding of gender of Physical Science teachers using feminist interpretations of theory of social constructionism and also there was going to a limitation to analyse the views and beliefs of physical science teachers using the four approaches by Morrel et al (2009).

2.7.1. Understanding the meaning of gender and gender equity in education

Firstly, in order to understand gender equality/equity it is important to know and understand how to measure equality and equity in education. This study is based on the fair and equitable education in science. Morrel et al. (2009) highlight four approaches that can be used to understand the meaning of gender and gender equality/equity which are summarized in Table 2.3. In this study, the analysis of the understandings of gender equity of Physical Science teachers is guided by the four approaches to understanding the meaning of gender and gender equality as presented by Morrell et al. (2009). Practically, these approaches overlap with each other but most of the

understandings of teachers about gender and gender equity will be likely based on the first two approaches.

Table 2.3 Approaches to understanding the meaning of gender and equality/equity (source Morrell et al., 2009, p. 13).

Gender means	Gender equality means	Policy emphasis
1. Girls or boys	Equal amounts (parity)	Interventions to ensure parity
2. Constructed social relations of power	Transformed structures to redress power inequalities	Building institutions to transform power inequalities
3. Discourses of appropriate or resistant femininities or masculinities	Equality of esteem or recognition for diverse identities	Interactions: Encouraging cultures of participation, critique and affirmation of diverse identities
4. Plural concept, entailing both an intersecting structured positioning and a shifting form of agency and identity	Plural notion of equalities, includes freedoms to achieve valuable objectives and varied combinations of real alternatives	Empowerment: Interventions + institutions + interactions

The framework highlights different understandings of gender, gender equality, and policy emphasis. Firstly, gender can be understood as a biological construct, meaning a boy or a girl. This understanding of gender is linked to an understanding of gender equality as referring to the equal numbers for boys and girls, women and men in education. The policy interventions to achieve gender equality focus on ensuring that there is gender parity between females and males.

The first approach indicates that gender means boys or girls and hence gender equality can be understood in terms of equal numbers for boys and girls, women and men in education. This approach is linked with interventions to make sure that there is gender parity between females and

males. The first approach (Table 2.3) to understanding the meaning of gender and gender equality emphasises more on the education, empowerment of girls and women and gender parity.

Empowerment has to do with human beings, both women and men. Empowerment is a joint effort including individual change and communal action. Women empowerment means developing women's capacity to take control of their own lives and needs. It involves the ability to stand up on their own, demanding support from their societies and the State to ensure that their interests are taken care of. If they are capacitated within this arena, this will enable them to set their own agendas. Women empowerment also demands a reconstruction of the society and the division of labour (UNDP, 2000).

In the approach described above, gender equity is understood as equal numbers of boys and girls. Gender balance is defined as the representation of females in a programme at a level equal to their representation in the population of the corresponding institution (Baird, 1997). This approach aims at developing women. This will be achieved by bringing girl learners and women into school. It does not challenge the discrimination or oppression of women but emphasises the significance of including females in development and planning to enhance efficiency. In this approach, gender is equivalent to girls and women who are identified by biological differences. Education is understood as schooling. Development and empowerment is associated with growth of the economy.

This approach is criticized for its assumption that education is always delivered through formal schooling; that gender is not politically influenced but categorised; and that individual females are not to be considered (Unterhalter; Fine & Rose; Brighouse & Unterhalter, as cited in Unterhalter, 2005). This approach challenges gender inequity by bringing more girls to school. It focuses more on the head count of girls in and out of schools and the gender gap between boys and girls with regard to achievement and enrolments (UNESCO; UNICEF, as cited in Unterhalter, 2005). Equality is also understood as equal numbers of resources. This means that there should be equal numbers of places for girls and boys in schools, equal numbers of male and female teachers

employed, and equal numbers of female and male images in textbooks (Unterhalter, 2005). It does not focus more on teaching and learning processes; working conditions for female teachers; the way the societies view their work; and the interpretations by learners from the images which they see in their textbooks (Unterhalter, 2005). The issue of women exploitation, marginalisation, and social divisions are not considered. In this approach, the education for women is not for themselves but for others. The authorities believe that if you empower woman, you empower the nation.

The policies linked with this approach focus on increasing access for girls by providing them with free education, developing infrastructure of training and accommodation to ensure employment of more female teachers. Other communities are promoting and encouraging girls to enrol and pass their examinations through associated practices. According to this approach, Physical Science teachers would understand gender as girls, boys, females, males, women, and men. Teachers would understand gender equity and equality as equal number numbers of boys and girls in schools. This is sometimes referred to as gender parity. According to this view, there should be equal amounts of expenditure on the education of girls, boys, females, and males. There should be stipend programmes in place, which encourages girls to stay in schools so that there are equal numbers of boy, and girls who finish high school education (Raynor & Wesson as cited in Morrell et. al., 2009).

The second approach highlights that gender can be understood as socially constructed through power relations between men and women. These structures need to be addressed through building institutions to transform power inequalities. The second approach focuses on challenging inequality issues. This approach emphasises labour divisions and gendered power structures inside and outside the household. Its aim is to differentiate between practical and strategic gender needs. Its key feature is also empowerment and understandings of gender equality Kabeer (1999) argues that gender empowerment in education entails measuring access to schooling up to a particular level; making decisions about education by women; and should be analysed with links to achievements that flow from education. The authors understand gender equality with regard to the

removal of structural obstacles to gender equity, gender bias laws, unfair treatment at work and schooling and unequal distribution and access to resources.

According to this approach, teachers would understand gender as socially constructed. This means that the socio-cultural, socio-economic, and political practices between men and women are informed by social structures, laws, and customs within a given society. Teachers would understand gender equity as the redistribution of power. Teachers would be of the view that gender inequity and oppression should be challenged, for example gendered curricula, which marginalises and isolates girls from doing maths and Physical Science. Another area of inequity is that of the gendered education system which spends much money in tertiary institutions at which very few women enrol. The education system spends very little money at early childhood and adult education whereas there are many women at these levels who need investment. Teachers would also understand gender equity as transformation of these unfair and bias structures. Teachers would also understand gender equity as challenging inequity, discrimination, and oppression. Gender (or sex) discrimination occurs when a person is subjected to different or unequal treatment ('discrimination') in any number of situations, when that treatment is based on the person's gender (Reuters, (2013).

The third approach emphasises the stability of gender definitions. It focusses more on the processes of gendered identification and action plan. Even though this framework does not directly influence government policies, it has influenced the development of learning support materials and institutions that acknowledge the complexity of social identities (Unterhalter, 2005). This approach deals with the discourses that recognise different identities for both males and females. In this approach, gender is understood as discourses of appropriate or resistant femininities or masculinities. Gender equality in this approach is understood as equality of esteem or recognition for diverse identities. The policy interventions attached to this approach are linked to interactions that promote cultures of equal participation for diverse identities. The third approach critiques all the practices linked to the development of a woman (Unterhalter, 2005). These authorities view education and schooling as something that eliminates the use and importance of indigenous knowledge (Tuhiwai Smith; Kowakole, as cited in Unterhalter, 2005). They understand gender as "fluid and shifting processes of identification" (Unterhalter, 2005, p. 27). Mannathoko (1999)

argues that these authorities view equality as a recognition of difference. It does not emphasise equality of women only as in the first and the second approaches. The third approach includes and addresses all the marginalised and subordinated identities, including gays and lesbians.

According to this approach, teachers would understand gender as shifting identities, where all the minority population will be recognised as equal and important. Teachers would understand gender equity as transformation of “hierarchies and boundaries of self -esteem, opening up a wide range of identities and social relationships as valuable for women and men, subjecting all identities to discussion, critique and change” (Morrel et al., 2009, p.15).

The fourth approach is the combination of the first three approaches. This approach is linked to the empowerment of both men and women. This approach puts emphasis on gender equality through interventions, institutions and interactions (Morrell et al., 2009). This approach differs from the first, second and third approaches regarding the understanding of gender and education, and the procedures of policy development. This framework works at a higher level of abstraction. It also emphasises a framework that develops policies and practices legitimately, other than concrete policies or forms of practice (Unterhalter, 2005). This approach focuses on human development, which includes rights, needs, and capabilities. Unterhalter (2005) argues that equality in education needs to be based on the understanding of human capabilities. This means, “what it is that each individual has reason to value” (p.28). San and Nussbaum (as cited in Unterhalter, 2005) view the importance of education as a key capability. This approach emphasises the creation and sustainability of conditions for everyone, regardless of their gender, race, ethnicity to achieve outcomes (Unterhalter, 2005). In this approach, gender is understood as a plural concept, entailing both an intersecting structured positioning and a shifting form of agency and identity. Gender equality is understood as a plural notion of equalities, includes freedoms to achieve valuable objectives and varied combinations of real alternatives.

According to this approach, teachers would understand gender as “inequality and capability denial” and gender equity as “equality of rights and capabilities” (Unterhalter, 2005, p.16). Gender

is associated with human rights for women within the education system. Teachers would also view gender equity as creating the conditions for justice for both men and women, according to their needs.

2.7.2. Feminist interpretations of social constructionism

Acker and David (1994) contends that feminist theories aim to address the female's subordination to males. They focus more on guidance to understanding gender inequality and action. This study will relate to three traditional types of feminism as explained by Acker and David (1994) to analyse the views and beliefs of science teachers about gender equity, namely liberal feminism, socialist feminism, and radical feminism and education. Feminists' theories are relevant to this study because they "serve a dual purpose as guides to understanding gender inequality and as guides to action" (p. 43-44).

Liberal feminism

Liberal feminists believe that "sex differences (biological) are gender differences" (Acker & David, 1994, p.44). The focus of liberal feminists is to ensure that there are equal opportunities for different sexes. Similarly, Sikes and Measor (1992, p.20) agree that liberal feminism appeals to the "central principles of liberty, equality, and fairness for all to justify women's rights". In educational contexts, their purpose is to remove obstacles that prevent females from exercising their full potential. According to liberal feminists, both boys and girls are presented with the same opportunities in education and the same treatment. Liberal feminists further argue that the same treatment may produce inequality especially if "prior socialisation ensures the sexes typically have differential initial competence or interest in a given subject" (Acker & David, 1994, p.45). The liberal feminists also focus on socialisation, stereotyping and discrimination of females in education. Children are believed to be socialised by parents, schools and the media into cultures, gendered behaviours and sex roles that limit their full potentials. Moreover, Acker and David (1994) claims that socialisation promotes social interactions between different genders which disadvantage girls and women. Liberal feminists are criticised of elitism. This means that their strategies may only benefit very few women to "have careers and join ranks of the powerful, the structures of oppression survive untouched" (p.44). Moreover, O'Brien (as cited in Acker & David, 1994, p. 44) assert that liberal feminists are also accused of changing "the concept of equality of

outcome to equality of opportunity”. Moreover, Sikes and Measor (1992) assert that liberal feminists are also criticised on their over-emphasis on individual freedom at the expense of others in the community.

Socialist feminism

The focus of socialist feminism is to remove oppression by banning capitalism. Their interest is more on the position of females within the family and economy. In educational contexts, the authors are concerned about how schooling structures reproduces class, sexual, social and labour divisions. Socialist feminism challenges curriculum differences not only because females are trained in office skills but because females and girls are not trained in sciences and other related fields like their male counterparts (Acker and David, 1994). Socialists feminists are criticised by radical feminists in that they tend to make alliances with men, in which the “women’s interests are bound to be subordinate” (p.44). Moreover, Sikes and Measor (1992) maintain that socialist feminism argues that schools reproduce gender inequality and class inequality. Sikes and Measor (1992) further assert that labour division is also important in socialist feminist thinking. Socialist feminists also suggest that schools enforce appropriate roles to girls by reproducing the division of labour. Socialist feminism further suggests that schools “play a part in gaining the consent of girls to their subordinate status and to their place in the domestic sphere” (p.25).

Radical feminism

Similar to social feminists, radical feminists focus on changing social structures, which challenge and eliminate male dominance and patriarchal structures. According to Obrien (1983, p.13), “the goal of a feminist education is not equality in knowledge, power and wealth, but the abolition of gender as an oppressive cultural reality”. They also focus on daily life gender politics in schools. For example, teachers giving unequal attention between boys and girls. The radical feminists are accused for “prioritisation of sexual oppression over that based on race and class” (Murphy & Livingstone, as cited in Acker and David, 1994). Unlike liberal and social feminists on education, radical feminists had made limited “attempts to relate school life to the economy and to the family” (Acker & David, 1994, p.50). According to Sikes and Measor (1992), radical feminists focus on the analysis of the way in which patriarchy spreads in schools. They emphasise the power relations between boys and girls in schools. Radical feminists maintain that boys dominate in schools and classrooms which results in negative impact on girls succeeding in schools. They assert that boys

“take the lion’s share of the teacher’s attention” (p.28). The following section describes the feminist interpretations of the theory of social constructionism used by Morojele (2013; 2014).

Social Constructionism is a sociological theory that puts forward a different view, orientation and philosophy about understanding the nature of knowledge (epistemology) and reality (ontology) (Gergen, 1985). The principal proposition of the Social Constructionism theory is that the processes by which people come to describe, explain and thus understand the world (including themselves) in which they live is through communal interchange (socialisation) (Gergen, 1985).

The Social Constructionist theory is also one of the well accepted and fundamental pedagogical theory for understanding learning as the processes by which people come to describe, explain and thus understand the world (including themselves) in which they live (Belanger, 2011). As a pedagogical learning theory, the proposition of Social Constructionism is that learning (processes and what is learnt) occurs through social interaction (socialisation), i.e. what is understood as knowledge and reality is a product of socialisation. The Social Constructionist theory postulates and assumes that learning occurs through all the stages of life and can be applied to infant, child and adult learning (Belanger, 2011). Learning (the processes of understanding the current nature of knowledge and reality) is lifelong, dynamic and contextual (Gergen, 1985; Belanger, 2011).

As with many other theories, the Social Constructionist theory has protagonists/proponents and antagonists/contenders. Feminist thinkers (philosophical supporters of the female gender) are amongst the leading proponents of the Social Constructionist theory (Gergen, 1985). The Feminists’ interpretation of the Social Constructionist theory is that, unlike the Empiricist perspective, it is liberal and accommodative of different approaches to understanding the nature of knowledge and reality (Gergen, 1985). According to feminists’ interpretation of the Social Constructionist theory, it is favoured because its communal basis of knowledge cannot be employed by males to construct views of women that contribute to the defeat, repression and oppression as has been the case with the Empiricist theory (Gergen, 1985).

The Social Constructionist theory and particularly its interpretation by feminists is used as a theoretical framework for analysing the views and beliefs of Physical Science teachers about gender equity in education. Based on the social constructionist theory, it is thought that the views and beliefs of the Physical Science teachers are a product of learning through socialisation. It is thought that views and beliefs of Physical Science teachers about gender equity in education have been developed, matured and adapted to their socio-cultural contexts and experiences of childhood, adult school learners and adult tertiary learners up to the current professional environment. Other researchers support the influence of the socio-cultural contexts, socialisation processes, practices and experiences of the perspectives (including views and beliefs) of people about gender equity in education, for example its influence on school boys (Connell, 1996) and teachers (Haggerty, 1995; Morojele, 2013; 2014). The theoretical positioning for analysing the views and beliefs of Physical Science teachers about gender equity in education is similar to that of Morojele (2013; 2014).

2.8. Conclusion

We live in a society in which women experience a substantial inequity based on their gender. This chapter presented a review on the progress made by the South African democratic government on gender equality, equity issues in general, and education in particular, since it took over from the apartheid government in 1994.

In this chapter, the researcher reviewed the relevant literature on gender equity issues in general, education and science education in particular. This chapter focused on the state of gender equity in South Africa in general and the views and understandings of Physical Science teachers about gender equity. This chapter further presented the policies that have been developed and implemented in South Africa on gender and the conceptual framework that frames this study.

The next chapter presents the research methodology employed in the study.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The purpose of this study has been to explore the Physical Science teachers' views, understandings, beliefs and experiences on gender equity in Umgungundlovu District. This chapter describes the research methodology employed in the study. The chapter begins with an outline of the research approach and paradigm. Thereafter, the research questions and context of the study are outlined. This is followed by a discussion of the sampling procedures for selection of the schools and participants. The data collection instruments and procedures are then described, followed by an explanation of the data analysis process. Thereafter, issues related to ethical considerations, limitations and the strengths of the study are outlined. The chapter concludes with a discussion of trustworthiness.

3.2 Research approach

Qualitative and quantitative researchers collect information and use it to tell a story. They use different research methods to collect and analyse data. Qualitative researchers record videos, pictures and words as their data and identify themes and patterns to create meaning. On the other hand, quantitative researchers collect numbers and quantities as data and use statistical methods to analyse data (Check & Schutt, 2012). This study is located in the qualitative approach. Denzin and Lincoln (2003, p. 5) assert that the qualitative approach includes an "interpretive, naturalistic approach" to the environmental setting. Qualitative researchers study cases in their environments and they try to understand people from their own points of view. The qualitative approach helped me to Gain a deeper understanding of how Physical Science teachers view and understand gender equity in science education from their own perspectives in their settings. The qualitative design was also selected for this study because of its focus on the teachers' "experiences from their perspective" (Roberts, 2010, p. 143). The aim was to explore views and experiences about gender issues from science teachers' viewpoints. Wainwright (1997) asserts that qualitative research aims to get a deeper understanding of information provided by the participants. A qualitative approach also allows the researcher and the participants to have direct interactions, for example interviews.

3.3 Research paradigm

This research is located within the interpretive paradigm. Guba (as cited in Creswell, 2009, p.9) asserts that the research paradigm is “a basic set of beliefs that guide action”. According to O’Donoghue (as cited in Punch, 2009), the interpretive paradigm focuses on the ideas that human beings bring to situations in their own understanding of the world. Interpretivist researchers believe that “educational reality is socially constructed and that the goal of educational research is to understand what meanings people give to reality, not to determine how reality works apart from these interpretations” (Check & Schutt, 2012, p. 15). The interpretive paradigm was suitable for this study because it enabled me to obtain detailed information from the Physical Science teachers about their own views and understanding of gender equity in science education. Teachers shared their own meaning of gender equity, which in turn provided more clarity on how they understood and view gender equity issues in science education. This approach was also appropriate for this study because it facilitated an in-depth understanding of Physical Science teachers’ experiences and beliefs about gender equity in science education.

The critical questions that guided this study are as follows:

1. How do Physical Science teachers understand gender equity in science education?
2. What are Physical Science teachers’ personal and professional experiences of gender equity in science education?
3. What are Physical Science teachers’ views and beliefs about gender equity in science education?

3.4 Context and sampling of the study

This research project was conducted in the Umgungundlovu District in KwaZulu-Natal Province, which was chosen as I was familiar with this area professionally; knew the teachers and schools in this District; it was convenient and accessible. Cohen, Manion and Morrison (2007) define sampling as a process of selecting people who will participate in the study. Sampling methods show researchers how to select participants that can lead to making sound generalisations about the population whom they want to study. Bertram and Christiansen (2014) indicate that sampling is about deciding on people, objects and environments to be involved in the study. The sampling

strategy employed in this study was purposive sampling. Purposive sampling is a process whereby researchers identify the participants for their research based on the “judgement of their typically or possession of the particular characteristics being sought” (Bertram & Christiansen, 2014, p. 156). Qualitative researchers normally work with very small samples of participants in their own contexts. The participants are studied in-depth, unlike quantitative research that requires a large number of cases and requires statistical significance (Miles & Huberman, 1994). Kuzel Morse (as cited in Miles & Huberman, 1994) further assert that qualitative samples are purposive in nature rather than random. This sampling strategy was appropriate for this study as it enabled obtaining information from the Physical Science teachers who had been pre-decided on by the researcher. These teachers were identified as I felt that they would provide me with valid and rich information about their views, understanding, beliefs and experiences of gender equity in science education.

3.5 Selection of schools and participants

Umgungundlovu is a district with 17 circuits and several schools. The Imbali and Edendale circuits were purposively because they have schools that still have Physical Sciences, Life Sciences and Mathematics as some of the subjects offered. The purposive sampling procedure was used to select schools that met the following criteria:

- (i) Schools that were willing to take part in the study.
- (ii) Schools that had Physical Sciences teachers with more than two years teaching experience in the subject.
- (iii) Schools that were not single-sex schools.

Six schools were included in the study. In each circuit, the schools selected for the study were close to each other for the convenience of the researcher. For ethical reasons, only the teachers who were willing to participate in the study were included for the interviews. Eight Physical Science teachers were targeted for the interviews. The sample of teachers for the interviews was initially intended to be comprised of four females and four males in order to balance gender, however I ended up interviewing two females and four males due to gender imbalances among the schools and lack of willingness of many female teachers to participate in the study. The profile of the participants is briefly described in Table 3.1.

Profile of participants

The following table indicates the profile of the participants who participated in the study. The profile of the participants is more clearly described in Chapter Four.

Table 3.1. Profile of participants

Participant's Name	Gender	Age	Qualifications	Teaching experience	Subject taught	Grades
Nhlanhla	Male	49	BEd Honours.	24 years	Physical Sciences, Mathematics	10, 11, and 12.
Nomusa	Female	34	BEd Degree	4 years	Natural Sciences, Mathematics, Physical Sciences.	7,8,9,11 and 12
Smanga	Male	41	Advance Certificate in Education (ACE)	17 years	Physical Sciences	10, 11, and 12.
Lattifa	Female	38	BEd Honours.	10 years	Physical Sciences, Natural Sciences	8, 9 10, 11, and 12,
Muzi	Male	44	Secondary Teacher's Diploma (STD)	19 years	Technology, Physical sciences, Mathematics	8,9,10 and 12
David	Male	27	BEd degree	4 years	Mathematics, Physical Sciences	8,9,10 and 12.

3.6 Rationale for selection of criteria of schools

The first criterion, namely which is the willingness of the schools to partake in the study, was very important because the school with a science teacher/s should be willing to participate. The second criterion, namely schools which have Physical Science teachers with more than two years subject teaching experience was important because the study required the participants to recall and cite their views and understandings based on their childhood experiences, as learners in primary and high schools, as candidates in tertiary institutions and as science teachers. It would have been a problem if a novice teacher was included in the study, because they might not have provided valid information. The third criterion, namely a co-ed (i.e. not) single sex school was also significant because this study is based on gender equity, which involves imbalances between males, females, boys and girls. If the school is single sex, the data might be biased and hence invalid.

3.7. Gaining access

Firstly, I applied for permission to conduct this research from the principal at each selected school. Each school to be included in the study was then visited to select the participants. The Physical Science teachers were selected at the schools to participate in the study through written and oral invitations. Permission was requested to speak to the targeted study participants during the lunch break from the principal of each school. After obtaining permission from the principal of each school, the Head of Department (HOD) for Science in the school was requested to invite Physical Science teachers to a meeting. At the meeting, the teachers were invited to participate in the study. The teachers were given informed consent letters included an explanation of the purpose of the study, what was expected from the study participants and that participation and withdrawal were voluntary. Participants were asked for permission to audio-record their interviews. The names of teachers who volunteered to participate in the study were recorded in a Participant Register. The study participants were given the Informed Consent Forms and asked to sign it after reading and understanding its contents. Suitable dates, times and venues were negotiated with each participant who volunteered to be interviewed, as well as convenient dates and times for follow-up interviews with participants.

3.8 Data Collection

This study employed qualitative, semi-structured individual in-depth interviews as the data collection instrument. The main aim of using semi-structured interviews in this study was to obtain different ideas from Physical Science teachers and how they perceived gender equity and its influence on their personal and professional experiences. Diccico-Bloom and Crabtree (2006, p.315) highlight that individual in-depth interviews provide an opportunity for the researcher to Gain insight in “social and personal matters.” Bertram and Christiansen (2014) indicate that an interview is a dialogue between the interviewer and the interviewee. This discussion is not similar to everyday talking. There is a semi- structured interview schedule and the researcher is the one who asks the interviewee questions. The interview was a suitable and relevant instrument for this study because it enabled me to obtain information from the Physical Science teachers about their views, beliefs, experiences and understandings about gender equity in science education. This data collection instrument enabled me to delve deeply into Physical Science teachers’ experiences and their understandings of gender issues in science education. Teachers were able to ask for clarity whenever there was a need during the interview. The semi-structured interview approach also enabled me ask probing questions during the interview process. Interviews were recorded with the permission of the participants, and later transcribed verbatim.

3.8.1. Piloting interview schedule

Before undertaking this research, a pilot study was conducted. As is suggested by Silverman (2010), it is of benefit to try out different types of questioning methods before conducting the main study. A pilot study is the feature of a good study, both quantitative and qualitative. Two pilot interviews were conducted with colleagues at the school at which I was a teacher and these pilot interviews helped a great deal. Firstly, they helped to develop an interview schedule. Secondly, they helped me to determine whether rich and interesting information would be obtained from the participants. A research study as a novice researcher is not an easy task. As the pilot respondents were providing me ‘no’ or ‘yes’ answers, I was thus able to then change the questions that were not clear or not providing me substantial data. This was thus attended to prior to conducting the main study. Thirdly, the pilot study helped me to practice interviewing technique as prior to this,

I did not have any experience in conducting in-depth interviews. The interviewing style was changed in the pilot study for the better. Lastly, I learnt how to manage the participants, the whole interview process and my own role by learning to listen to the respondent attentively before rushing to the next question.

3.8.2. Data collection process

The data collection instrument that was used in the study was semi-structured interviews. This instrument was appropriate for the study as it enabled me to collect rich, in-depth information from the participants. Most qualitative researchers utilise interviews for data collection. I made three visits to each school. The first visit was to ask permission to conduct the study. The second visit was to identify the dates for data collection. The third visit was to conduct interviews. After the first visit to schools, the principals together with the HODs arranged for interviews to take place on the school premises. One teacher was interviewed offsite due to his busy schedule, and the other teachers were interviewed within their school premises, during which one-on-one in-depth interviews were conducted with a sample of six respondents. Participants were asked about their experiences of gender issues as children at home, learners, trainees, and as teachers. Each interview lasted approximately 60 minutes because teachers were allowed time to narrate their stories. The interviews were audio recorded with the informed consent of the participants. The interviews were later transcribed.

3.9 Data analysis

Cohen, Manion and Morrison (2011, p. 537) highlight that qualitative data analysis involves “organizing, accounting for and explaining” the information. This means that the researcher is trying to make sense of informants’ information. In qualitative data analysis, researchers analyse raw data in the form of text, words and not numbers (Check & Schutt, 2012). Qualitative data are quite attractive because they provide researchers with well grounded, deep explanations and rich information from participants’ contexts (Miles & Huberman, 1984). Several methods can be used to analyse and present qualitative data. Such methods include Content Analysis, Grounded Theory;

and Narratives (Silverman, 2010). After conducting interviews, these were transcribed and thereafter were read several times to enable me to be familiar with the collected data. All the interview responses were then collated in a table according to each research question. Key features from the collated data were identified as were similarities and differences from the data. The transcribed data from interviews were analysed according to the research questions and categories that emerged were identified and coded according to Thematic content analysis by Anderson (1997). Kerlinger (as cited in Cohen, et al., 2011, p. 559) defines coding as “the translation of question responses and respondent information to specific categories for the purpose of analysis.” In this study, inductive data analysis has been employed to interpret and draw conclusions. The data was coded, with the identification of patterns and then identify themes. The conceptual framework was used to analyse the understanding of the meaning of gender and gender equality/equity in education using the four approaches presented by Morrel et al. (2009). To analyse the views and beliefs of teachers about gender equity in science education, the feminist interpretations of the theory of social constructionism, as described and used by Morojele (2013; 2014) was used. The feminists’ theories that were employed in the data analysis were Liberal feminism, Socialist feminism and Radical feminism.

3.10 Ethical considerations

Bertram and Christiansen (2014) define ethics as a behaviour considered being good or bad. The ethical issues discussed here are mainly taken from Cohen, Manion and Morrison (2011); Cohen, Manion and Morrison (2013); Miles and Hiberman (1994) and Bertram and Christiansen (2014) framework for conducting educational and social research. As this study involved collecting data from people, it was my responsibility to ensure that ethical issues were taken into consideration during the entire research process. This study deals with sensitive matters of Physical Science teachers’ lives, which are their views, beliefs, experiences and understandings of gender equity in science education.

Before conducting the research, an ethical clearance certificate was obtained from the University of KwaZulu-Natal through the relevant protocol. The ethical clearance number is: HSS/041/015M. Application was made to the KwaZulu-Natal Provincial Education Department for permission to

conduct the research in Umgungundlovu District high schools. After obtaining permission from the DOE, letters were written to all high school principals in Umgungundlovu District in KwaZulu-Natal province that were sampled for the study, seeking for permission to use educators and schools as sites for the study (Appendix C).

Participants were informed that their participation was on a voluntary basis and they were free to withdraw from the study at any time if they wanted to do so. The participants were given all the information they needed to know about the study so that they fully understood what their participation involved. The participants were assured that the data they provided would remain confidential throughout the research process, and that this information would not be discussed with anyone else except the participants themselves and the researcher. The real names of the schools and participants were not disclosed in the study report/s. Anonymity of schools and participants were assured as those were given pseudonyms in order to protect their identities. The interview recordings were kept in a safe place. I ensured that questions asked during the interview would not harm the participants, e.g. loss of dignity and personal respect in any way.

3.11 Trustworthiness

Qualitative researchers prefer not to use terms such as validity and reliability because of their association with quantitative research. Instead, they use terms such as credibility, trustworthiness, dependability and transferability. According to Botes (as cited in Ndemuweda, 2011), trustworthiness is referred to as the degree of truthfulness and the value of the study. Lincoln and Guba (1985) maintain that trustworthiness in the study is substantial in evaluating its worth. Lincoln and Guba (1985) suggested four criteria that the qualitative researchers can consider to ensure trustworthiness in a qualitative study. According to Lincoln and Guba (1985), trustworthiness entails credibility, transferability, dependability and transferability. Credibility refers to the confidence in the truth of the findings, meaning the congruency of the results with the reality. Lincoln and Guba (1985) claim that credibility is the most important factor in ensuring trustworthiness of the research. Transferability refers to the extent to which the findings can be applicable in other situations. This means the possibility of applicability of another study to other contexts. This resonates with Ndemuweda (2011) given that transferability refers to the relevance

of the research findings. Dependability refers to the consistency of the findings should the study be repeated in similar context, i.e whether researchers would obtain the same results if the study was repeated in a similar context, with the same research methodology. Confirmability is the extent to which the results of the study are the ideas and experiences of the participants and not the interest of the researcher. This means that the results should be shaped by the participants other than the bias and motivation of the researcher.

To ensure the issue of trustworthiness of the study, a pilot study was conducted to check whether the data collection tool would provide the desired information. This was very helpful because it enabled me to modify the interview schedule before conducting the main research. To ensure credibility of the study findings, I selected the participants who were knowledgeable and had experience in teaching science. This enabled me to get different points of view because the participants were talking from their own experiences and were able to accurately remember and recall the issues and events in question. To ensure the credibility of the findings, I employed the line of questioning that was derived from the previous similar projects to collect data. I also used the procedures employed in the previous studies as methods of data analysis. In order to ensure that I obtained the honest responses from the participants when providing data, respondents were given the opportunity to withdraw from the study at any point during the research process to make sure that the data collected only involved those who were willing to participate and to provide data openly. I also encouraged participants before the beginning of the research session to be free and open in order to establish a rapport and to gain their trust. I also told them that there were no right or wrong answers for the questions asked. In order to check for contradictions, I used probes to uncover untrustworthiness.

In addition to ensure the issue of trustworthiness in the study, I recorded each interview and carefully transcribed it to ensure that they were accurate. I also undertook member checking as suggested by Lincoln and Guba (1985) to bolster the finding's credibility. This was done by sitting down with the participants and listening to the recorded interviews to check that nothing was missed during the interviews. At the end of the data collection session, participants were asked to read the transcripts in order to check if their words matched what they intended them to mean.

To ensure transferability of the findings was impossible because the findings of this study were specific to small number of individuals and environments. Therefore, it was impossible to demonstrate that the conclusions and results were applicable to other populations and contexts. In order to ensure the dependability of the results, I discussed and reported the processes within the research in a detailed manner to enable the future researcher to repeat the research should the project need to be repeated in the same context. Shenton (2004, p.71) called such research design “prototype model”. To address the issue of confirmability, I acknowledged the decisions made about the selection of the methods employed in the study and explained the rationale for the selection of criteria.

3.12. Limitations of the study

Firstly, I was challenged by the fact that there were very limited number of studies in this field, especially in South African context. This research would have been richer if there were more input from other researchers, within a similar context. Although qualitative research allows for a natural form of interaction with people in everyday settings, situations and experiences, it also has challenges and limitations. One of the limitation was that as with other qualitative studies, this study was also small-scaled and thus its findings and results are personal, subjective and contextual, and therefore cannot be generalised. According to Boyce and Neale (2006), if the sample is small, the results are not generalizable. Only six Physical Science teachers from different schools in one district participated in the study. The findings from this study therefore had limited generalisability for other districts. Qualitative research does not aim to generalise – to counteract this limitation, the schools selected for the study were spread fairly across the district, which at least increased the intra-district generalisability. Nonetheless, other researchers however, are expected to utilise the findings for the purpose of ‘particularity’ and ‘transferability’ rather than ‘generalisability’ (Creswell, 2009 p.193). Nonetheless, this study was not aimed for generalisability of the findings but to explore the understandings and the views of Physical Science teachers about gender equity in science education.

Another limitation was the possibility of power relations between the researcher and the participants which could influence the interview (Bertram & Christiansen, 2014). For example, the

data sources were Physical Science teachers; there could be power relationship since I was the HOD for a science department. The interview responses would be bias (Boyce & Neale, 2006). The participants could have given the responses that they thought I wanted to hear. This could also lead to dishonesty. To minimise these limitations, I explained from the outset to the participants that in the study I was acting in the capacity of a university student and researcher. It was emphasised to them that they should therefore not view and treat me in the capacity as their Physical Science teacher colleague and HOD. I tried by all means to avoid mannerisms that would have given the image of my capacity as a teacher and HOD. I further ensured that the participants were not directed or influenced in any way during the interview, for example by expressing feelings or gave opinions. I also encouraged the participants to respond as honest as possible.

3.13. Strengths of the study

Despite the above mentioned limitations, this study has some number of strengths as well. Firstly, this research has provided a platform for Physical Science teachers to voice, share and express their understandings and views about their childhood, and professional experiences about gender equity in general, education and science education. This experience for Physical Science teachers is the process that is usually marginalised in education. It was therefore an honour for me to encourage and motive Physical Science teachers to talk about their inner and unheard voices about their experiences of gender, a subject that is often ignored.

Secondly, all the participants after each interview session, confessed that it was a privilege for them to be able to share their experiences of gender which they had never told anyone. For them, it was like a therapeutic process because this research enabled them to “offload” their inner experiences and emotions of gender. They were glad because they were able to reflect on their experiences and some of them were able to identify the discrimination which they faced as children because of their gender. Finally, the findings of this study add to a larger body of knowledge about gender equity issues within South African context and internationally. I therefore believe that the results are true and correct representation of the understandings, views and beliefs of the participants as this now serves as a springboard for future research in this field of study.

3.14. Conclusion

This chapter focused on the methodology and the design employed in the study. The research approach and paradigm of the study has been described and the sampling procedures explained as well as how the research participants were selected. The procedures of data collection methods, semi-structured interviews, data analysis and the rationale behind the selection criteria were also discussed. The ethical considerations, trustworthiness, limitations, and the strengths of the study are stated.

In the next chapter, the findings of the study are presented.

CHAPTER FOUR: DATA PRESENTATION AND THE ANALYSIS

4.1 Introduction

The purpose of this study was to explore Physical Science teachers' views and understandings about gender equity in science education. The previous chapter described and explained the research methodology and the research design of the study. This chapter aims to present, analyse, and describe the findings of the study. The data in the presentation is obtained from interviews with Physical Science teachers. I allowed the participants' voices and experiences to be heard as direct quotations were included in order to display their different and similar views and understandings of gender equity in science education. Bertram and Christiansen (2014) state that using direct quotations is a way of presenting what the participant has said. This was also important because it allowed the voices of the respondents to be included. Pseudonyms were used to protect the identity and to ensure the confidentiality and anonymity of the six study participants. The chapter begins with short biographies of the six Physical Science teachers. This is followed by Physical Science teachers' understanding about gender equity issues in science education, personal and professional experiences of gender equity in education in general and science education. Finally, the chapter presents the views and beliefs of Physical Science teachers about gender equity in general and in science education.

This study sought to answer the following questions:

1. How do Physical Science teachers understand gender equity in science education?
2. What are Physical Science teachers' personal and professional experiences of gender equity in science education?
3. What are Physical Science teachers' views and beliefs about gender equity in science education?

4.2 Profiles of Physical Science Teachers

Two female and four male Physical Science teachers participated in the study. The background information of the teachers included the reasons why the participants decided to continue with

science, people who influenced them and why they become science teachers. The participants gave different reasons why they chose to continue with science, why they became science teachers and people who influenced them. Their views are presented in the sections which follow.

Respondent one - Nhlanhla

Nhlanhla was a 49-year-old male teacher. He had 24 years of teaching experience and was the Head of Department (HOD) for sciences. He had been an HOD for ten years. He taught Physical Sciences in Grade 11 and Mathematics in Grades 10, 11, and 12. His highest qualification was BEd. Honours. His school was located in a township and was a well-resourced school. The principal of the school was a male. When I met him for the first time in his school to ask him about the convenient time for the interview with him, he said that he could be interviewed instantly. Fortunately, I had the interview schedule and tape recorder to hand on that day. We then went to his office and that was the beginning of our interview. I began by thus asking Nhlanhla about why he chose to do science subjects in school. He indicated that his teachers and parents influenced him to pursue science subjects. This is how he responded:

“My teachers and parents influenced me to be a science student because they would say that you should do sciences to become an Engineer or a pilot that’s what a man must do. Miner Geologist is the work of a man. They would tell me that never go to become a secretary or a nurse that is for females and the hard sciences particularly Physical Sciences is for male. The same way when choosing the subjects, the teachers would say that, so they influenced me that way”.

When asked whether teaching was his first career choice, he confidently gave the following response:

“No. I wanted to be an Applied Scientist”. He mentioned that he did not like teaching because teaching and nursing were careers that were associated with female fields. He appeared to believe what he was told by his parents and teachers that men should do Engineering and sciences. Nhlanhla indicated that although he could not become a scientist, he stills enjoyed teaching because he liked sciences subjects.

Respondent two - Nomusa

Nomusa was a 34-year-old female teacher. She had four years of teaching experience. Her highest qualification was BEd Honours. She taught in a combined school located in the township and was a very under-resourced school. Although the school was a combined school, they had a very low enrolment. The principal of the school was a male. She started teaching in 2012 in the same school. She was teaching Grades 7, 8, 9 Natural Sciences and Grade 12 Mathematics and Grade 11 Physical Sciences. When I asked her if teaching was her first career choice, she responded,

“No. I had a passion for Psychology”. Nomusa indicated that she could not do psychology due to financial constraints from home. She then started working at University of KwaZulu-Natal (UKZN) canteen in order to raise funds for studying. She indicated that she enrolled for the Bachelor of Education (BEd) Degree at University of South Africa (UNISA) as a part time candidate, because she would be able to study and work at the same time. She mentioned that she chose teaching because she also knew that she would secure a job very easily in teaching because science teachers in South Africa were in demand. When asked about what influenced her to continue with sciences, she explained, “My parents did not play the role but the teacher did play the role because he knew that I was good in which subjects. The [application] forms we filled in, checked by the teachers and they would see that you qualify for which field of subjects in Grade 10. In the class I registered for, we were selected according to our performance and marks. So I was amongst those who were selected so I would say the teacher played a huge role and the parent did not”.

Respondent three- Smanga

Smanga was a 41-year male teacher. He had 17 years of teaching experience and he was a Head of Department (HOD) for sciences. He had been an HOD for sciences since 2011. His highest qualification was Advance Certificate in Education (ACE) with specialisation in the Physical Sciences. His school was in a township. It was a technical school and the principal was male. When I asked him if teaching was his first career choice, he responded, *“I wanted to be a Mechanical Engineer”*. He taught Physical Sciences Grades 10, 11, and 12. He indicated that he could not do Engineering because during his time there were no career exhibitions to guide them through career choices these are done now. Moreover, he ended up doing teaching even though it was not easy for him to get through college. When asked about people who influenced him, he stated, *“From*

my parents they never played any role because they were illiterate. What I believe to all those learners who were born by illiterate people or have a lower standard of education they never get an encouragement from home. You cannot compare illiterate parent to literate parent and those parents who were educated used to channel the younger kids. I can say that that was a lack of support, which was caused, by lack of standard of education from our parents. At school influences of teachers, our teachers used to divide us according to feminine and masculine subjects. For example, home economics was for girls and sciences were for males”.

Respondent four - Lattifa

Lattifa was a 38-year-old female teacher. She had 10 years of teaching experience. Her highest qualification was BEd Honours. Her school was situated in a township area and the principal was a female. Lattifa started her career in 2005. She was teaching Physical Sciences in Grades 10, 11, and 12, Natural Science in Grades 8 and 9.

When I asked her if teaching was her first career choice, she responded,

“Teaching was not my first career I wanted to do Biomedical Technology and I didn’t receive response on time and ended up doing teaching. I never thought of teaching as a career in my life. I went to teacher training only because I did not receive the response on time from where I wanted to study”. Lattifa indicated that she studied teaching because she could not get into her first career choice and she spent the whole year at home doing nothing. The following year, she was assisted by a relative to secure a place to study teaching from 1997 to 1999 at a College of Education. She also indicated that she started studying towards Secondary Teachers’ Diploma during the second term. When asked about people who influenced her to do science subject she highlighted, “in high school I did not choose to do sciences. My Grade 9 teachers advised me to do sciences in Grade 10. I was doing home economics and my teachers took me out from that class without giving me the reasons. Maybe they saw potential in me. However, by that time we were never encouraged or given the guidance on how to select subjects in Grade 10. I also did not choose to be a science teacher. I went to teacher training only because I did not receive the response on time from where I wanted to study. Back then, things were not easily accessible as it is currently. The person who influenced me to be a teacher was my relative who also arranged for me to get into Teacher College. The person who interviewed me was the one who influenced me to be a sciences teacher because he saw my good results”.

Respondent five - Muzi

Muzi was a 44-year-old male teacher. He had 19 years of teaching experience. His teaching qualification was a Secondary Teachers Diploma (STD). His school was located in a township and the principal of the school was a male. When I asked him if, teaching was his first career choice, he responded: *“I wanted to become a doctor. I had no reason for not to continue. Anyhow, I got into teaching as a second choice and there were not acceptances into medicine until after I had started doing teaching qualification at university”*. He was teaching Technology in Grades 8 and 9, Physical Sciences in Grades 10 and 12, and Mathematics in Grade 10.

Muzi indicated that he ended up doing teaching because he was not accepted in medicine. It was unfortunate for him that they only opened for admissions when he was already doing teaching. When asked about people who influenced him to continue with sciences, he responded, *“both my teachers and my parents influenced me to do sciences”*. Moreover, Muzi indicated *“because of career guidance I got from my school principal, he encouraged me to do science so I became interested in those subjects.”*

Respondent six - David

David was a 27-year-old male teacher. He had 4 years of teaching experience. His highest qualification was BEd. Degree. His school was situated in a township and the principal of the school was a male. He was teaching Mathematics in Grades 8 and 9, Physical Sciences in Grades 10 and 12.

When I asked him if teaching was his first career choice, he responded,

“No. I love commerce; I wanted to be a Chartered Accountant not a teacher.” David said he was admitted in Commerce but one day, representatives of the Department of Education came to discuss the Funza Lushaka Bursary scheme. They were recruiting for people who were interested in teaching and he decided to leave Commerce because of financial constraints, and use this opportunity from the Department of Education. This is how he became a teacher He also mentioned that at the beginning of his profession, he intended to leave teaching with the hope that he would register for BCom degree but he jokingly said that he was not even registered for first year ‘up to now’. He indicated that his parents did not play a role in encouraging him to pursue sciences only his teachers.

Most of the teachers also did science subjects because either they enjoyed the subjects or they wanted to explore things. It was surprising to learn that almost none of the teachers chose teaching as their first career choices. Most of them wanted to do something else but they could not because of the different reasons cited. Nevertheless, five participants' first career choices were science related fields. Only David's first choice was Commerce. In addition, those parents who influenced the participants to continue with the sciences influenced them to do it because they thought the science was for boys. The participants indicated that the role played by their teachers in channelling them into the sciences was based on participants' performance. Teachers were the ones who knew in which subjects the participants were good, based on their school performance. The forms they filled in were checked by the teachers and they would see that you qualify for which field of subjects in Grade10.

4.3 Presentation of findings

In this chapter, the key findings from the data collected from the six participants of study as discussed in Chapter Three is presented. The data were analysed within the conceptual framework and literature review discussed in Chapter Two. After the key findings and analysis are presented, I provide some conclusions and synthesis into the findings according to the research questions.

4.3.1 Physical Science teachers' understanding of gender, and gender equity in science education

This section addresses the first research question, which deals with the understanding of gender equity in science education of Physical Sciences teachers who participated in the study. The understandings discussed in this section are related to gender in general, gender equity and gender issues in science education. Teachers were first asked about their understanding of the meaning of gender, sex and gender equity. The purpose of asking this question was to explore if they understood and distinguished between these concepts. The interview responses showed that the teachers had varied ideas about the meaning of the concepts of gender, sex and gender equity. The results revealed that teachers understood gender as male or female and as socially constructed. They understood gender equity as equal distribution of resources and access to opportunities, and they also understood gender equity as fair treatment of both males and females.

4.3.1.1 Gender as male or female

When asked what they understood sex and gender to mean, participants in this study gave answers that showed varied understandings of these terms. Five of the participants understood gender as referring to male or female. Nhlanhla understood gender as *“the different roles played by males and females in society”*. When probed on the different roles played by both males and females, he indicated that *“in a home set-up, females will be doing roles that are normally performed by the mother the roles that are associated with the home chores of cooking, cleaning the house, looking after the children. Whereas, the boys will be performing roles that are in relation to what the father also does like cleaning the cars, as well as working to the cars, mending fences, repairing the house, all that kind of work, masculine work”*. Nhlanhla also understood sex as *“something to do with genitallia that a person is male or female”*. Smanga added, *“by gender we mean people who are different in terms of sex biologically and that thing was created by God and no one can change that”*. Smanga further defined sex as is *“where each group of living things are place according to their function and the process of reproduction”*. Lattifa, Muzi, David and Nomusa shared the same understanding of gender on that *“if you are in a group you will identify yourself as a male or a female”*. Lattifa added, *“sex has to do with the difference in biological reproductive organs of human beings. This is a characteristic that is used to classify a person as a boy or girl”*. Furthermore, David elaborated on that *“I see myself as a male with male genitals, deep voice, beard, and broad chest. I was born as a male and no one can change this fact. Even if a surgeon cuts my penis, I have other elements that tell me that I am a male”*. This understanding of sex is in line with Sikes and Measor (1992, p.5) that sex *“refers to the most basic physiological differences between men and women-differences in genitals and in reproductive capacities”*.

David also acknowledged that gender denotes *“a number of characteristics that categorises human beings as either feminine or masculine”*. When asked him to elaborate on this, he mentioned that *“I was not born with a specific gender but society that I found myself in gave me. My father, my mother, my siblings, extended family, and society grew me up as a man and not a woman. In other words, they dressed me masculine clothes, exposed me to balls and not dolls, trained me how to behave as a man, and above all they gendered me into various roles that society perceives them as masculine”*.

By contrast, Muzi understood gender and sex as the same thing. He defined both as “*male and female*”. Nomusa understood sex as mentioning yourself “*as a boy or a girl*”. This understanding of gender and sex is in line with the first approach from the conceptual framework by Morrell et al. (2009). This approach highlights that gender means boys or girls. In addition, gender was also understood as something that was created by God and that was never changing.

The findings showed that participants understand sex as associated with the human reproductive organs, whereas gender is associated with maleness or femaleness. This understanding is in line with Jackson and Scott (2002, p. 1) where they define gender as “hierarchical division between women and men” and state that sex “refers to a person’s biological status and is typically categorized as male, female embedded in both social institutions and social practices”. Gender is understood as different biological features which individuals are born with. This is not socially constructed or learned. Under normal circumstances, people are born with different female and male private organs. These private organs are not changing. Moreover, this finding agrees with Connell (2009, p.9) on that gender is the “cultural difference of women from men, based on the biological division between male and female”. Here, biological understanding of gender is assumed to mean different biological sexuality between males and females.

4.3.1.2. Gender is socially constructed

The results from the study revealed that two of the six participants in this study also understood gender as socially constructed in society through roles that society assigned to people of different sexes.

Nhlanhla explained gender as *also “socially constructed – this refers to the roles males and females played in society”*. David shared the same sentiment with Nhlanhla that gender is a “*social construct within our own cultures, religion, education institutions, family structures, and so forth*”. This concurs with Grown, Gupta and Kes (2005, p.30) who argue that gender “defines and differentiates the roles, responsibilities, obligations, and social norms of men and women”. This understanding is in line with one of Morrell et al., s (2009) categories of understanding of the concept gender. In terms of the conceptual framework, this indicates that gender can be understood as socially constructed through relations between men and women.

According to Sikes and Measor (1992), gender is created by society. Gender also determines “specific social and cultural patterns of behaviour and social characteristics of being a man or a woman in a particular historical and social circumstances” (p.5). Gordon and Browne (1989, p.412) explain socialisation as “the process through which the child learns which conduct is acceptable and what the community expects of him”. Moreover, Holmes (2008) asserts that agents of socialisation such as family, school, media, and workplace teach girls to be caring, and boys to be tough, strong and independent.

In families, communities and societies children are socialised differently according to their gender. Through socialisation, children learn expected social behaviour, conduct, gendered roles, norms, values, attitudes, morals and culture. The socialisation process begins at home where children interact with their parents from birth. It is through this process where the child understands himself or herself as a boy or girl and what the society expects of him or her. The way in which people live their lives is determined by socialisation. The way people dress, talk and walk is socially constructed. Within societies, there are different patterns of socialisation that promotes girls to become “feminine” and boys to become “masculine” (Sikes & Measor, 1992, p.8). Therefore, gender is socially constructed through daily interactions, and social division between males and females through social division according to different roles, responsibilities, obligations, and social norms within societies.

The participants in the study understood gender to mean male or female and socially constructed. In my view, male or female understanding was more prevalent than socially constructed because this understanding was more prevalent as according to Holmes (2008), people tend to believe that males and females are born different, so this means that “they have different bodies, different biology, different psychology and therefore they act differently” (p.1). Moreover, Connell (2009) asserts that people instantly see a person as a male or female, boy or girl, man or woman. It is my assessment that the participants understood gender as features that are biologically determined rather than socially constructed. The socially constructed understanding of gender was more problematic because this is not general understanding of gender. It differs from society to society. For example, in other societies, women wear skirts and men never wear skirts. This is entirely socially constructed. The current understanding of gender as socially constructed is being invoked because the socially constructed notions about gender are significant in understanding a person’s

identity, behaviour, actions etc. According to Holmes (2008), understanding about gender might be “embedded in social structures”. These social structures could result in different patterns of “femininity and masculinity” (p.56). The majority of the teachers in the current study understood gender as defining whether a person is a male or a female (sex) based on genital organs possessed. A minority of the teachers understood gender as socially constructed in terms of the different roles a person played within a given society - these roles are categorised according to femininity and masculinity.

These findings indicate that the participants had different understandings of gender, which is in agreement with the literature. The understanding of gender as indicating the biological nature of a person with regard to genitalia (male or female) shown by the majority of the participants is in accordance with one of the two definitions of gender found in the literature, for example Mda and Mothatha (2000); Holmes (2008, p.2); and Ryle (2015) state that sex or gender denotes the biological differences between men and women based on the kind of body which they have. The understanding of gender as socially constructed masculine and feminine roles is another well accepted definition of gender (Jackson and Scott, 2002, p. 1; Holmes, 2008, p. 2). Therefore, the majority of the teachers had acceptable definitions of gender, which indicates that they had the knowledge of the concept of gender. Differences in the understanding of gender amongst the participants is likely to result in differences in their understandings of and views about gender equity. The results about the understandings of gender equity fits in the first approach of understanding gender equity that was discussed in section 2.7.1., and liberal feminism of the conceptual framework because teachers understood gender as girls and women, and understood gender equity as equality of resources and opportunities.

4.3.1.3. Gender equity is equal distribution of resources, access to equal opportunities, and fair treatment

The results revealed that participants in this study had different understandings of gender equity. Two of the six teachers interviewed understood gender equity as the equal distribution of resources and equal access to opportunities. When Nhlanhla was asked about the definition of gender equity, he indicated that *“in the gender equity it will be the equal entitlement or ownership related to either males or females”*. When asked him to elaborate, Nhlanhla stated, *“so if it is gender equity it will means that there are equal opportunities for males and females to access resources, to*

access opportunities for learning and all that". It was evident that Nhlanhla understood gender equity very well, but when he explained gender, he seemed to define it as different gendered roles. He seemed to contradict himself. Lattifa also agreed that *"gender is equal distribution of resources, access to opportunities, fair treatment amongst females and males in societies, communities, and institutions"*. This concurs with the Gender Equity Task Team's gender equity definition, which is the promotion of equal opportunities for men and women. Gender equity is not only about the provision of equal opportunities, access to resources and educational opportunities or gender parity. It is to provide the required conditions for gender equity to happen and to be achieved.

The results also revealed that some participants understood gender equity as the fair treatment of females and males. Muzi and David understood gender equity as *"giving men and women fair opportunities and equal treatment of men and women regardless their different needs"*. Muzi also expressed a similar sentiment when he described gender equity as *"the fair and considerate treatment of persons given their sex/gender and the historic/previous treatment or biases based on traditional stereotypes and/or beliefs about sex/gender expectations in society. In science education, females have historically not been given the space and support to pursue education in science"*. When probed, David elaborated, *"for instance, women in South Africa have been marginalised. Thus with gender equity, the state allocates economic support to them in order to raise them to a more decent state. The proponents of gender equality would say that men and women are equal while gender equity promoters would say that men and women are different and therefore their needs and opportunities ought to be considered differently. For example, more funding to support girls doing science subjects, safe classrooms for girl students (rape cases), free sanitary towels in primary schools and so forth"*. The understanding of gender equity as equal access to opportunities and fair treatment correspond with what was reported by Gender Equity Task Team Report (as cited in Mda & Mothatha 2000, p. 40) which is *"concerned with the promotion of equal opportunities and fair treatment for men and women in personal, social, cultural, political and economic arena"*. This understanding of gender equity is in line with the second approach discussed in the conceptual framework, which relates the understanding of gender equality with the removal of structural obstacles to gender equity, gender bias laws, unfair treatment at work and schooling and unequal distribution and access to resources.

Smanga added, *“by gender equity we mean to say people having the same position in terms of sex or the numbers are equal. For instance, let us say that in a company they have equal numbers of females and males. Any company around SA according to constitution must employ equal numbers of males and females but this is still doesn’t happening”*. This understanding of gender equity is in line with the first approach of the conceptual framework of understanding gender equality. Gender equality is understood in terms of equal numbers for boys and girls, women and men. Nomusa highlighted that *“I am not good with gender things”* when she was asked about her understanding of gender equity. This response indicated that she did not understand gender equity.

It my view that the understanding of gender equity as fair treatment between men and women was more dominant over equal distribution of resources and access to equal opportunities. This finding indicated that participants in the study understood gender equity as fair treatment. The understanding of gender equity is being assumed to be fair treatment because in the past, South African women (irrespective of their race) had always been disfavoured by the past policies and laws. After the democratic elections in 1994, South Africa implemented equal opportunity and affirmative action legislation for South African women to address the imbalances of the past. Therefore, inequity issues of women became important including their “rights, equality, welfare and empowerment” (Mathur-Helm, 2005, p.57). Thus, recently the understanding of gender equity as equal distribution is being undermined and invoked because the Gender Policy Framework (GFP) will never be achieved unless women in South Africa have equal “opportunity, access to resource sharing, control and decision making in the economy, provision of services, and access to fair treatment” (Mathur-Helm, 2005, p.57). Therefore, although South Africa has implemented the gender policies as discussed in the literature review chapter, their effectiveness and success is still questionable and under debates (Mathur-Helm, 2005).

Five of the participants understood gender equity as the equal distribution of resources and access opportunities and fair treatment to both males and females. The teachers’ understanding of gender equity is the same as defined in the literature, for example UNDP (2000) and Mda & Mothatha (2000, p. 40). Therefore, these findings indicate that the teachers in this study do have reasonable understandings of gender equity in general. This corresponds with Monyemore (2012) findings of primary school teachers on gender issues pertaining to gender balances with relation to males and females within their society. Monyemore (2012) found that teachers understood the South African

Constitution's clause very well which aims at eliminating all forms of discrimination regardless of gender, race and ethnicity. These findings fit within liberal feminism, as their focus is to ensure that there are equal opportunities for both males and females.

4.3.1.4. Gender equity issues in science education

The results from the study showed that participants understood that gender equity issues in science education is about giving males and females equal opportunities to participate in the sciences. When teachers were asked about what constituted gender issues in science education Nhlanhla explained: *"I think it is about whether there is an equal opportunity to do sciences or to be professionals in the sciences between the females and males. If there's equity that means the opportunities to do sciences, to do science education, to be a science practitioner these options are equal to boys and girls or for male and females."* In addition, Lattifa and David agreed with each other *"gender equity issues are about giving boys and girls equal opportunities to do sciences"*.

This corresponds with how Rarieya et al. (2014) defines gender equality in education as females having equal learning opportunities as their male counterparts. They further suggest that an equity approach to gender in education means that females must be given more in order that equality will be achieved. The policies implemented in South African education have resulted in gender equality in enrolment and participation of both male and female learners. The success in terms of access is also prevalent, but the quality of educational experiences for the majority of learners remains critical (Moletsane, Mitchell & Lewin, 2010). Rarieya, Sanger, and Moolman (2014) claim that schools remain the institutions where boys and girls continue to experience gender inequities, as a result it is so difficult to deal with gender inequities because they are escalating instead of improving. This argument is line with the study by Naidoo (2010) on the construction of gender. Naidoo (2010) found that boys and girls exercised power that was shifting and constantly negotiated between them. The results from the study by Naidoo (2010) indicated that the "construction of masculinities and femininities were performative act that were context dependent" (p.83).

On the other hand, Smanga and Nomusa seemed to have no idea about gender issues in education. Nomusa said that she studied a gender module at university level, but when asked about the gender

issues studied, she seemed to have forgotten or not to know about them. She even claimed that she does not focus on gender issues. This is what she stated in isiZulu: *“Mina angifocus ezintweni zegender”* (*“I don’t focus on gender issues”* English translation). On the other hand, when Smanga was asked about the gender issues in education and in science education, he demanded that I give him the dictionary so that he can look for the concept in the dictionary before he answers that question. He finally responded *“from my experience, before the early 90s, there was no issue with gender equity as such; there was stigma even at post-secondary level that females were distinguished”*. This indicated that he had no understanding about gender issues in science education. When Muzi was asked about specific gender issues in science education, he honestly responded: *“I am not sure about specific issues, especially in education.”* At first, Muzi seemed to understand gender and sex as to mean the same thing. Nevertheless, he had an understanding about gender equity. Despite this, he indicated that he had no idea about gender issues in education. In my view, this poses a serious problem for the education system because teachers are seen to be change agents. If a teacher is not aware of gender issues in education, how can he address gender inequity at a school level?

Three teachers understand gender equity issues in science education as encouraging and bringing more females and girls to do sciences. In other words, they understand gender as the proportion of girls to boys. These teachers think that in terms of numbers, girls are almost equal to or are above the number of boys in high schools. They also understand gender issues in terms of male dominance in science education. About three of the participants had little understanding of gender issues in education and the other three had no idea on specific issues on gender equity. Overall, these results show that a significant proportion (about half, which is 3) of the teachers in this study have no understanding of gender equity issues in education. This is likely to impact negatively on their contribution to the achievement of gender equity in education.

Devine (2003) asserts that inequality in education is an infringement of the rights of women and girls as a result, this will impede social and economic development (UNICEF, 2003). In recent studies, gender and science have gained much attention. However, with all this attention, girls and women continue to be underrepresented in the sciences. In other words, very little has changed for girls and females in science related fields and careers. The literature still reports about women still lagging behind males in Science, Mathematics and Technology (SMT) education; persisting

gender stereotypes in education; continuation of females to enrol in feminine careers such as nursing and social work; and male domination in the hard sciences (Masanja, 2010, Chikunda, 2010). This level of understanding of gender equity issues of the participants in the study is somehow a problem because the current literature highlights that science education is in crisis in South Africa. If participants in the study have little understanding of gender equity issues in science education, this will accelerate the problem instead of addressing it. These teachers are expected to see the underrepresentation of girls in science education and gender inequity as serious gender issues. This would mean that teachers need to be sensitised about gender equity issues in science education and should be aware of some of the factors that impede the success and access of girls in science. This study found that participants have some basic understanding of gender equity issues in science education. However, they do not focus on gender equity issues in general, education, and science education in particular because they indicated that before the interviews, they did not see gender equity as an important topic or something that needs to be discussed.

One of the key findings of this study is that Physical Sciences teachers have some understanding of gender equity concept in general. However, the extent of their understanding of gender equity issues in science education is very limited. One of the participants even indicated that she does not focus on gender issues. This finding is similar to what Monyemore (2012) found in a study that investigated teachers' views on gender equity in primary schools in Soweto, Gauteng. Teachers from the study lacked understanding of gender equity issues because during their teacher training they did not receive training on gender equity in science education issues. In addition, gender equity issues are not the centre of attention in the workshops that are organised by the Department of Education. The participants' limited understandings of gender equity issues in science education have confirmed my claim that there is a need to educate and train teachers on gender and science issues. They need more knowledge on gender equity issues in science education so that they will be able to confront gender inequity in high schools. The majority of the teachers indicated that there is gender equity in science education up to certain extent because of their understanding of the equity clause in the South African Constitution which eradicates all forms of injustices for every citizen. Here, gender equity in science education is understood as being whether there are equal opportunities for both males and females to study the sciences or whether they are treated

equally. The findings also highlighted that teachers believe that there is no gender equity in education in general because in schools there are large numbers of male school principals as compared to females. This trend was also observed when I was doing recruitment at the schools, one female principal was found.

4.4 Physical Science teachers' personal and professional 'gendered' experiences

This section addresses the second research question that deals with the Physical Sciences teachers' personal and professional gendered experiences. In this study, the experiences discussed are related to experiences of gender at home as a child; as a learner in primary and secondary school; in school science; post school education; teacher education and curriculum; and as a physical teacher in school and in the classroom. I decided to group these categories as above because French and French (as cited in Gaine & George, 1999) suggested that the educational experiences of boys and girls are a three-fold process namely:

- (i) Children learn gender identity through the primary socialisation process at home, involving the media, the toys they play with, and the comics and books that they read.
- (ii) They consequently arrive at school with firmly embedded ideas of gender appropriate behaviour and attitude.
- (iii) Schools through their organisational structures (both formally and informally) reinforce these stereotypes (p. 82).

4.4.1. Personal Experiences of gender at home and community as a child

Participants were asked to talk about their personal experiences of gender from home and the community. This section discusses the following themes that emerged from the interviews: labour division in the home and community and parents valuing boys more than girls.

4.4.1.1 Gendered Division of labour at home and community: *We grew up doing different chores.*

When the participants were asked about their experiences while they were growing up in their families, the findings showed that the girls' duties were perceived to be softer to accommodate their sensitive nature and to develop their nurturing skills. The girls would normally do the same

work as their mothers and boys would do the work done by their fathers. The findings showed that household chores were divided according to femininity and masculinity. Nhlanhla responded, *“it was according to gender lines that the domestic types like housekeeping, cleaning cooking was for my sisters and the hard work-manual work, like looking after animals, and making repairs all that were for the boys”*. David added, *“we grew up doing different chores. Our sisters prepared meals and washed the dishes. They knew that it was their responsibility to feed us. Boys’ work was tearing the land, grazing cattle and so forth”*. Smanga summed up the household chores of these teachers as *“girls were doing domestic work like washing dishes cleaning the house, cooking and doing all the work that was supposed to be done by girls. We as boys were doing gardening, looking after cows and goats then the work was divided according to gender lines. You could not find me washing the dishes, because even if I am willing but my parents will shout at that one”*. This division of labour according to gender lines is consistent with what Connell (2006) affirms that in many societies and cultures, certain duties are performed by females and some by males.

It was surprising to find that no male participants felt bad about the different labour division because they thought that it was tradition and culture, whereas female participants felt that it was not fair to them. Male teachers indicated that this is how it should be done because of their culture and tradition. When teachers were asked about how this division of labour made them feel, Nhlanhla stated, *“it was fair. I had no problem with it because I found it not to be difficult because it was part of the culture. When I grew up I was always told that this is for girls this is for boys and we just joined that band work so we had to do our work as assigned to boys and girls assigned to their chores, we never thought there could be any change to it. We just grew up with it, lived in it”*. Smanga also agreed with Nhlanhla *“I didn’t feel bad because the way I grew up it was like that and now where I am, because I am an educator now I see that that was wrong but by that time I did not feel bad. I thought it was cultural, it was procedural we should live with it”*.

The male teachers also indicated that there were no specific issues with different labour division because this is what was happening in the community. David elaborated: *“this division of labour was so because our society had categorised them as either male or female roles. It made me feel as one going through what the society believes a man should do in order to be accepted in a society”*.

On the other hand, female participants indicated that this was not fair to them because all the domestic work was done by them and they said that this was too much to attend to. Their household chores were so demanding that they did not have even time to play with other children, whereas boys would have enough time to go out to socialise and play with other boys. It was even worse if you are a first-born in your family because you will be expected to look after your siblings. Lattifa unhappily stated, *“I felt very sorry for my sisters because they have to do all the work and also look after us. And they were beaten time and again even for crimes they did not commit”*.

Nonetheless, the male participants did not see anything wrong with different labour divisions at home while it was in practice, but they indicated that it affected them as they grew older. Since the labour was divided according to gender, they did not learn how to do domestic work. When it was time for them to start working and becoming tenants or to live on their own, they indicated that they struggled because they were supposed to do their own household chores. Some of them even could not cope when it was time for their sisters to get married because they were expected to do cooking and other feminine chores. Smanga stated, *“I was a tenant one day where I was doing girls’ work. Washing dishes cooking etc., it was very difficult for me because they never groom me to do that in the earlier experience but later it takes some time for me to keep the house clean and to cook. And everything, it affected me in a big way”*.

David also added, *“this changed with time when my sisters got married. My brother and I started cooking. We lost that gender privilege of eating meals that we never cooked”*. These results are consistent with what Joseph (2011) found in the study of boys’ perceptions about gender. He found that females and males received different treatment at home. Work was divided according to gender. This gendered division of labour corresponds with what Walters and Manicom (1996) called the first pillar of patriarchy. This is “the sexual division of labour that assigns men and women to different occupations and thus to different levels of prestige and reward” (p.23). This gendered treatment channels boys and girls to different levels of expectations, as they grow older. According to the interviews, four out of six participants grew up in households that were dominated by girls. The findings revealed that the older girls in the family attended to most of the household chores and looked after their younger siblings while their parents were working. This girl domination exposed these girls to more gender inequity, because some of them were doing tasks that could have been done by boys. The findings presented above highlight the cultural norms of

division of labour according to gender lines. From the findings, it was noted that in almost every household participant's, the work was divided by gender. This resonates with Kimmel and Holler (2000) that "labour is divided according to gender lines (as well as by age)" (p.50). Labour is assigned to males and females according to their gender. This means that in families and societies, there are tasks that are reserved for men and others are reserved for women. From this perspective, the gender division of labour is explained based on the biological meaning of gender. This means that if you are a boy you are expected to go hunting and if you are a girl you will cook and do the washing.

4.4.1.2 Girl-children as "passers-by"

When participants were asked about whether they were discriminated against because of their gender by their families or the community in which they grew up, the findings revealed that parents and communities valued boys more than they valued girls. The results also revealed that males were privileged and were given more freedom than females. Nhlanhla stated, *"my parents tended to look at the boys as the continuity of the family. We will continue our family as boys, whereas girls were looked at as passers-by that would leave our family when they get married. Therefore, there was unfair investment in both of us. If resources were very scarce, my parents would opt for the boys to continue with education and the girls discontinue. The reason being that my parents believed that it was not wise to invest in the education of a girl child because she was a passer-by who would later leave the family for marriage"*. He further added *"as a boy, I actually think that I was not discriminated against, because the community seemed to put more value on boys than girls as the boys were viewed to be the next household heads. As boys, we were always exposed to challenges that would make us stronger and develop more"*.

The results revealed that families and communities had different moral expectations between boys and girls. It is clear from the above responses that the participants were not treated equally at home and in the community. This was due to the fact that boys were trained to be like the family heads who would take over and carry on the family name once the father passed on. However, girls were seen as passers-by who would get married one day and leave the family. Nomusa explained, *"no I don't think I was the favourite child because most of the household chores were done by me. And*

if I didn't do them I would be punished and if the boy did the same thing they would say he is still the child". Although this was culture and tradition according to the results, female participants did not like it, they indicated that it was discrimination on its own.

Muzi remarked, *"in the community, boys were expected to be in the street and to be strong and naughty. Girls were expected to be good and at home doing something to keep the home homely. Specific families did specific things, but the general was along those lines"*. It should be mentioned that most male participants felt that girls were favoured in terms of punishment compared to boys. Males received harsher punishment because they were trained to be strong men.

Furthermore, David added *"my sisters were actually working more than I did which I consider it the process through which people are taught how to behave as discrimination per se based on the fact that they are women who were trained to be good future housekeepers for their families. However, with regard to corporal punishments I think we boys received a heavier spanking than our sisters"*. This is consistent with what Holmes (2008) called socialisation, and more specifically it fits into the social constructionism theory (Gergen, 1985) as explained in Chapter Two, section 2.7. Holmes (2008) defines socialisation as the process through which people are taught how to behave and Gergen (1985) states that people understand the world they live in and define themselves through social exchange (socialisation). Thus, the findings presented here indicate that the teachers participating in this study had gender related experiences through social exchanges (socialisation) as part of the community. Social Constructionism theory proposed that the learning processes occurs through social interaction. Teachers' understanding of their experiences of gender are the product of socialisation.

The results revealed that the way in which these teachers were socialised was according to gender lines. Nhlanhla explained, *"they would tell that you will do this because you are a girl and do that because you are a boy. And we would do that without questioning their authority"*. The results showed that, according to their culture, the male would always be in authority and superior over woman. Teachers stated that even the Bible mentioned that the male is the head of the household. They stated that even if you can think that you are equal to a male, this will fail because this is against the Bible and culture. This finding corresponds with what Connell (2006) called masculinity. He explained that the historical ideas and meaning of masculinity had the view of the

“male sex role,” which was linked with power, authority, dominance, bravery, and heroism. From the findings, the differential treatment and identification were recognised as responsible for gendered role socialisation. This gendered role socialisation was seen as working within the family and the society as a whole. This means that the participants were dealt with differently depending on their gender or sex by parents and other adults within the community and society. Through this social constructionism theory, the participants modelled different expectations, behaviours, and standards according to their different gender. This in turn encourages female emotionality, which is that it is fine for women to cry. This is consistent with socialisation process as defined in Chapter Two, section 2.5 as the phenomenon through which people learn knowledge, values, language and social skills to conform to the norms, customs and roles needed within a certain community.

The child’s socialisation depends on his or her interaction within family, community, and societal contexts. The parental differential socialisation encourages the appropriate behaviours and discourages inappropriate behaviour for both boys and girls. Parents also have hopes and wishes about the kinds of people that their children will become as they grow older. That is why they socialise their children the way they are doing because they want to install the roles and behaviours and personalities they want their children to play and portray as adults. It is this childhood socialisation which creates gender differences, and gender inequities.

The baby becomes socialised even before she or he is born because the baby is born into a society that hold gender expectations and assumptions that existed within the society long before the baby came along (Ryle, 2015). Gender experiences begin even before children start schooling. These experiences teach people how to become men and women.

This finding corresponds with Ryle (2015) who argues that in other cultures more value is placed on male infants than on females. They believe that sons can take care of adults and they can perform rituals and other religion related matters. In addition, Malherbe, Kleijwegt and Koen (2000) assert that culturally, parents would normally ensure that boys receive education because they are regarded as the breadwinners. According to UN (2000), female children suffer neglect and abuse because of these preferences that are awarded to boys. One of the findings from the study is the traditional belief of regarding a female as a caregiver, mother and wife still exists in communities. The belief that it is an investment and a benefit to educate a boy over a girl still

prevails in societies. Other families still educate boys at the expense of girls should they face financial constraints. Malherbe, Kleijwegt and Koen (2000) argue that people as the product of their communities and that they will automatically be influenced by the social practices within their societies. Culturally, it is assumed that women are born with “natural roles” (p.121). These roles are assimilated and should be fulfilled from childhood. The findings of the study highlighted that traditionally the characteristics for males are authority, masculine and power; whereas domesticity, soft and submissiveness are commonly held by females. These findings influence the learning and teaching of science in schools because the personal experiences of Physical Sciences teachers informed their way of doing things in one way or the other about gender equity in science education.

4.4.2. Personal experiences of gender as learners in primary and secondary school

This section presents findings on participants’ primary and secondary school gendered experiences. The participants were asked about their experiences of gender as learners in primary and secondary schools. The themes that emerged include participants’ gendered treatment, gender based violence, and choice of subjects.

4.4.2.1. Gendered treatment

The results revealed that primary schools were dominated by female teachers but had male teachers as principals. All the participants indicated that their secondary schools had fewer female teachers who specialised in Physical Science and /or Mathematics, and that it was mostly men who taught these subjects. The participants indicated that the dominance of males in these fields created an impression on the part of the participants that Physical Science and Mathematics were strictly for males. Smanga summarized *“boys received better treatment maybe because the science fields were dominated by males”*. According to the participants, (four out of six) who were males indicated that male domination in the field of science and maths discouraged female participation in these subjects at school. Muzi added, *“differences were in the humour which, on gender, were indicative of underlying gender stereotypes that mostly still persist today.”* The section below discusses the

different gendered treatment that the participants received from their teachers. The discussion starts with tasks and chores; followed by teacher expectations and finally punishment.

(a) Tasks and chores: *boys clean the board and girls pick up litter*

Teachers were asked to talk about their experiences of schooling, which they thought was impacted upon by their being male or female. One of the key issues that all participants mentioned was the different treatment of boys and girls by teachers. One such treatment was the division of labour that seemed to have been a key feature of their schooling. The findings revealed that the participants were given school chores according to gender lines.

Nhlanhla stated, *“the tasks also were different for example in cleaning the classroom, when we clean the classroom within that there were differences in the tasks for example boys were not asked to apply polish on the floor and kneel and apply polish on the floor. Girls were asked to apply polish on the floor, which was hard task whereas boys carry the litter out and throw it in the rubbish pit but were never asked to polish and put cobra on the floors that was for the girls. So that was kind of discriminatory.”* Nomusa shared the sentiment that *“the teacher would assign the boys to clean the board. Boys were the ones who would move the desks. But when it comes to cleaning the girls would do the cleaning and not the boys.”*

Lattifa added that *“teachers never asked the boy to softer tasks. They were asked to do other difficult tasks”*. Moreover, Muzi indicated the teacher would say *“boys clean the board and girls pick up the papers”*. The findings revealed that teachers used gender to mark out the participants meaning that teachers would say boys do this and girls do that. These findings resonate with the findings by Thorne (1993) that learners are often referred to as boys or girls in classrooms usually for purpose of social control. The findings also agree with the findings by Diko (2007) that girls were expected to be able to do domestic chores, to show neatness and to internalize gendered divisions of labour. The findings indicate that these social relations encourage inequity. The schools indirectly socialise learners to maintain gender inequity. The findings showed that teachers as the curriculum implementers were the ones who were seen as the culprits who encouraged gender bias through their teaching and learning activities.

When asked about their gender related experiences and observations (as learners of science), participants in this study mentioned that there were tasks that were assigned to them by their

teachers according to gender lines. Nhlanhla explained *“opening and closing of the gas tap in the lab was assigned to boys -carrying of gas cylinders and connecting them it was assigned to boys but whereas cleaning some apparatus and sweeping the laboratory were assigned to girls”*. Smanga elaborated *“during practicals after we done with practicals the teacher would not allow us to clean the apparatus, because he was the one who gave us instructions, he will only call the girls that they must go and clean the apparatus”*. When asked about how they felt about being assigned the tasks according to gender line by their teachers, all the participants mentioned that they did not see a problem with that. They thought that it was part of their culture. These experiences are linked with understanding of gender as socially constructed. They also justify different gender roles.

Nhlanhla mentioned, *“I always thought that it was in line of our culture. I felt that it was about culture which has to do with specific gender roles being assigned to boy and girls ...it was right in line; I didn't see anything wrong”*.

Smanga added, *“I never felt bad since I was a child. But since I became a teacher I have realised that something is very wrong”*. Also during teaching and learning of science lessons, the interviews revealed that science teachers taught and assigned tasks to learners differently. This differential treatment on the division of labour by teachers channelled girl learners in domestic work and boys into science. The findings highlighted that gendered division of labour by teachers was socially structured because they allocated particular types of tasks to particular categories of learners. This allocation of tasks is linked with social construction of gender because it became a social rule and a condition.

(b) Expectations and punishment

In this section the participants responded to the question about differences in how girls and boys were treated by teachers and principals generally in the schools they attended, for example in terms of expectations to succeed at school, teaching and learning, activities to be done, sports, and punishment.

Muzi responded that *“the expectation was along the gender lines. Girls were expected to do well in their early primary school years. At high school the expectation was that hormones will kick in*

and the girl child will then take a back seat – regardless of how good she was earlier”. This corresponds with the discussion in Chapter Two that in primary schools, girls performed well or even better than boys. It is only in high school that girls underperform and fail. According Muzi, one of the factors responsible for this problem is that in high school girls are reaching adolescence “hormones will kick in”. Socialisation of children occurs both in primary and secondary school, however, in high school children experience puberty. This stage presents more issues for learners and they begin to focus on future choices this in turn affects their school work. This corresponds with Sikes and Measor (1992) statement that learners go through adolescence in secondary school and this is a very important stage of gender socialisation and construction of gender. During this stage, many aspects of the learner’s school life are affected.

Lattifa mentioned that “the teacher treated boys differently from girls in a way that if the girl answer she would elaborate on that answer as if the answer was not good enough but if it was a boy he would not elaborate on that answer. He would more often choose boys to give answers than girls”. This finding agrees with feminist researchers in Sikes and Measor (1992, p.63) that “boys get more attention, more teaching and instruction than girls”. This revealed that the teachers were also encouraging gender differences during teaching and learning. Teacher-student interactions are significant in the classroom. The way in which these teachers interacted with the participants lowered the confidence of girl learners. Girl learners were treated as they were invisible in the classroom. Nhlanhla indicated that girl learners felt as they were lost in sciences. This different treatment that was received by the participants differs from Stromquist’s (2008) view that self-esteem and respect that emanate from visibility and recognition during learning are associated with effective participation and performance. Therefore, the way teachers and learners interact is of paramount importance for competent participation. These findings are in line with Chikunda (2010) who indicated that social expectations of boys and girls affect classroom interactions.

Smanga added, “I can say that we were treated equally, the only thing that I observed is that during break time they did not allow us to play with girls. They used to separate us. The teachers themselves if you play with girls they give you funny names as if there is something wrong in your head. Then they use to tell you that you must play with boys, soccer, and not playing with girls. Then they were always discouraging us. They were the ones that were promoting gender

stereotypes. That treatment was bad, because if you are a boy it does not mean that you will be always be good when you are playing soccer. I used to love netball, and play it in my community but when I go to school I used to be separated by my teachers that I must go to soccer of which I know that I don't know how to play soccer. Of which I know I was not talented in soccer. It did affect me".

Smanga contradicted in this statement because he indicated that they were treated the same in terms of expectations but that he did not see gender practices. Moreover, David indicated *"there were Sports that were absolutely divided according to gender football-soccer for example that was for boys. Shotputs which was carrying heavy weights was for boys and javelin in my school whereas girls were playing netball, I didn't see any boy played netball. [Laughs] however there were some games that involved both boys and girls such as athletics like running both were involved like volleyball both were involved"*. In addition, Nomusa said *"boys were playing with boys. And girls were playing with girls"*.

In terms of punishment, the boys were beaten on the buttocks and the girls were not beaten on their posteriors but in the palm of their hands. Nhlanhla stated, *"in primary school there was some differences in terms of punishment when I went to primary school and secondary school, the corporal punishment was allowed but there were different ways in which a male student and female learner would be caned. E.g. The bending and touching the toes when they were canning us as boys. There would not do that to girls. The girls would stretch out their hands and beaten on the palms"*. Nomusa added, *"by that time the corporal punishment was still allowed, I still remember is that everyone when they were being punished, boys were lying on the desk and girls would be hitten on hands"*.

These results concur with Stromquist's (2008) report that teacher expectations create inequities in social interaction which result in poor performance. Muzi indicated *"there was a decisively huge number of boys doing well than girls at the senior classes"*. Furthermore, David indicated *"we were all struggling but girls were worse"*. In addition, Baird (1997) states that teachers often have low expectations of girls. However, Baird (1997) indicated that the teachers are not aware that they have this low expectation of girls and do not know how this negative expectation manifest themselves in the classroom.

These findings indicate that the school environment had influenced the gendered roles of the participants through socialisation. Their teachers transmitted gendered role expectations by indicating appropriate behaviours for participants. For example, in the assignment of tasks in the classroom and sex-stereotyped expectations. Gaine and George (1999) argue that learners tend to perform according to teacher expectations. Thus, teacher expectations become a powerful force on learners which is not easy to ignore. From the findings of this study, it is revealed that learners were expected to perform gendered duties, and boys were expected to perform better than girls academically. Schools create and maintain relations of dominance and subordination in terms of power as they explain their own different gender regime (Kimmel, Hearn & Connell, 2004). The school rules and teacher expectations can influence learners' experiences and how they live their lives in schools. This means that there are possibilities for learners to perform different femininities and masculinities in a school setting.

The results from the study highlight that males are not given domestic chores at home and school. Domestic chores are normally given to females. These different gender roles and labour divisions assigned to children at home and school promote gender stereotypes. There are still practices within schools and societies that are regarded as taboos. For example, a boy is not expected to sweep while a girl is sitting or watching a television. In schools, girls are expected and boys are not asked to do domestic work. This study reveals that parents and teachers are the ones who perpetuate gender inequity at home and school through allocating duties according to gender differences. Monyemore (2012) claims that teachers reconstruct the area of assigning duties according to gender lines. Domestic work is still given to girls because they are considered weak and soft, whereas heavy tasks are given to boys because they are considered strong and tough encourages gender inequity indirectly. These tasks include cleaning, removing furniture, conducting experiments and lifting heavy objects. In high schools, female teachers are still found in social and catering committees and males dominate in sports committees. The majority of male participants who participated in the study did not see anything wrong with assigning duties according to gender differences.

These results are similar to what Joseph (2011) found that household chores were not appropriate work for a real man. It was regarded as a woman's domain. To be considered a real man, you must do a man's job. However, some of the research participants voiced that this has an impact in the

long run for example if the female is not around, the males who were raised according to sex differences suffer because they don't know how to do domestic work. Furthermore, Chisholm (as cited in Moorosi, 2007) also maintains that South African men scarcely take a full domestic responsibility, such as looking after children and other household responsibilities, while women more often seem to be grappling with the issues of career and family at the same time. The study revealed that teachers were gender biased with regard to teaching, they did not treat the learners equally because society expects more from boys. This different treatment and gender stereotypes may contribute to girls not succeeding in sciences, not because they lack ability.

These findings are also consistent with what Acker; Porter; Streitmatter; Wilkinson and Marret (as cited in Monyemore, 2012) asserted about the stereotyping of boys and girls which is unintentionally perpetuated by teachers from pre-school throughout the school system. Teachers are part of society, their experiences of gender inequity are based on how they were socialised as children, learners and professionals. These results fit within the Social Constructionist theory which describes that learning occurs through all the stages of life, including the infant, child and adult learning stages. The findings of this study highlight the need to capacitate science teachers about gender equity because schools and teachers are seen as change agents.

The results of this study show that teachers manage and organise their classrooms on the basis of gender. This gendered division of labour promotes stereotypes about masculinities and femininities. This research is not trying to suggest that biology does not create differences between genders. Nonetheless, it is visible that there is interaction between biological and social attributes in the process of gender socialisation. Dietz (1998, p.426) claims that during the socialisation process children are “encouraged to adopt and develop certain personality traits that are often referred to as masculine and feminine”. Gender differences begin from the family where children are treated differently in terms of names, dress, toys and expected behaviours. This segregation continues to the defined gendered division of labour. Therefore, children depend on these masculinities and femininities to interact with others and themselves. Another concern for liberal feminists in education focuses on socialisation, gender roles and gender stereotyping. Liberal feminists thought that learners are socialised by the agents of socialisations into traditions that impede their success unnecessarily to gender stereotyped roles. Simultaneously, socialisation disadvantages females from exercising their full potential.

4.4. 2.2. Choice of school subjects: *Maths was mostly for boys*

In most primary schools, the findings revealed that the curriculum was largely the same for both boys and girls, except for craft and games where the participants were offered different material. In secondary school, the findings revealed that there were subjects that were done by participants as learners in schools that were for girls only or boys only. Participants indicated that there was a gender divide even though it was not written down or a rule. For example, home economics and needlework were done by girls, whilst boys did metalwork and woodwork.

Nhlanhla elaborated *“for example, metalwork and woodwork were for boys, whilst needlework and cookery-home economics were for girls, but that was not written anywhere as a rule. So, it gives me the impression that, actually, these subjects were maybe traditionally assigned according to gender”*.

Lattifa added *“in primary school we did one and the same subjects and in high school there were subjects that were done by girls and boys only for example home economics was done by girls and wood work was done by boys. You would never find a boy doing home economics and girl doing woodwork”*.

David concluded, *“when it comes to choosing the subjects traditionally science subjects are associated with males because of the professions that are being looked ahead to be done for the future engineer, physicist, mechanic and so on can be seen as for males and Physical Sciences they are training people along those lines so that can be male dominated”*. This is in line with Sikes and Measor (1992) that historically, high schools had offered sex segregated curriculum to learners. Nomusa added *“Maths was mostly for boys and other subjects were for girls”*. However, this is no longer the case. When probed on why she did science because she stated that Mathematics was mostly studied by boys, Nomusa explained *“I was not good with writing notes, I used to write very slowly when it comes to writing notes. I liked Mathematics very much”*. The curriculum now offers a full range of subjects. Moreover, Smanga said *“at school our teachers used to divide us. They channelled all the girls to go to do home economics in such a way that we were having more boys who doing science than girls. Girls were also channelled to do consumer studies”*.

This finding resonates with what Wolpe, Quinlan, and Martinez (1997) reported that it is well known that females do not tend to pursue sciences at school. If they do sciences, it is often biology or zoology. Moreover, they are in line with Gaine and George (1999) who stated that research on children entering early schooling at 5 years have highlighted that these children are aware of gender specific activities and occupations. Gaine and George (1999) maintain that early socialisation has an influence on the choice of school subjects. As a result, when it is time for these students to choose subjects in high school, they opt to make stereotypical choices. For example, girls are reluctant to choose subjects seen as masculine such as Physical Science and Mathematics, and boys do not want to be seen as feminine by choosing subjects such as Home Economics. In addition, Sikes and Measor 1992, p. 73) agree with Gaine and George (1999) that even if learners are offered a wide range of subjects, they continue to make “sex stereotyped choices”. Unlike the other five participants, Muzi indicated *“there was vocational guidance. We had to choose, but based on our academic performance; the school recommended us based on our academic performance”*. In his school, they were guided on the choice of subjects.

In my view, the subjects were not selected based on gender but on academic achievement. The participants felt that teachers were gender biased in teaching especially when they were giving examples. Most of the examples were based on males, for example when the teacher used an example of a man driving a car. They did not remember even one example when a teacher would mention a girl doing the work that was associated with men or boys. Teachers also focus more on boys than girls, especially the clever boys. These findings resonate with the work of Kelly (1988) and Thorne (1993) that during classroom interactions, boys received more teacher attention time than girls; boys received more academic and behavioural criticism than girls. Participants said even though some of the girls were shy, it felt like they were lost in the classroom. Most of the time the teacher would ask the boys to assist with conducting practical experiments. The girls would observe and copy notes. No participants had a problem with the way teachers interacted with them during teaching and learning activities at that time. Male participants even mentioned that they felt positive about it because it was similar their culture where males were given heavier tasks. Nhlanhla explained, *“I believed that the carrying of the heavy like my father carrying the logs was most suited well it was a continuation of what we were doing at home so I understood it”*.

On the other hand, female participants during the interviews realised that they were actually marginalised and discriminated against with this form of treatment: Lattifa stated, *“it is only now that I see that we were discriminated as girls by our teachers. I thought this is how it should be because our tradition does not allow us to question adults. Ours is to obey and take orders”*. Nhlanhla clarified, *“I think teachers being humans and part of the community it has been cultured in them. It was about female and male roles in society. So coming from home where as cleaning tasks was assigned to girls, it continued even to schools that once the task was hard and challenging, or dangerous it would be assigned to boys. Even at home if there was a snake to be killed, boys and the father had to do it. I think being part of the community they just continued it”*. This is linked with feminist research and the narrative sensitizing the participants.

The participants further indicated that their teachers were also human beings and from within society. It was understandable that they were following from values and traditions which they grew up within. The subjects that were taught to girls were historically driven by domesticity, which was the aim of education to emphasise the “sacred calling” for women (Acker & David, 1994, p.39). This is no longer the case, because in some schools, boys and girls do Engineering and Graphics Design (EGD) and Hospital Studies. This research indicates that school teachers also had a strong influence on school subject choices because most of the participants interviewed indicated that they were influenced and encouraged by their teachers to study science in high school. These findings resonate with Morojele (2014) who claimed that based on these ideologies, children are pressured to conform to perform gender to what is seen as a normal state of affairs. These findings correspond with Stromquist (2008) who found that gender construction in schools developed different notions of what it meant to be a girl or a boy, with characteristics for masculinity and femininity. As a result, Light and Durndell (as cited in Siann & Callaghan, 2001) claim that girls in schools are less likely to choose science subjects.

4.4.2.3. Schools as unsafe places for girls: Older boys... used to beat us up and force us to clean their desks

In classrooms, boys and girls do the same activities such as working on their school work. Schools are considered as safe places for all learners. Nevertheless, learners do experience violence. The

results revealed that there were groupings according to gender. Nevertheless, the norm was that boys were generally playing together and girls in groups. The participants experienced gender divisions on school playgrounds. Nhlanhla stated, *“during break time and play time learners group themselves according to gender boys only and girls only”*. David added, *“during break time, boys used to dominate the large space because we, had to play soccer”*. These findings are in line with Thorne (1993, p.44) that boys “controlled large fixed spaces designated for team sports...the fixed spaces where girls predominated...were closer to the building and much smaller”. Thorne’s observations were that boys control more of the playground space and invade and disturb girls’ group activities.

The participants experienced violence based on gender during break times and after school hours. Lattifa explained, *“we were studying with older boys and they used to beat us up and forces us to clean their desks. In addition, we used to report them to our older siblings and they would fight after school. Some were bullies who used to beat and take money from other children. But it was not as prevalent as it is today”*. The results of the study are in line with Stromquist (2008) that school socialisation in femininity and masculinity results in different degrees of school violence between boys and girls. These include physical, verbal, social and threatening forms of victimisation. Muzi added, *“boys hit girls (within and outside romantic relationships). There has been an improvement (it must have subsided by now, markedly, hopefully) I would like to think that a lot of education against violence on women and girls has made a difference”*. Nomusa further mentioned, *“in our classroom, the sitting arrangement was done according to our performances. The ones that did well used to sit in the back and the ones who were not performing well would sit in front. The boys who sat in front would want to take the space for a girl in the back by threatening them because they did not want to sit in the front. And this would result in physical fights during breaks and after school”*. These findings are in line with Naidoo’s (2010) findings that boys used classroom space to dominate and use power to control girls through their masculinity behaviour. Holsinger and Jacob (2009) assert that the important influence of quality education involves the characteristics of schools and learning environment, with substantial differences in how they influence learners’ education. This study also found that girls experience violence in schools. This is in line with Holsinger and Jacob (2009) who claim that school based violence is a violation of girls’ right to education. The Panos Institute (as cited in Holsinger & Jacob, 2009) further stated that the consequences for these violence experiences for girls include

loss of concentration, low self-confidence, and poor academic performance. These results concur with Acker and David (1994) who argued that schools are seen as amplifiers of male tendencies towards violence.

The findings also agree with De Wat (2007, p. 675) that gender-based violence involves “men and women, in which the female is usually the victim; and which is derived from unequal power relationships between men and women. Violence is directed specifically against a woman because she is a woman, or affects women disproportionately. It includes, but is not limited to, physical, sexual and psychological harm including intimidation, suffering, coercion and/or deprivation of liberty”. Moreover, the findings resonate with Joseph’s study (2011) that some boys indicated that sometimes a man was forced to hit a woman. These boys in his study indicated that they hit girls just to protect their dignity and to maintain their masculine image. Women experience gender based violence because they are women. Women also experience violence that is different from what men experience.

4.4.3. Physical Science teachers’ professional experiences of gender as teacher trainees

4.4.3.1. Different treatment from lecturers

When the Physical Science teachers were asked about how they were treated by their lecturers in terms of gender, three of them mentioned that they were treated the same irrespective of their gender.

Nhlanhla stated, *“I think that the treatment was the same except in the content was not met by the females like the bad examples on the content and gender biases. It was not because of the teachers and it was because of the gender biases on the textbooks and all that. But in terms of the teachers delivering it, I found them to bring some equity there. Teachers did not discriminate per se that the sciences were really meant for boys or increasingly opportunities for men so I think there is some equity in the tertiary education”*. According to Nhlanhla they all received the same, however from his narrative he felt that there was bias in the curriculum.

Nomusa and Smanga added, *“the treatment was the same and equal where we were studying because we were treated like adults.”*

Smanga mentioned, *“at tertiary we received equal treatment it is unlike high school where we never receive equal treatment as I mentioned earlier”*. However, Lattifa disagreed *“no really, male science lectures were favouring male students and female lectures who were in languages of course favoured female students. Males were always asked to do maths problems on the board and females were asked to read and write notes. In science, the practical work was done by males; females were treated like babies”*. The other two participants indicated that they were discriminated against because they studied in White dominated institutions. Muzi said, *“when I went to that university, I found that people who were there were the White people. They used to teach us together but they would ask white to remain behind and they offer them extra lessons. Other than Africans.”* David shared the same sentiment as Muzi *“I witnessed gender inequity during group work, we were grouped according to race. You would not find a White or an Indian sited next to a Black even during lectures”*. These findings highlight that 3 of the 6 participants indicated that they received same treatment from lecturers. The other 3 indicated that the treatment was not the same, more especially for those who studied in White dominated institutions.

4.4.3.2. No training on gender during teacher training

When asked about whether the participants received any training on gender as teacher trainees, five of the participants revealed that they did not receive any training on gender in tertiary institutions. In other words, no one sensitised them on gender equity issues while they were training to become teachers. Only one participant indicated that she received training on gender. Nhlanhla stated, *“no, I don’t remember any; I don’t think there was training at the university”*. Smanga said, *“No I have never seen it. I trained in 1997 to 1999 it’s when I obtained a three-year diploma”*. Lattifa remarked, *“no there was no training offered on gender during my teacher training at the college”*.

Muzi responded, *“no training was offered”*; similarly, David indicated, *“no no no, there was no training at tertiary”*. These findings resonate with those of Chikunda (2010) that inferences from the results suggested that there was no systematic effort by teacher education institutions to sensitise teachers on gender issues. However, one participant said she did receive training at the university but when asked her about the gender issues which they were taught, she said that gender equity was confusing. She seemed to have forgotten the purpose and content of the module. Nomusa responded, *“yes it was there. As I am able to do it in my class, it is because I did it at the*

university. It was a module. It was but I have forgotten the name I will check it for you it was specific on gender studies that all people must participate equally. All those things”.

Based on the narratives from the participants, teachers who were trained during earlier times did not receive training on gender but the newly trained teacher reported that they received some training. However, Nomusa having mentioned that she was trained on gender, during the interview seemed to have forgotten what they were trained about on gender. She also indicated that she does not focus on gender issues as if gender equity and education is not important to her. From the findings, Physical Science teachers who were trained during earlier times need to be trained on gender equity issues in science education in order for them to be able to implement equity in their teaching practices.

4.4.4. Participants’ experiences of gender as teachers in schools

This section discusses teacher experiences of gender in schools. The findings from this study highlighted that most of the participants’ experiences of gender in schools emanated from socialisation. Here, participants were asked about their experiences of gender equity in their schools and how were they treated by the school management, learners, and the School Governing Body (SGB).

4.4.4.1. Female teachers are less vocal... participate less than males

The participants were asked about their experiences of gender equity in their schools and how were they treated by the school management, learners, and the School Governing Body. The findings revealed that females seemed to be more submissive and respectful to male principals. The findings also highlighted that female and male participants continued to do gendered roles in schools. The participants indicated that there was some equity in their schools, although it was not up to an expected level. Nhlanhla explained, *“I’ve said in the administrative and managers like principals they try to give opportunities and give to both females and males. However, what I find in our meetings is that females are less vocal and they are less confident in terms of participating and giving views in the meetings. It sounds like especially if the principal is the male they are submissive than males, similar to be submitting to their male partners giving me the idea that is more of culture. For example, in our African cultural system females participate less than males. It is all about culture. Females are expected to be more submissive and respective to males”.* This

finding relates to what Morrell et al. (2009) explain as the meaning of gender. These authors defined gender as constructed social relations of power. This finding is linked with the second approach of understanding gender as socially constructed, meaning that “the socio-economic and political relations between women and men are shaped by social structures” such as culture, norms and laws (Morrell et al., 2009, p.14). This explained why female teachers were less participative in meetings. This is how they were socialised. All the participants grew up with a belief that females were subordinates. However, this contradicts what Sahin (2013) defines as gender equity. Sahin (2013) describes gender equity in education as giving both males and females equal opportunities in terms of economic, social, cultural, and political developments. They are not expected to be submissive to their male counterparts.

Moreover, Nomusa added, *“I have never experience that the principal saying you because you are females you will be left behind. I always see the principal calling everyone and encouraging all to participate. What I usually notice is that everything is free and transparent. It is solely dependent on a person’s choice to take part or not. We are all equal in the meetings and we all get the same respect for both females and males. It is the fault of females that they do not voice their opinions.”* Lattifa agreed with Nomusa, *“in my school, everybody is treated equally and with respect irrespective of their gender for example in meetings and gatherings. All our views are treated equally and of importance. Everybody is given an opportunity to voice out their views and treated with respect”*. These findings indicated that everyone was treated the same and given the equal opportunity by the principal and SGB, it therefore seemed as if it was the fault of these female teachers not to participate as much as male teachers.

When the participants were asked about their gender experiences in their schools and classrooms both by learners and teachers, they mentioned that labour was divided according to gender lines in schools. The results revealed that some tasks and roles are assigned according to gender. Smanga stated, *“females normally do the catering. it’s either self-catering which is a leading thing or fashionable but if it is going to be really serving or buying plates and all those things putting them together the females will do that. Whereas the males will do the muscular work, such as setting up the braai stand for braaing the meat...so there will be some divisions of roles according to gender”*. Nomusa and Lattifa were of the same sentiment, Nomusa stated, *“when it comes to*

teachers, only females do the catering males don't dish food". Lattifa explained, "female teachers do catering whenever we are having school functions. Males do the hard tasks like fixing things. I think the reason for doing this is that this is how we were socialised from childhood from home and society. It our culture that is not expected of a male to serve and cook for a woman. Other things are taboo from our society. For example, you cannot expect a father to sweep the house and cook whereas a mother is sitting and watching TV. I don't have a problem with the division of tasks because this is how we grew up from our societies". Muzi added, "the way people are socialised think that the difficult things should be done boys. In addition, girls must do soft and easy things". These results showed that females were doing feminine tasks whereas males did masculine work. This is consistent with gender and socialisation as discussed in Chapter 2. This finding is consistent with the study by Makhaye (2012) who found that female principals faced challenges due to gender stereotypes. They are expected to perform feminine chores and not to be school leaders because of socialisation.

Mda and Mothatha (2000) assert that the socialisation of males and females determine the way in which they lead their lives. Hence, gender is socially constructed and culturally constructed through our daily interactions within an institution. These findings are similar to those of Diko (2007) who found that teachers continued the sex-typing roles when dividing duties amongst themselves. She also found that male teachers dominate in most powerful committees and females were in catering and cleaning committees.

All participants stated that they received the same treatment from school management team and the school governing body. Learners in most cases respect and fear only male teachers. They do not give the same respect to female teachers as male teachers. David highlighted, *"but when it comes to the learners it's funny to me that the people they think like are being oppressed or suppressed they seem to promote male teachers than female teachers. For example, they are more of respecting the authorities of the male teachers than the female teachers, the command and the authority served they are more accepting the authority of the male teachers over female teachers. You hear just said even female teachers would say 'bayangidelela ngoba ngiwumuntu wesifazane' (they disrespect me because I am a female) so there is more respect given to male teachers by the learners".*

These results correspond with Mngadi's (2016) report that the system differentiates men from women by setting standardised roles. This creates power differences between men and women. She asserted that "the role of a woman is more passive, submissive, and servile while that of a man is more dominant, obstinate, and uncompromising" (Mngadi, 2016, p.24). This is due to social constructionism and cultural practices. It is evident that teachers are central to the transformation of any society and are change agents in schools in particular. As teachers form part of the broader society, they are also the product of gender construct within societies. Teachers are socialised in patriarchal structures and societies which encourages gender inequities. Historically men were always superior to women. Women were expected to be subservient to men, and not to speak against men in public. The Social Constructionism theory discussed in Chapter Two explains why the participants behaved the way they did in their schools, in terms of gendered roles and behaviours. It also explained why females continued to accept these roles as women. All this was due to socialisation. Although no one forced them to accept these gendered roles, chances are that these stereotypes occur as voluntary.

4.4.4.2. Boys are participating more than girls

When asked about their experiences of teaching boys and girls, all the participants interviewed in the study indicated that there were more girls than there were boys in science classrooms. The interview transcripts revealed that in science classrooms, boys were more active than girls were. Another matter that participants highlighted was that when they were learners, there were more boys in science classroom than there were girls.

Nomusa responded, *"boys are participating more than girls because there is a boy who is very intelligent"*. Muzi agreed with her, *"boys are participating more than girls. Boys have a dominant mentality of superiority over girls"*.

Smanga added, *"during classroom situation boys are active. Especially a*

Gain when there are difficult problems in Mathematics or any explanation that need to be done on the board boys come forward and solve the problems on the board". Lattifa further mentioned, *"I have already mentioned that the boys are most active in the class during science lessons and*

practicals. Girls are most passive most of the time". The results revealed that boys dominated during teaching and learning. Even teachers believed boys and trusted boys with most difficult problems and scenarios over girls. Teachers highlighted that in terms of performance in matric, boys certainly performed better. Smanga elaborated, *"I think that the performance is an indication that on opportunities there is no gender equity in the teaching of science and maths and so the boys are dominating in the sciences. And I find that they are performing generally better than girls which is a result of being like I said girls having less confidence finding themselves like they are lost in sciences and not motivated to do it and so forth. Therefore, I think that is the result for poor performance for the girls"*. These results correspond with the findings of the research by Baird (1997) that teachers underestimated the level of female participation at high school level.

When probed about the reasons for poor performance by girls, teachers cited several contributing factors, including the socio-cultural environment, for example when the sciences become tougher and more challenging, there is talk that harder things are for the boys. David indicated, *"you find that the teachers for those subjects that are perceived harder like maths and physics are predominantly are males. The boys work harder to demonstrate that they are more capable than the girls are in these harder subjects and thereby show muscular superiority."*

Another factor that the participants indicated as contributing was that of socio economic backgrounds. Smanga stated, *"I am working in rural areas where you find that, don't believe that we must educate girls. They believe that boys must be educated because girls will get married, assume a new surname, and assist another man to acquire and manage property."* Muzi shared the same sentiment with Smanga by indicating *"girls perform poorly. Maybe because of the environment they grew up, where parents don't even care about their performance"*. The participants gave the following reasons for underrepresentation and underperformance of girls in science education namely negative bias towards sciences and also lack of motivation. Furthermore, the findings of the study resonate with Baird (1997) and Chikunda (2010) who indicated that the factors contributing to fewer girls studying sciences compared to boys are socialisation and cultural influences, lack of female role models, discouragement from parents and teachers, lack of confidence, lack of interest and aptitude, ability and brain differences. Chikunda (2010) asserts that culture has an influence on girls' progress in science because most African communities are patriarchal. Unlike the other four participants, Nhlanhla indicated *"they perform equally*

depending on the child's academic ability not because of gender". Nhlanhla had been consistent in stating throughout the interview that gender did not influence the participation, performance and learning of science, it solely depended on whether a person had the ability and aptitude to sciences. Similarly, Lattifa agreed with him that gender did not affect learning of sciences, she mentioned "I believe that the learners who are not performing well in science subjects have no aptitude for these subjects; gender is not the issue".

From these findings, five participants indicated that during teaching and learning of sciences, boys are more active, perform and participate more as compared to girls. Therefore, these findings show that teachers and parents still believe that girls are less capable in the science field than boys. This means that girls are stereotyped by their teachers and parents as poor performers in the sciences. Ruble, Cohen, and Ruble (as cited in Kurtz-Costes, Rowley, Harris-Britt, & Woods 2008, p.388) define stereotype as "judgements about the abilities or attributes of individuals based on their membership in a social group". These gender stereotypes in turn influence learners' perceptions about sciences and related careers. For example, from these perceptions about science a child can make a decision about his or her career choice based on these adult stereotypes. This is in line with Kurtz-Costes, Rowley, Harris-Britt, and Woods (2008) that gender stereotypes can influence gender differences in science ability by inhibiting girls' competence in science. The personal and professional experiences of gender equity in science education of the participants appears to indicate that females are somehow deficient and that girls and women participation in science education will increase if only females can be more like their male counterparts and also make them to be more suited to science.

4.5. Views and beliefs about gender equity and science education

In this section, the data related to the third research question is presented. This research question focuses on Physical Sciences teachers' views and beliefs about gender equity in general, education, and science education. The views and beliefs of Physical Science teachers about gender equity are thought to have been created, nurtured and adapted to the socio-cultural, religious contexts and experiences through the life stages from birth, childhood, up to the professional environment. Other scholars support the influence of culture, socialisation, practices and experiences on peoples'

perceptions about gender equity in education, for example its influence on school boys (Connell, 1996) and teachers (Haggerty, 1995; Morojele, 2013; 2014).

The participants believed that gender inequity still persists, that there is male domination in certain fields, and socialisation influences and shapes one's socio-behaviour and social systems (norms, expectations and compliances). The interview responses were very strong in suggesting that gender equity was important in schools in order to achieve a better future.

4.5.1. Gender inequity still exists

The participants were asked about whether there was gender equity in education and tertiary institutions.

Nhlanhla explained, *“I don't think there is gender equity. The focus when teaching sciences seems to be mainly on men. In teaching institutions, sciences are predominantly taught by males and hence male learners are more comfortable than females because the educator of their gender”*. Smanga and Lattifa shared almost the same sentiments, Smanga said, *“[they] are trying to promote gender equity but there more males who are professors and lecturers and there especially for sciences. From other fields like languages you can only find women remember I spoke about the left hand hemisphere that they are good in languages. I believe in that theory and I have to believe it because it does exist. I believe in something that is existing”*. Smanga indicated *“I read one book by the scientist Bossley he said people are different when they are born. And then they have got two hemispheres. Right hand and left hand hemisphere. He said males used to think using right hand hemisphere that's why they are good in maths, science and accounting. Anything that has to do with calculation some of the girls, not all of them are using left hand hemisphere. That's why some of them are not good in maths and sciences. They are good in domestic work”*. This corresponds with Masanja (2010) that females continue to lag behind in Science, Mathematics and Technology (SMT) education and that gender stereotyping continues where girls tend to study feminine careers and boys to study hard sciences.

Lattifa said, *“no, as I have mentioned earlier, they are only trying to balance the numbers. This also does not help because the high standards that are in place do not allow more females to dominate in sciences as their male counterparts. Most of them end up dropping out or changing*

courses because of the difficulty of science. The curriculum is still not accommodating and friendly to females. They are saying there are equal opportunities but it is just a disguise because not all females have access to these opportunities. They set high standards that hinder females to enter science education. So according to my view this is not fair treatment. The higher positions of professors are still occupied by too old, white males". Smanga highlighted, *"gender inequity still exists. It will take us time to close the gap yes we are trying to close the gap as a country". Before 1994 there was a huge gap, currently the situation is better than it was in 1994. Although the gap is being closed, there is still that problem that we have more males in higher positions. Somewhere somehow you find that some other females seem lacking the skills. However, I can say that some perceived lacking skills are actually psychological. In their minds, always tend to believe in and rely more on males than females when seeking solutions to problems they encounter in life. Thus, females don't trust one another".* When probed, Smanga indicated *"the problem that we are having in my cluster the advisor cannot perform she is being assisted by the male teachers most of the times and then she used to believe males she does not believe in females. She used to ... when we discussed something and she is got a problem she would always mention the name of a male teacher to get assistance".* These findings indicated that some females do not possess the required skills and are just given positions because they are promoting gender equity in South Africa.

Based on what Smanga said in the foregoing, it seems that females also contribute to gender inequity favouring men. The females do so, according to Smanga's views, by either not acquiring the necessary skills for science related careers or by not having confidence in their abilities in the field of science. Therefore, from Smanga's views, it appears that the problem of gender inequity is partly with the females. However, Smanga's views are contrary with the views that are widely reported in the literature. As reviewed earlier, several studies and reviews indicate that females are generally marginalised in sciences compared to males (for example Baird, 1997; Brotman, Moore, 2008; Moletsane & Reddy, 2011; Acker & Oatley, 1993). Nomusa stated, *"if you listen you can still find that in other science related fields there are still more boys than girls. There is still a shortage of female participation in sciences, they are there, but they are not exactly equal to the number of their male counterparts".*

These findings reveal that participants believe that gender equity is not yet achieved in higher education institutions, and that the education system is only trying to balance the numbers of males

and females, but not the fair treatment. Although South Africa has made progress in increasing the number of females in tertiary institutions, the findings of this study suggest that science teachers think that gender inequality is still in existence. Nevertheless, the participants in this study commented extensively about the ‘difficulty’ of science and the ‘high standards’. David mentioned *“the perception of the community and the learners, elderly/parents think it’s difficult for girls because they were not involved in the science subjects themselves”*. In my view, the participants believed that the problem was with girls who find science difficult and who cannot meet the high standards of science. These views and beliefs of science as being labelled difficult and essentially masculine could contribute to the construction of feminine and masculine identity. This resonates with Measor’s (1983) findings that learners use performance in other subjects to explain their masculinity and femininity. This means that since girls are defined as feminine, they could use their inability in science to emphasise their femininity.

4.5.2. Males dominate in science education: sciences are a ‘male thing’

When asked whether there was male domination and gender imbalance in science education, participant’s responses revealed that males dominated in science education. Five teachers indicated that there was male domination and gender imbalances in science education. However, Nomusa said she was not sure about the current situation, but acknowledged that in the past there were gender imbalances and male domination in science education. Nomusa responded, *“I’m not sure about the current situation and statistics but I can say previously there were many male teachers.”*

Nhlanhla stated, *“I think there is male domination in terms of equality numbers, numbers of proportions. There are more males in our country doing sciences in schools, tertiary level, and teacher level. We have more scientists, more mathematicians who are males than females that is my observation. As professionals, the people who facilitate and actual responsible to move sciences like teachers and lectures again we see the sciences being dominating by males as lecturers. In terms of performance again I find that males are performing better”*. Smanga agreed, *“there is gender imbalance because more males are offering sciences over females even at tertiary level, in classes you find that there are more males and mostly males are excelling in maths and science other than females. Females from my own experience and belief they are excelling in languages. That is why most females are journalists.”* Lattifa and Muzi shared the same view, Muzi said *“there is gender imbalance in science education. I think that there are few female*

science teachers as compared to male teachers. In high schools, I think that there are few male learners as compared to female learners. Whenever we have science meetings or workshops we find that there few females. Even in marking centres, there are more male teachers as compared to female teachers". Lattifa indicated, *"in classes, there are more girls now. This is because in primary schools there are more girls in schools. But after matric most girls don't get good marks which allow them getting places in tertiary institutions so we end up having lesser females in science education in higher education institutions."*

From the findings, the participants highlighted that there are more female learners in high schools. However, there are fewer female science teachers. This finding is supported by statistics on education. The South African Department of Basic Education (2013) reported that in 2013, of 241 509 learners, 132 784 girls and 108 725 boys wrote Mathematics. Furthermore, 184 383 learners, 97 995 girls and 86 388 boys wrote Physical Sciences. From the interviews, the participants indicated that most female learners after matric do not pursue science related careers. As a result, there are very few teachers who enrol for science teaching. Another reason they cited is that tertiary institutions set high standards that hinder females from being admitted to study sciences. Universities require high marks for Mathematics and Physical Science. Participants indicated from the findings that females get poor results because of poor learning experiences in schools and that they are also stereotyped. These findings highlight that there is gender inequity in science education. These findings resonate what Julia Gillard (Chair of the Global Partnership for Education) reported in the fourth global Women Deliver conference in Copenhagen. She said that "the under-education of girls is one of the most pressing social issues of our time. When we educate our girls, we reduced child deaths, healthier children and mothers, fewer child marriages and faster economic growth. Yet, 63 million girls are not in school" (cited by Adichie, The Witness, 18 May 2016, p.7).

David concluded, *"gender imbalance is about the demographics/numbers, and I think as far as this is concerned, there is still a low number representation of the women in the teaching of sciences. You have more teachers teaching languages and other humanities and more men teaching Mathematics and other science subjects. This I think is due to the long held believe that sciences are a "male thing." This phenomenon is also reflected among the students, where most girls seem to shy away from sciences because of the negative bias towards sciences and also lack*

of motivation". Moreover, these findings indicate that females are underrepresented in science education. This finding is in line with Chikunda (2010, p. 111) that "in teaching-learning milieu, men comprise the majority of those who study, teach and practice science". Muzi added, *"universities have led the way in supporting and so there is reasonable sympathy for women at this level of institutions. There is still male dominance, but the greatest amount of support for women is led by universities. A few have had female vice-chancellors and deans of faculties. Of course, more so in humanities and other non-maths, science and Engineering faculties"*.

Lattifa elaborated, *"my personal view of gender equity issues in post school science is that female is underrepresented in male dominated careers like Engineering. Females are not treated fairly as their male counterparts. You still find more male lecturers in sciences even if females are in senior positions males still do not have trust in them. Even the nature of the curriculum delivered is still not friendly to females"*. David acknowledged, *"there are some programmes that are geared toward encouraging young girls to enter science. But more needs to be done"*.

The majority of teachers believed that gender imbalance is about the numbers. They thought that there were still fewer female science teachers compared to male science teachers. When asked about whether there was male domination in science education, all the participants mentioned that there was male domination in science education. Nhlanhla, Nomusa, and Smanga agreed with each other *"yes there is male domination even in cluster level during teaching and learning males are dominating"*.

Lattifa and Muzi were of the same view, *"yes there is male domination in science education. They control in science related careers like Engineering, etc. they outnumber and outperform females in these careers. Women still do not occupy higher positions in sciences. Even the females who succeeded and done well in sciences their stories remain untold. It is only about males"*. David concluded, *"male domination is a reality and will remain so forever until we address the male chauvinism from our own cultural and religious settings so that we can face patriarchy. The language of science is male dominated (biology uses the word man i.e. in food chain/food web), the theories and paradigms that students use are male"*. All the participants believed that there is male domination in science education. These result corresponds with what American Association of University Women [AAUW] (as cited in Baird, 1997) called boys 'domination'. Males tend to dominate the apparatus, teacher's attention, and educational resources. Teachers indicated that this

male domination results in scaring females away from sciences and making sciences classrooms an alien place for females. These findings resonate with radical feminism as discussed in the conceptual framework by Sikes and Measor (1992) that boys dominate in classrooms. The boys' interests dominate the curriculum while the interests of the girls are not considered. The findings highlight that teachers concentrate on boys and this lowers the self-esteem and confidence of girls. The reviewed literature shows that although the democratic South African government has made great strides in attaining gender equality in most spheres of life, there is still gender inequality in Science, Technology, Engineering and Mathematics (STEM) with respect to successful participation in education and training and professional careers. The literature shows that at school levels in South Africa, there has been a continuous increase in the enrolment of girls in Mathematics and Physical Science to the extent that there have been more girls studying high school Mathematics and Physical Science. However, more boys have passed these subjects than girls, which raises questions about gender equality. At South African institutions, the STEM fields have been and are still dominated by males with regard to both enrolment and success.

4.5.3. Everyone has the right to equal opportunities: *the artificial/social/traditional hurdles must be addressed*

The teachers were asked their views about whether females and males were given equal opportunities. The participants believed that in terms of equal opportunities to do sciences, males are still favoured. Nhlanhla remarked, *"I think there are almost equal numbers of males and females doing sciences. In terms of the opportunities to actually do the sciences and be successfully which is the equity part that's where there is a problem I think they still in favour of males but in terms of numbers which is equality I think there is no serious issue about it"*. This view corresponds with the liberal feminism by Acker and David (1994), which focuses on equal opportunities for both males and females. There was a noticed recognition that gender bias was an issue that required attention, especially in subjects such as Physical Science and Mathematics. David advised, *"so the artificial/social/traditional hurdles must be addressed and women be given equal access and necessary support to do science in demographically proportionate numbers"*. Moreover, these findings agree with the liberal feminism of Sikes and Measor (1992) which emphasises that every individual (irrespective of their gender) should have equal rights, and any legal or social obstacles that impede their development and achievement should be banned.

Participants also stated that in science for instance, most universities encourage women students to apply for bursaries and scholarships, and award them more than their male colleagues. Nhlanhla stated, *“I still think that the opportunities may be different in the sense that like I said when you look at the way sciences are taught they seem to make boys feel more comfortable to do sciences in a tertiary level. When you see in the science content, the scenarios the males still feature a lot in the examples making it look like the sciences are for males”*.

Nhlanhla further explained, *“I think we have equity imbalances we have less opportunities that are given to females to study sciences so that’s why I said there must be deliberately way of trying to bring about equity by promoting more females to come up and equalising with the males by doing sciences and maths at school level and tertiary level”*. Nomusa responded, *“I see it as a right thing with benefits as people of South Africa because you will find that males in this country have that thing because they are men. They want to rule and leave that controlling life. They think they are the ones who have a say. They think if you are not a male you don’t have a say with a country you are living in. They act as if you don’t have a brain and your mind is not working well because they will always tell you what to do. We are not going to reach to a point where we will say that we are equal now”*.

Lattifa added, *“this is a very good move. I support it 120 %. We are no longer in apartheid now things have changed now. This will help to address the scars of the past and will empower women at the same time. We are living in a democratic country so every citizen must enjoy the benefits and fruits of democracy. Everyone has the right to equal opportunities and equal access to the resources and education”*. The participants blamed the apartheid government which created inequality and imbalances between males and females. However, they recognised that South Africa is transforming by the promotion of equal rights for its citizens (Constitution of the Republic of South Africa, 1996).

Muzi elaborated, *“there is everything good about it. Females, biologically more prone to mood and emotion, should just be supported to compensate for this fact. At the same rate, it should be allowed and encouraged to incorporate the female touch in the science and science education mix. Women bring sensitivity, emotional presence and emotional intelligence, as well as humane aspects to the field of science and science education. Their contribution balances science and*

science education to reflect our dynamic society. Science can benefit from that, in spite of science being a world of reason, of objectivity, and less of emotion and subjective feel.” It seems that Muzi has the assumption that women are being marginalised in the sciences because of their feminine traits that include being sensitive, subjective and emotional. Muzi reasons that science is generally not compatible with feminine traits, it demands reasoning and objectivity without human feelings attached to it. However, Muzi seems not to support the nature of science and its demands. He thinks that real life situations are complex and dynamic, subjectivity and objectivity, and emotions and reasoning contribute to a real and balanced human being even if he/she is a scientist. Muzi therefore thinks that females are needed in the field of science, actually their participation in science is important as it contributes to a more real and balance field, *“their (females) contribution balances science and science education to reflect our dynamic society”*. It is interesting to note that Muzi is well aware that one of the major cause of the marginalisation of females in the science is that there is a generally notion that due to their feminine nature they are too weak and not fit to do sciences. This notion is documented in the literature, for example Mlambo-Nguka (as cited in Adichie, 2016); Moletsane and Reddy (2011); Mathur-Helm (2005).

David explained, *“the Constitution of South Africa does not allow any discrimination based on gender or any other factor. This is as regards to gender equality. Nevertheless, it is not enough for women to be equal to men. Equality, gender equity should be prioritized because women have different needs that should be addressed first before we can talk men and women equality. Gender equity is a must do thing”*. These results correspond with South African government policies and legislations developed in favour of females discussed in Section 2.5 of the literature review chapter. On the other hand, Nomusa believed that the opportunities are there and open to everyone equally, the problem is with the girls who do not grab the opportunities. Nomusa remarked, *“the opportunities are there but people are not there. The problem is with us females we don’t want to seize opportunities or else the problem is that we don’t meet the requirements”*.

The findings revealed that most of the participants’ statements tend to show the deficit model of thinking, where females need to be ‘fixed’ because they are ‘deficient’ in one way or another. According to the interview responses, the participants either think that women are lazy, shy, lack self-confidence or they lack required skills and they are too emotional for higher positions. According to Mathur-Helm (2005), South African women still face socio-economic struggles. The

apartheid policies favoured men, especially White men, and this resulted in unequal sharing of resources and information between males and females (Mathur-Helm, 2005). The South African government has now given females the equal opportunities as their male counterparts in all spheres of life. All the participants supported and agreed to equal opportunities for everyone. They also believed that there was a great deal that needs to be done by the government.

These views and beliefs concur with the liberal feminism that focuses on equal opportunities for different sexes. Participants also think that the opportunities may be different in the way sciences are taught. Four of the participants also believe that women do just as well as men when given a chance at education. However, due to society's male domination and other stereotypes, the path to success for women tends to be more challenging than that for their male counterparts. Women still do not receive the full needed cover and protection against male perpetrators. The responses of Physical Sciences teachers resonate with the report of Moletsane and Reddy (2011) that females remain underrepresented in Science, Engineering and Technology fields. Very few women register for Engineering at postgraduate level. As a result, few women end up working in the SET sector.

4.5.4. Socialisation has contributed to current gender inequity: *Societal practices and institutional structures*

Teachers were asked about their views (and based on own experience, if any) if there were any teaching strategies that hindered the participation of girls in science or any that promoted this. The findings revealed that the way that people are socialised also plays a huge role in their education.

Muzi stated, *“girls face social stereotypes at home, in the community and in school. Some churches have improved, but mostly this is not universal. The female traditional roles at home limit the amount of time girls have to study and understand their work. If they do not get the support. This means that the average girl in a traditionally stereotype average family, community, and environment will not have anywhere close to her boy counterpart to enter and succeed in science education. South Africa, especially in rural and traditional communities, still does not view the girl child as a future leader, science education included”*. This view is consistent with Mlambo-Ngcuka (as cited in Adichie, 2016) that the issue of prejudice against women is important for all, irrespective of country because gender inequality is present in all societies. Mlambo-Ngcuka (as cited in Adichie, 2016, p. 7) further alluded that “we have under invested in ending these deep

prejudices...and need to look again at traditional laws that discriminate against women. At a macro level we need to make a change so women are looked at as solution providers for family and the economy, and not as dependants”. This view is in line with Radical feminism in the conceptual framework discussed in Chapter Two, and its aim to change social structures and eradicate the gender stereotypes and patriarchal structures in societies. Rarieya et al. (2014) claim that gender affect males and females differently.

David added, *“women are not in science subjects because they are not encouraged to venture into those fields. On the same vein, they lack female role models that are in those subjects. Their female role models are doing nursing or teaching. Birds of the same feather flock together. Parents contribute to their children’s choice of carriers. These parents are traditionalists who would like their children to be like their aunts or elder sisters who studied feminine careers like nursing”*.

The participants also highlighted some of the reasons that result in female underrepresentation in science education. Lattifa explained, *“the reason is that females after matric they don’t continue with sciences. They opt for other career fields like teaching. Another reason is the poor results the girls are getting which hinder them to get places in tertiary institutions”*. The findings revealed that girls achieve poor results when compared to boys because they lack self-confidence, are shy and are not encouraged. It was recognised that if this gender inequity issue is not swiftly attended to, South Africa will continue to have less females in science related careers. This in turn poses a serious challenge in the growth and development of the economy of the country. Nomusa indicated that *“this is important topic because we continue having less women in professions perceived to be masculine, if something is not done. The topic is relevant because there is a need for mentors, parents, teachers, and politicians, teachers that encourages girls to take science subjects and remove that gender stigma in those fields. View about the importance of addressing gender inequalities in science. On the other hand, if we don’t discuss this subject and thereafter act, we risk having more scientific research, publications, and inventions that uses language that trivializes women or excludes women and this would negatively impact women on their perception towards science”*.

Teachers were also of the view that women are not involved science subjects because they are not encouraged to venture into those fields. These views and beliefs corresponds with Mlambo (2011)

that societal practices and institutional structures keep females away from STEM subjects and careers. The findings revealed that the problem of gender inequity in the sciences and underrepresentation of females are also the result of factors outside the school and classroom. These factors include societal stereotyping of sciences as masculine. This is in line with Frieze and Hanusa (as cited in Acker & Oatley, 1993; Kurtz-Costes, Rowley, Harris-Britt & Woods, 2008) that cultural stereotyping of science as unfeminine is very strong and is also reinforced by other aspects of life. It was clear from the interviews that adults (parents and teachers) perceive science as unfeminine. They hold a belief that boys have more ability to study the sciences than girls. These beliefs in turn can undermine girls' ability to study science. Moletsane (as cited in Rarieya, et al., 2014) further claims that females do not receive quality education in high schools; therefore, they achieve bad results in matric which hinder them from gaining placement in tertiary institutions especially in sciences. The findings indicated this happens through gender stereotypes that girls experience in classrooms. The findings revealed that girls do not receive the attention they deserve from teachers, the science curriculum is 'not friendly' to girls, the way the content is presented make female students feel like they are outsiders, meaning that they do not belong in the science class.

When teachers were asked about whether the way people were socialised contributed to the current state of gender equity, Nhlanhla remarked: *"absolutely, I have explained that to you several times that it has lot to do with the sciences and anything that is harder and heavier socialisation and culture...you know having psychological effects that men are stronger for and so forth"*.

Smanga responded, *"we cannot close the problem of gender. Gender inequity will always exist as far as my belief. Men are not treated equally to women even in the bible version. Even God in other verses it indicated that the man is a superior a woman must always submit to the men"*.

Lattifa added, *"yes. I believe that the way people are socialised have a contribution to the current gender equity status in science and science education. The way our parents and the societies bring children up has contributed so much in gender inequity issue. This is where the gender differences and gender stereotypes begin. The way we were socialised they made it looked as if science is too difficult and it is masculine. Female were socialised in a way that when they are old they will become mothers and take care of their families. Education is not important for a woman. Only a*

man can learn because one day they will work and take care of their families financially. Therefore, girl children are given dolls and boys are given toy cars. So they are introduced to sciences at a very young age. That is why they do not have a problem with sciences because they become mechanics and engineers at this age and girls learn to become mothers when they are playing with toys. As a result, when they grow up they go to study for social working, nursing, and teaching because they learn to take care at a very young age. As they grow up girls, lose interest in science education because they were socialised to become caregivers. And boys grow up with interest in sciences and tougher things because they were socialised in such a way”.

Muzi highlighted, “yes, I think so. The social structure is largely, and based on the male being the leader and more trusted leader – for historical and evolutionary reasons, most probably. Great progress has been made in right direction, but stereotypes still prevail. A female candidate has to demonstrate a bit more than a typical male candidate to receive a measure of respect. This reflects society’s bias than anything else”. David responded, “of course yes. When the parents socialise boys and girls that they are both equal and deserve equal treatment, they grow up conscious of that. Socialisation will help them become aware that what we call a male field is fallacious and needs to be challenged. When we are well socialised by people that are not slaves of cultures, we will have a generation that sees science as a field for anyone willing to learn or teach it. It’s only through socialisation that male domination can be reduced and this will have a tremendous effect on the number of women that would be teaching or learning sciences”.

The results of the study resonate with the work of Fausto-Sterling; and Kelly (as cited in Baird, 1997) that the socialisation process begins when children are still in the womb. In other families, communities and societies, the socialisation of boys and girls differs remarkably. Boys are expected to play with toy guns rather than dolls. The types of toys for girls are usually not as complex and challenging as boys’ toys. These expectations and childhood experiences are thought to be essential for studying and applying of science principles. Schools, teachers, and the curriculum promote gender roles and stereotypes from early childhood through higher education. Moreover, Baird (1997) asserted that content, models and strategies used in sciences are irrelevant to experiences, interests and socialisation of girls.

All the participants in the study believed that the way people are socialised, has a huge contribution to the current state of gender equality status in science education. The way parents and society raise and groom children have contributed substantively much in gender inequity issues. The gender differences and gender stereotypes begin from the way people are socialised. This is consistent with Cooper (2011) that these social norms and cultures give men more access to opportunities, freedom, and resources to develop their abilities as compared to females. The study also revealed that the teacher-learner interactions to some extent encouraged gender bias. However, it came very strongly that the socialisation was strongly influenced how individuals and society behave. It also extended to the issues of self-identity, which in this case is about femininity and masculinity with which the cultural norms were very influential. The study finding also showed a difference in opinions of teachers about their experiences, views, and beliefs towards the learning abilities and dominance of either gender in classroom. The gender socialisation which take place at home and in the education system impacts on differently through their life experiences. Joseph (2011) argues that children's earlier childhood socialisation has an impact on their perceptions with regards to gender and gender equality.

One of the key findings of this study is that the way in which people are socialised plays a huge role in shaping and providing a person with necessary knowledge and skills in order to become an active member within a given community. This corresponds with what is asserted by Burr (1995, p.53): "...identity therefore originates not from inside the person, but from the social realm, where people swim in a sea of language and the other signs, a sea that is invisible to us because it is the very medium of our existence as social beings". In addition, Morojele (2013) argues that gender relations in education could be understood through the lens of the social practices that teachers, learners and parents attribute to gender. He further maintains that discourses are constructed from socio-cultural beliefs and human relations.

These findings are also in line with Joseph's (2011) study on an investigation of Grade 10 and 11 boys' perceptions of gender, gender equality and sexism in a secondary school, which found that only boys are taught leadership skills from home because they are perceived as born leaders. Society views Mathematics and Physical Science as tougher subjects which is why boys don't encounter challenges with these subjects because these subjects are associated with masculinity. Boys are exposed to harder tasks at a very young age. This corresponds with the affirmation that

masculine culture does not start suddenly in adulthood; it begins from birth through gender role socialisation (Connell, as cited in Joseph, 2011).

Teachers are humans, traditional and part of the broad society, it has been cultured in them to do things the way in which they do. This is line with what Morojele (2014, p.104) asserted that “with teachers being so entangled in the historically constituted gendered social relations in their specific contexts”, as a result they end up socialising learners into “unequal gendered expectations and performances which reinforced the existing gender inequalities”. These findings fit within Social Constructionism theory which explains how people come to describe, explain and thus understand the world (including themselves) in which they live in. The childhood socialisation of Physical Science teachers has influenced their personal and professional experiences regarding gender equity. What emerged in the study is that all the participants were socialised in the same way and had similar experiences during their upbringing regarding gender equity. Males were seen and raised as family heads, strong, tough and born leaders.

4.5.5. There is a need for gender awareness teaching in science

Teachers were asked if there was need for gender awareness teaching in high schools and if there was a need for teacher education to provide training for gender awareness among teacher trainees. The results revealed that teachers think that there is a need for gender awareness teaching in high schools and that teacher education should provide gender training for teacher trainees.

Nhlanhla explained, *“eh-yes I think so, I think that the school management and the teachers must deliberately explain why there are policies to promote the gender equity and to encourage females participate more in sciences and in science education and later in the science promotion to give the background contents that our cultural system and our practices they have always made it appear like the sciences are not for the females. I think teachers should have the same idea that intellectual capacity and different disciplines in sciences is not gender specific ...that should be explained to the females particular so that they can have confidence and feel that they can equally do the same with the males because this is seemed to be cultural entrenched that the females are not their place to do sciences, but they are like intruders. I think they should be told that they are equal and good, so it should be done in the schools.”*

Smanga added, *“there is a need for gender awareness it should start with the DBE where they should run workshops, and talk about this issue. Moreover, need again to invite females, young girls and good role models. And they must come and motivate them so that they can give girls more confidence as young at high school level.”* Lattifa agreed with Smanga *“definitely there is a need for gender awareness teaching in high schools. Teachers should be made aware that they are dealing with different gender of learners. Whatever teachers are doing or teaching should have that in mind in terms of lesson planning and preparation. This will help them with the strategies and methodology that they can use which will accommodate both females and males. This will lead to fair treatment of boys and girls.”* David added *“yes, there is a need so that there is balance in terms gender”*.

Muzi explained, *“I think that there is a need for teacher education to provide training for gender awareness among teacher trainees. This will help because the government is promoting gender issues. Therefore, teachers are in a very good platform to address this issue. This will also help because now we are bringing more females in sciences we need to be sensitised with the strategies, which help us as teachers to achieve gender equity in education and science education. This will also help with the matric pass rate because there are more girls who sit for national senior examination as compared to boys. Nevertheless, you find that girls are performing poorly as compared to boys. That is why South African results are poor even ANA and TIMMS is an indication. If we can be able to treat learners equally maybe they can all perform well.”* Nomusa indicated *“I think there is need. So as to accommodate more females and deal with gender imbalance in the work sector”*.

All the participants believe that there is a need for gender awareness teaching in high schools. They mentioned that some teachers still encourage and promote gender inequity although they may not be aware of this practice or they are doing it unintentionally. Although teachers were sensitised about gender equity, very few of them had received formal training on this concept during their training as teachers or currently during practice. These results are reflective of the study by Monyemore (2012) where teachers felt the need for training on gender discrimination free classroom practices. Teachers proposed the mainstreaming of gender awareness in schools. Education in general and Science education in particular, can be used as an engine to empower girls and women- if females are educated and empowered the education system and other socio-

economic spheres benefit. The rationale of this study is that information and knowledge of the understanding and views of Physical Sciences teachers about gender equity and equality in science education would be beneficial to all key stakeholders of gender equity and equality in these subjects because the teachers could be used to promote and encourage gender equity and equality. This is because schools and teachers are regarded as agents of socio-economic and socio-cultural change.

4.6. Teachers' views and beliefs about gender and learning of science

Teachers were asked whether gender affected the learning of sciences. The results revealed that gender does not affect the performance of learners in sciences.

4.6.1. Gender does not affect learning of science: *Science requires brains (not muscle)*

Nhlanhla stated, *“no no no it doesn't affect a learner I've already said that I believe it is the right of distribution irrespective of gender. It is more on the capabilities. From the traditional approach it has always been that particularly Physical Science is tending to be dominated by males”*. Lattifa shared the same view with Nhlanhla, and mentioned, *“no I don't think that the gender affects the participation and performance of learners in sciences. I believe that it all depends on the aptitude of a person. There are girls who performing far better than boys. If you have that capability within you will perform better in both maths and Physical Sciences. In choosing subjects, it depends on the career path you will pursue after matric. It does not depend on your gender. From my experience, I believe that the learners who are not performing well in science subjects have no aptitude for these subjects; gender is not the issue. Another factor that contributes to poor performance is the stereotype that the society is holding about the science as masculine. So girls will perform poor because of this myth”*. Muzi also added, *“Science requires brains (not muscle), and women have the stuff in abundance”*.

Nomusa had a different view that gender does affect the performance and participation of learners. She mentioned, *“so I would say that a gender contributes to a performance and participation of a learner.”*

According to the interviews, gender does not affect the participation and performance of learners in sciences. Teachers believe that it all depends on the aptitude of a person. These findings are similar to the results found by Chikunda (2010) in a study conducted in Zimbabwe on the level of gender awareness of science teachers. The results indicated that the majority of these teachers believed that science is not affected by the gender and attitudes of a person. Another factor that contributes to poor performance is the stereotype that the society holds about science as unfeminine.

The participants mentioned that before they were included in the study, they did not think that gender was an important issue in teaching and learning of science. They had thought that boys perform better than girls. Nevertheless, the problem was that sometimes in the classes they find out that some girls do perform better than boys do. Smanga indicated, *“I used to shout at the boys if they are outperformed by girls. I didn’t think of gender issue”*. David said that *“being taught by male teachers in science also contributed in this. Because I knew that these subjects are for boys if you are a girl doing them you must be strong in character and brain”*. According to their socialisation, they thought that boys should perform better in sciences. This was in contradiction with what the participants said above. They could not associate this with the issues in science education. They only thought that there was something wrong with the learners they are currently teaching because always science is associated with masculinity.

The participants cited the following as the reasons for less participation of girls during teaching and learning namely that girls were shy and lacked self-confidence to study sciences. Smanga highlighted, *“girls are not participating because they are shy, they are always being discouraged, and they never believed in themselves. Even now there are few girls who believe in themselves”*. On the other hand, the participants in the study indicated that they had high confidence when they were learners and were very active, especially males, during teaching and learning. In spite of this, two of the four male teachers admitted that when they were high school learners, some of their female classmates were academically superior to them. The female participants indicated that although they were shy, they still had confidence in themselves. It was not easy for a young person to focus on academic work, especially without positive role models and consistent guidance. In terms of attitudes in science, girls had negative attitudes because they felt that they were ‘lost’ in science and boys had positive attitude towards it because they were always active. However, all

these assumptions and beliefs are contradictory to what the participants said above, namely that gender does not affect performance and participation in science. These contradictions indicated that the participants do not have sufficient understandings of gender equity issues in science education.

In my view, teachers need to be trained on gender equity issues in science education. The rationale of this study was to explore the views and understandings of Physical Science teachers about gender equity issues in science education. It was found that the Physical Science teachers have an understanding of gender issues, they would be made ambassadors for gender equity in high schools. This study revealed that participants have little understanding about gender equity therefore they need to be trained and capacitated to be made ambassadors for gender equity in science education. These findings are similar to those of Monyemore (2012) on primary teachers on gender equity. She found that these primary teachers had little understanding about equity. The views of these teachers indicated that there was a need for a deeper understanding of gender issues.

4.7. Views and beliefs about the science curriculum: *Science laws taught were discovered by male scientists*

Teachers were asked about the new curriculum “CAPS”, and what they thought of this curriculum in terms of gender in science education. They were asked if they thought the curriculum recognises that gender equity in science as important. The results showed that there is nothing specific in the CAPS curriculum in terms of gender. In other words, teachers indicated that it does not recognise gender equity as important in science education. Nhlanhla stated, *“I don’t find anything specific in CAPS in terms of addressing gender equity, because the content of the CAPS curriculum is also dominated by masculine examples and scenarios. Therefore, I don’t think there is anything that really changes the equation there. So, I don’t think it has an effect on gender equity but I think it has an effect in terms of content on the advancement on the teaching process the approaches they use but not necessary on gender equity I don’t think it an effect there”*.

Lattifa remarked, *“the curriculum does not say anything about gender equity in science education. The government say that there are gender policies in place that address gender equity in schools*

and in science education. However, I have never seen such policy. I don't think that the curriculum recognises gender equity as important in science education. The curriculum is still unfriendly to females and favours males. The examples in textbooks are still gender bias. They display males as scientist. Even the laws that we teach about in science and maths were discovered by male scientists. E.g. Newton and others. They have not included female scientists yet in high school Physical Sciences. There is nothing in the curriculum, which is specific on gender. I feel bad about this because the government is saying as teachers we must encourage and bring more females in science, yet the department of education is doing nothing about teachers in terms of training them on gender issues".

Smanga was of the same sentiment, *"the curriculum is not friendly to females. The way it is designed, for example if you look at sciences there is nothing there that accommodates females. If you look at the topics, there are so difficult in a way that the curriculum was designed for males. We do electricity, mechanics; all these topics are more male friendly."* Even Muzi agreed that *"the way that the science curriculum is designed, is not friendly to girls. It talks about things that are beyond their reach. This makes it too difficult for them. The examples that are used in textbooks show males most of the time. I had mentioned earlier, no female scientists that are in their textbooks. This makes them think that science is not theirs. It is always about complicated things. Even the practicals that are done are hazardous which scare girls because they are not brave enough to handle dangerous things."* David shared the same sentiment, *"the curriculum is friendly to males. If you are teaching boys about motors and generators, you will find that they already have knowledge of these devices. This is because they are introduced to them at a very young age. The girls find themselves being lost in the curriculum. Therefore, I would say the curriculum does not recognise gender equity as important. Further, the curriculum does not address any issues of gender equity in the sciences. I feel bad about this whole thing because the South African government is implementing gender equity policies, but there is nothing included in the curriculum that address gender issues".*

The participants indicated that the way the curriculum is presented in Physical Sciences even in Biological Sciences and Mathematics, in the examples and textbooks and see people carrying out an experiment or viewing something under the microscope, you always see males. Nhlanhla said, *"I always think it makes females think that they are lost in the discipline of sciences. So I think*

that the curriculum must show the equity in the way that is presented, the text, pictorial, examples even the people presenting at the higher level training, facilitator level, teachers, lecturers, they should try even using examples that can bring gender equity and equality so that there will be more number of females and female teachers or there should be equal numbers of female and male teachers so that when the learners come to class for training they will always think that if we are going to science we are going to see a he, almost in everywhere in all schools that will reduce their confidence level and think that they are lost. And remember also that usual the male voice is sometimes sound harsh if we always going to a science class biology physics chemistry and the girls will always meet a harsh voice a horsy voice it always brings some discouragement in females. I think we should work on bringing equality in facilitator level of teachers". This finding agrees with Gaine and George (1999) that the curriculum can isolate learners if the content is not being relevant and related particularly to learners' lives. These results are also in line with Moletsane and Reddy (2011) that the science curriculum tends to be girl unfriendly, for example the activities and drawings in textbooks are male orientated.

The teachers also indicated that the science curriculum is not presented in a manner that facilitates learning of science by girls. They said that the girls found it hard to relate the science curriculum with their real life contexts, which made it hard for them to understand science. The curriculum is predominantly taught by males, which tends to suggest that there is a small chance for females to succeed in science. These results are in keeping with Gaine and George (1999) that gender stereotyping through books and teaching materials utilised by teachers contribute to the images of which male and female learners have of themselves. It is clear from these findings that even the content and the material that is contained in school textbooks is sex stereotyped.

When teachers were also asked about whether gender was ever a focus in professional development activities organised by the DoE, teachers stated that it was not a focus. Most workshops focus only on the content and not on gender issues. Initiatives are interventions or programmes that aim at developing teachers and expanding their knowledge, values, and skills (Ndemuweda, 2011). These programmes are organised and planned by outside education specialists. The results of the study are in line with the assumption by Holsinger and Jacob (2009) that gender is not a priority in education policies. They stated that many policies are based on learner enrolment in schools.

4.8 Teachers beliefs about power relations

When teachers were asked about the power relations between men and women, Nhlanhla and Smanga shared the same sentiment Nhlanhla mentioned that *“I believe that men should have over women, because although I am a scientist and Christian. According to Christian values and principles, women should be obedient to the men... a man is the head of the family...Even my Nguni culture is the same as Christianity, upon marriage the females changes her surname that of the husband. Therefore, I think that women shouldn’t have power over men”*. This finding corresponds with what Stromquist (1991) referred to as gender ideologies. This is defined as “the social organisation of the family, the community, and the state, in such a way that male power is reinforced and perpetuated” (p.7). Walters and Manicom (1996) assert that “this male control of female sexuality limits female’s space and physical mobility and shapes conceptions of what women should be” (p. 24).

Lattifa and David disagreed, *“no, I don’t think men should have power over woman. We are no longer in apartheid regime when women were oppressed. The Bill of Rights and the RSA Constitution clearly stipulates that we are all equal now no one should have power and control over the other. I don’t care what the culture or the bible says there is no other law that is above the constitution. Women have rights too. If men have power over us that is oppression and discrimination”*. David shared the same view, *“I say no. We need to challenge this misconception because it is fallacious. No one should have power over the other because of their gender, class or race because no one chose their social location. I never chose to be a man or a woman and if someone controls me because of this, then this it’s very unfair and wrong”*.

Finally, Muzi concluded, *“I believe it should not be men over women and it should not be the other way round. Reason and objectivity should prevail. The whole debate should not be based on gender, but on what is best for science and science education. Merit should dictate terms. So, faced with two candidates, one female and the other male, the best candidate must be selected based on performance against set criteria and not on their gender. In education, all students must be given equal treatment and space to access science education. Female students must be encouraged, and*

they can compete with their male counterparts. Science requires brains (not muscle), and women have the stuff in abundance”.

South African women had been always being marginalised, victimised, and discriminated against irrespective of their race because of past policies (Marthur-Helm, 2005). These past policies created an inequality of power between males and females. Four of the participants believed that no one should have power over other irrespective of their gender, class, and race. This corresponds with the Constitution and Basic Human Rights. In contrast, Nhlanhla and Smanga believed that men should have power over women. Their views correspond with the socio-cultural practices that define females to be inferior to men. Nhlanhla and Smanga justified their beliefs and views on the basis of religion and culture: they believed that it is within a social system in which males hold primary power, predominate in roles of political leadership, moral authority, social privilege and control of property; in the domain of the family, fathers or father-figures hold authority over women and children. Nomusa, Lattifa, Muzi and David were of the view and belief that men should not have power and control over women. Sciences teachers' views agree with radical feminists that its purpose is to change social structures, which encourage male dominance, and patriarchal structures. The views and beliefs about gender equity in science education of the participants provide insights into several problems faced by learners in science classrooms. According to their views and beliefs, science curriculum disadvantages girl learners by reproducing society's gender role stereotypes in their teaching and in their classrooms. The participants interpreted the underrepresentation of girls in science in terms of culture because according to their views and beliefs, science in most cultures is socially defined as masculine domain.

4.9 Conclusion

In this chapter, the data analysis has been presented, and the findings of data collected from the participants of the study. The data sources were six Physical Science teachers as indicated earlier. In presenting the findings, I have tried to keep the balance and avoided bias by presenting direct quotes and language as they are. This was done to avoid misrepresentation of the ideas of the study participants. In this chapter, the findings were analysed and discussed within the conceptual framework of the study. In this chapter, the meaning of gender, gender equity, and gender equity

issues in science education, experiences of gender of science teachers as learners, trainee teachers and professional experiences was discussed. This chapter finally presented the views and beliefs of Physical Science teachers about gender equity and science education.

The next chapter presents a summary of the findings, the recommendations and conclusion.

CHAPTER FIVE: SUMMARY OF THE FINDINGS AND RECOMMENDATIONS

5.1 Introduction

This study sought to explore Physical Science teachers' gendered experiences, and their views and beliefs about gender equity in science education. The study adopted a qualitative approach, and data was produced data through semi-structured individual interviews with six Physical Science teachers in the Umgungundlovu district in KwaZulu-Natal. Thematic content analysis was employed to analyse the data collected from the interview respondents. In this chapter, a summary of the key findings of the study is presented. This chapter ends with the recommendations, the areas for future research and conclusion.

This study was guided by the following key research questions:

1. How do Physical Science teachers understand gender equity in science education?
2. What are Physical Science teachers' personal and professional experiences of gender equity in science education?
3. What are Physical Science teachers' views and beliefs about gender equity in science education?

5.2. Summary of the findings

5.2.1. Teachers understanding of 'gender' and 'gender equity' in education

There was no consensus from the participants (Physical Science teachers) in this study on the meaning of the concept of 'gender'. On the one hand, some participants understood 'gender' according to biological explanations. For example, they used genitalia as one of the criteria to categorise people as male or female. On the other hand, others understood 'gender' according to the social meanings attached to the gender and sex roles differences. These teachers argued that the physical criteria do not work in sorting or categorizing people as males or females. This lack of a shared understanding of what gender means is concerning considering the important role teachers can play in either challenging or entrenching gender stereotypes in their classrooms. This

highlights the need for greater knowledge and sensitization to raise awareness for Physical Science teachers about gender equity issues in science education. However, all the participants agreed that if there is gender equity, this will mean that all human beings are free to develop their personal abilities and make choices without limitations set by the strict and unlawful policies and gender roles; and that the different behaviours, aspirations and needs for both males and females are taken into consideration, valued and favoured equally. They maintained that gender equity and fairness of treatment on the basis of gender, would mean fair and equal treatment of males and females regarding human rights, benefits, obligations and opportunities. These findings are in keeping with the liberal feminists who argue that the inequity between men and women is rooted in how social structures treat them.

5.2.2. Socialisation and gender equity

The findings of this study revealed that the participant believed that the way in which people are socialised has contributed to the current state of gender equity. They maintained that socialisation explained the ways in which gender is assimilated and understood within a person. The participants felt that parents, teachers, peers and the community were responsible for the gender socialisation prevailing in society. These findings are in keeping with Social Constructionist theory that learning occurs through social interaction i.e. what is understood as knowledge and reality is a product of socialisation. The Social Constructionist theory indicates that learning occurs through all the stages of life (Gergen, 1985; Belanger, 2011).

5.2.3 Gender inequity in science education and science-related careers still exists

Teachers in this study believed that gender inequity still exists, especially in STEM subjects and careers. Participants agreed that science is a highly gendered subject, and that females continue to be underrepresented in these fields. They maintained that girls and women are portrayed in gendered roles and their socialisation is quite different from boys' socialisation. This highlights the need for gender awareness teaching which aimed at challenging patriarchal structures and socio-cultural practices which hinder the achievement of gender equity within societies. The

findings revealed that females are still underrepresented in science-related careers and fields. This study also found that there are fewer female teachers working in shortage subject areas, especially Mathematics and Physical Sciences. This indicates that females are less likely to get top management positions in schools. This study found that by adolescence girls perform poorly academically especially in sciences; as a result, by adulthood, females are grossly underrepresented in science-related fields and careers. These findings resonate with that of Mody and Brinard (as cited in Dlodlo & Beyers, 2009); Chikunda (2010); Clegg (as cited in Chikunda, 2010) who maintain that in African, Middle East and Asian countries women are grossly underrepresented in Science, Engineering and Technology careers.

Teachers also indicated that boys participated more than girls in science classrooms. This finding is in line with Moletsane and Reddy (2011) who assert that boys mostly outperform girls in science subjects. The findings highlighted that girls are disadvantaged by the boys' domination in the classroom. One of the participants (Muzi) indicated that this performance drop for girls is a result of hormones which corresponds with Sikes and Measor (1992) who maintain that when learners reach adolescence, they have great deal to think about, such as career choices and the world of work. This maturity stage eventually affects their school work. On the other hand, some of the study participants held stereotypical views and beliefs that boys were naturally expected to do well in science. These views and beliefs are similar to the claim by Kurtz-Costes, Rowley, Harris-Britt and Woods (2008) that gender differences in learner performance and participation are linked with traditional academic gender stereotypes.

5. 2.4. Schools perpetuating gender inequality

The school functionality and curriculum is the reflection of the way the society in which the school is located is structured. As with living in patriarchal societies, teachers have to work within an education system which is hierarchical. The findings revealed that schools and teachers, societal and parental attitudes continue to transmit gender ideology through their classroom gendered practices and expectations. As a consequence, learners develop different attitudes toward and different levels of performance and participation in science. Girls do not pursue science studies at

the same rate as boys. Brotman and Moore (2008) argue that that these patterns contribute to the females' persistent underrepresentation in science.

The formal gendering experiences of learners begins the moment they enter school and continue throughout the workplace. The findings highlighted that in schools, learners play different sports and different playground activities. These findings resonate with Malherbe, Kleijwegt and Koen (2000, p.122) who argue that "schools, reinforce what children learn about gender roles in the family situation. They emphasise gender stereotyping by transmitting social values that put girls and women primarily in the role of mothers and wives. They also shape children and adolescent's gender identities by making girls and boys experiences of schooling distinct." The findings revealed that teachers being product of their societies, they are also most effective and influential as the transmitters of patriarchal practices.

This study provides evidence that in the science classrooms, Physical Science teachers reinforce gender stereotypes in many ways of which they are often unaware of. For example, allowing boys to be hands-on and letting the girls do domestic work limits each learner to learn the skill of the other. This is in keeping with Maher and Ward (2002, p.2) who argue that school practices and cultures reinforce "gender-biased educational experiences". These practices are against the radical feminists' propositions, which focus on abolishing and eradicating the patriarchal structures and male dominance.

The findings revealed that teachers thought the Physical Science curriculum was gender biased. They reported that they found it very unfriendly and not accommodating to girls. This is in line with Brickhouse, Lowery, and Schultz (2000) who argue that females are marginalised by science because of its masculinity characteristic of the curriculum. For example, the findings of this study indicated that teachers thought science textbooks contained gender stereotyped materials. This has impact and influence on the interest and self-confidence of learners in their ability to successfully to perform and participate in sciences. The more the masculinity in the science, the less the girls liking it or performing well. These findings indicate that the education system, especially in schools, does not operate fairly and equally for all learners. It showed that learners' chances of studying and doing well also depended on their gender. This study highlighted that little was happening in the schools of the participants as a way of transformation regarding social gender

relations. Instead, socialisation maintained gender and learners were expected to learn and perform according to their appropriate sex roles. It was also found that even the workshop seminars organised by DoE, gender equity issues were never a centre of focus. The understandings, experiences, views and beliefs of physical sciences teachers in the study about gender equity highlighted how the science curriculum, cultural factors, power and socialisation impact in girls' access to science and related careers. In spite of all the attention that gender science education has received the understanding, experiences, views and beliefs of the participants little has changed for girls and women in science education.

5.3. Recommendations

The following are the recommendations that emerged from the findings analysed and discussed in Chapter Four. These findings clearly indicate that Physical Science teachers have very little understanding of gender equity issues in science education. However, sciences teachers need to have a deeper understanding of gender equity issues in science education in the school in general and in science classrooms.

5.3.1. Challenging gender inequity in science education

Education for equity and equality is more of a problem than it seems to be. Most of the time in education, teachers assume that they know what they are talking about whereas in fact they do not know. The first recommendation that this study suggests is that the education system should play a significant role in challenging gender inequity within education institutions at all levels. Teachers and schools are in a good position to challenge and discourage gender stereotypes and gender differences among learners. These gender stereotypes and gender differences begin from a very young age (from birth) through informal education and continue throughout adulthood through formal education and into the workplace. These gender differences are promoted and encouraged by teachers, parents, and peers through gendered roles and different expectations.

Teacher education, school authorities and teachers have substantial roles to play in working towards achieving gender equity and equality in science education. Teacher expectations and attitudes of teachers and school authorities must change and consider the disadvantage position of the female learner (Eze, Ezenwafor, & Obi, 2015). The introduction and effective implementation

of gender sensitive programmes in the school curriculum and gender sensitive teaching methods is of paramount importance. In addition, Weiner (as cited in Acker & David, 1994) suggested liberal feminist's strategies that focusses on changing the teachers and learners' attitudes, which include:

- (i) reviewing aspects of school organisation such as time table;
- (ii) analysing curriculum materials for stereotyping;
- (iii) persuading girls not to drop Science and Technology subjects;
- (iv) establishing teacher working parties on the issues; and
- (vi) providing teachers in training and those on in –service courses with ideas for combating sexism (p.47).

Continuing professional development for teachers

There are still many teachers who were trained before colleges of education introduced gender studies and who have not had the chance to attend In-Service Training. It is still vital for teacher education to provide a thorough introduction for these teachers on gender equity issues in science education. For teachers to be able to implement equal science education for all learners, current policies need to be reversed and emphasise gender equity issues. Teachers need be released for In-Service Training (INSET). The current documents seem to be ineffective if no time is given to the teachers to study and read them so as to enable them to develop working strategies to put them into practice.

This study suggests that schools and teachers become major engines of gender inequity transformation. In-service Education and Training and workshops will remain one of the key techniques to bring about the necessary change and development for teachers. These workshops must be provided by the Department of Education. This will provide teachers with the necessary training on gender issues which include gender sensitive science education and gender neutral science. To eliminate the culture of preparing learners for positions of domination and subordination, teachers need to be sensitised on socially constructed gender relations and they need to be trained on unbiased teaching practices. Therefore, those in position of power should take a

stand and support science teachers visibly, because no matter what the resources, strategies and support available to teachers, gender inequity still persist. This research understands that the attitudes of the parents, teachers, and society and education system cannot change overnight, but it is necessary to have time for teacher training.

Equal treatment and educational opportunities

This study recommends that everybody must be treated equally. This means that no one should be treated differently simply because of his/her gender and race. Every individual should be presented with equal and fair opportunities for educational, economic and social advancement. Everyone should be treated as an individual and that every individual deserves excellence in education. Learners are directly affected by the school practices that influence gender stereotypes. The cleaning up of the school and classrooms also need attention so that boys also have their own share. Play time activities also need more attention because in most schools the football game dominates the play area and other activities areas are crowded and often disrupted. Teachers also need to see how other activities and equipment are both utilised by boys and girls equally.

Gendered curriculum

Awareness about the gendered curriculum is the most important step in challenging the gender inequity in schools and classrooms. This study recommends that sciences subjects, for example Mathematics and Physical Sciences are designed and taught in such a way that they are more friendly and accommodating to girls. This will enable girls to continue with these subjects even in tertiary institutions. The school curriculum should be gender unbiased and be accessible to all learners regardless of their gender. The learner teacher support materials (LTSMs) should be analysed and selected with care to avoid gender biasness. Gender bias in education means to favour or give preference to one sex over the other. The curriculum should be relevant and interesting to both females and males. Sciences textbooks should not emphasise one sex over another, for example using stereotyped images of male scientists and over-usage of male dominance examples. In other words, the science curriculum should be gender neutral and the learning resources should be gender neutral.

Gender awareness teaching

This study suggest that schools and teachers become the agents of social change. Teachers are more than sources of knowledge, information or facilitators of learning. They are also change agents, mentors and role models. It is the duty of all teachers to help learners reach their full potential, capability and Gain the knowledge, skills and values that they will utilise in their daily lives as full participating democratic members of society. Teaching and learning should be learner-centred and learners should be responsible and accountable for their own learning and behaviour. Moreover, learners should take full responsibility for their decisions and actions.

The education system should incorporate the learners' families and communities through SGBs where possible. Teachers can extend gender awareness teaching to learners' families, homes, and patriarchal and traditional societies. In order to open the whole issue of inequity, it is of paramount importance to provide opportunities for teachers, parents and learners to discuss gender equity issues. Parents and communities should be sensitised to the equal capabilities of both boys and girls to study the sciences. There should be deliberate promotion of the concept of the shared responsibility of tasks in the home. Through gender awareness teaching, gender inequities within societies will gradually be removed. This could also be done through female role models who had succeeded and done well in sciences on par with their male counterparts.

In closing, children should be accorded an opportunity to be valued equally in their earliest years in order to realise their full potential. If this opportunity is not awarded to them, there will be even less hope that they will be given equal and fair treatment as they grow older. Furthermore, education for equity and equality would mean that policies, practices and strategies would promote notions of equity in educational institutions and society at large. South Africa, with its history of the apartheid system and patriarchy, encloses a society that functioned under the notions of gender dominance, stereotypes and subordination. Therefore, as clearly indicated in this research, the achievement of gender equity should not be considered solely the issue for teachers and schools, but for the society as a whole.

5.4. Areas for future research

I have carefully analysed, presented, and discussed the views and understandings about gender equity in science education of these Physical Science teachers and am hopeful that the findings of

this study will make a valuable contribution to the field of study on gender equity issues in science education.

In this study, the views and understandings about gender equity in science education of a small number of Physical Science teachers were explored. It would be of great interest if research that is more extensive could be carried out over a huge number of Physical Science teachers.

This study highlights the findings from Physical Science teachers from two circuits in the Umgungundlovu District high schools. It would be worth studying science teachers teaching in primary schools and from schools in different circuits, districts, and provinces.

Another study that may prove beneficial would be a confirmatory study in teacher education institutions to explore whether they incorporate gender equity issues during the current teacher training.

It would also be valuable to conduct research on how these views and understandings about gender equity in science education of Physical Science teachers influence their teaching.

This chapter presented the summary about the findings and the recommendations on how to challenge these gender inequities in science education. The Department of Education has a lot to offer in order to effectively address the gender inequity within the education system. This includes workshops and In-service Education and Training. Schools and teachers can assist in reversing this situation by treating all learners equally, avoiding bias, holding high expectations for every individual and presenting all learners with equal opportunities to succeed in education. This chapter has provided teachers with ideas on challenging gender inequity in science education.

5.5 Conclusion

In concluding this fruitful and empowering journey, as a researcher, I have learnt a lot about the different and painful experiences of gender of these Physical Science teachers. These experiences include childhood, personal and professional experiences of gender. Although this study revealed that these Physical Science teachers faced many difficult experiences of gender, they did not allow these experiences of gender inequity to interfere with their teaching. They continued to dedicate their time provide quality education to their learners. As a Physical Science teacher, I have gained

useful insights into the dynamics of gender in Science education. I have become very aware of the continued existence of gender inequity in science education globally and in South Africa in particular. Conducting this research has made me sensitive to gender equity issues in science education; I strongly feel that a collective and holistic approach is required to address the problem of gender inequity in science education, which is biased against females.

References

- Acker, S., & Oatley, K. (1993). Gender issues in education for science and technology: Current situation and prospects for change. *Canadian Journal of Education/Revue canadienne de l'éducation*, 18(3), 255-272.
- Acker, S., & David, M. E. (1994). *Gendered education sociological reflections on women, teaching and feminism*. Buckingham and Philadelphia: Open University Press.
- Act, S. A. S. (1996). *The Constitution of South Africa. (RSA 1997a) Report of the national commission for special needs in education and training/national committee for education support services*. Pretoria: Government Printer. (RSA 1997b) *White Paper*, 6, 277-291.
- Adichie, C. N. (2016, 18 May). Women's rights: Fighting the indifference. *The Witness*, p.7.
- Anderson, R. (1997). *Thematic content analysis (TCA). Descriptive presentation of qualitative data*. California: Institute of Transpersonal psychology.
- Baird, D. (1997). *Is the physics classroom any place for girls? The gender imbalance in physics education: How it came about and what teachers can do about it*. A paper Presented to the Faculty of National University in Partial Fulfilment of the Requirements for the Degree of Master of Science in Instructional Leadership with an Emphasis in Curriculum and Instruction. University of Michigan, Ann Arbour, Michigan, USA.
- Behr, A. L., & Macmillan, R. G. (1966). *Education in South Africa*. Pretoria: JL van Schaik.
- Bélanger, P. (2011). *Theories in adult learning and education*. Opladen ua: Budrich.
- Bertram, C., & Christiansen, I. (2014). *Understanding research: An introduction to reading research*. Pretoria: Van Schaik.
- Bianchini, J. A., Cavazos, L. M., & Helms, J. V. (2000). From professional lives to inclusive practice: Science teachers and scientists' views of gender and ethnicity in science education. *Journal of Research in Science Teaching*, 37(6), 511-547.

- Boyce, C., & Neale, P. (2006). *Conducting in-depth interviews: A guide for designing and conducting in-depth interviews for evaluation input*. Watertown, MA: Pathfinder International.
- Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. *Journal of Research in Science Teaching*, 37(5), 441-458.
- Brotman, J. S., & Moore, F. M. (2008). Girls and science: A review of four themes in the science education literature. *Journal of Research in Science Teaching*, 45(9), 971-1002.
- Bunyi, G. W. (2003, September). *Interventions that increase enrolment of women in African tertiary institutions*. In Case study prepared for a regional training conference on Improving Tertiary Education in Sub-Saharan Africa: Things That Work, Accra.
- Burr, V. (1995). *An introduction to social constructionism*. London: Routledge.
- Check, J., & Schutt, R. K. (2012). *Survey research. Research methods in education*. Thousand Oaks, CA: Sage Publications.
- Chikunda, C. (2010). Assessing the level of gender awareness of science teachers: the case of Zimbabwe's two education districts. *African Journal of Research in Mathematics, Science and Technology Education*, 14(3), 110-120.
- Chisholm, L., & September, J. (2005). *Gender Equity in South African Education 1994-2004: Perspectives from Research, Government and Unions: Conference Proceedings*. Cape Town: HSRC Press.
- Christie, P. (1985). *The right to learn: The struggle for education in South Africa*. Braamfontein, South Africa: Sached Trust/ Ravan Press.

Clark Blickenstaff*, J. (2005). Women and science careers: leaky pipeline or gender filter?
Gender and education, 17(4), 369-386.

Cleaver, F. (2002). *Masculinities matter: Men, gender and development*. London: Zed Books.

Cohen, L., Manion, L., & Morrison, K. (2007). *The ethics of educational and social research. Research methods in education. Sixth edition*. London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2011). *Surveys, longitudinal, cross-sectional and trend studies. Research Methods in Education, 7th edition*. Abingdon: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2013). *Research methods in education*. London: Routledge.

Connell, R. W. (1996). Teaching the Boys: New Research on Masculinity, and Gender Strategies for schools. *The Teachers College Record*, 98(2). 206-235.

Connell, R. W. (1998). Masculinities and globalization. *Men and masculinities*, 1(1), 3-23.

Connell, R. W., & Connell, R. (2000). *The men and the boys*. Great Britain: Univ of California Press.

Connell, R. W. (2002). *Gender*. Cambridge: Polity.

Connell, R. W., & Connell, R. (2005). *Masculinities*. Great Britain: Univ of California Press.

Connell, R. W. (2006). Understanding men: Gender sociology and the new international research on masculinities. *The SAGE handbook of gender and education*, 18-30.

Connell, R. (2009). *Gender: Short introductions*. Malden: Polity.

- Cooper, E. R. (2011). Millennium Development Goal 3: A Narrow Approach to Tackling Gender Issues? *Polis*, 5, 1- 48.
- Cornwall, M. (1988). The influence of three agents of religious socialization: Family, church, and peers. *The religion and family connection: Social science perspectives*, 16(2), 207-231.
- Creswell, J. W. (2009). *Research design: Qualitative and mixed methods approaches*. London and Thousand Oaks: Sage Publications.
- Crotty, A. (2008). *Women and girls in science education: Female teachers' and students' perspectives on gender and science*. PhD dissertation, University of Pennsylvania, Philadelphia, Pennsylvania, USA.
- Davis, K. S. (2003)”. Change is hard”: What science teachers are telling us about reform and teacher learning of innovative practices. *Science Education*, 87(1), 3-30.
- Denzin, N. K., & Lincoln, Y. S. (2003). *Collecting and interpreting qualitative materials*. London: SAGE.
- Department of Education (DoE). (2002a). *Revised national curriculum statement Grades R-9 (schools) overview*. Pretoria: Government Press.
- Devine, D. (2003). Children, power and schooling: *How childhood is structured in the primary school*. England and Sterling: Stylus Publishing, LLC.
- De Wat, C. (2007). School violence in Lesotho: the perceptions, experiences and observations of a group of learners. *South African Journal of Education*, 27(4), 673-690.

- Diale, M., Buchner, S. J., Buthelezi, Z., Gledhill, I. M. A., Grayson, D. J., & Kgabi, N. A. (2009, April). *Women in Physics in South Africa: The Story to 2008*. In *women in physics: Third IUPAP International Conference on Women in Physics*. AIP Publishing.
- DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical education*, 40(4), 314-321.
- Dietz, T. L. (1998). An examination of violence and gender role portrayals in video games: Implications for gender socialization and aggressive behaviour. *Sex roles*, 38(5-6), 425-442.
- Diko, N. (2007). Changes and continuities: Implementation of gender equality in a South African high school. *Africa Today*, 54(1), 107-116.
- Diko, N. N. (2004). *School reform and the education of girls in South Africa*. PhD dissertation, Indiana University, Indiana, Bloomington, USA.
- Dlodlo, N., & Beyers, R. N. (2009). The experiences of South-African high-school girls in a Fab Lab environment. *International Journal of Social and Human Sciences*, 3, 1-15.
- Ellis, S. (2008). The current state of international science statistics for Africa. *African Statistical Journal*, 6, 177-89.
- Essien-Wood, I. R. (2010). *Undergraduate African American females in the sciences: A qualitative study of student experiences affecting academic success and persistence*. PhD thesis, Arizona State University, Tuscon, Arizona, USA.
- Eze, T. I., Ezenwafor, J. I., & Obi, M. N. (2015). Effects of age and gender on academic achievement of vocational and technical education (VTE) students of a Nigerian university. *Journal of Emerging Trends in Educational Research and Policy Studies*, 6, (1), 96-101.

- Fennema, E. (1990). *Justice, equity and mathematics education*. In E. Fennema & G. C. Leder (Eds.), *Mathematics and gender*. New York: Teachers College Press.
- Fiske, E. B., Ladd, & H. F., (2005). Elusive equity: Education reform in post-apartheid South Africa. *African Studies Review*, 48(3), 184-186.
- Friedrich, A., Flunger, B., Nagengast, B., Jonkmann, K., & Trautwein, U. (2015). Pygmalion effects in the classroom: Teacher expectancy effects on students' math achievement. *Contemporary Educational Psychology*, 41, 1-12.
- Gaine, C., & George, R. (1999). *Gender, 'race', and class in schooling: A new introduction*. Abington: Routledge and Falmer.
- Gauntlett, D. (2002). *'Self-help books and the pursuit of a happy identity', extended version of texts from media, gender, identity*. An Introduction. Milton Park: Routledge.
- Gergen, K. J. (1985). The social constructionist movement in modern psychology. *American psychologist*, 40(3), 266-275.
- 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.
- Gordon, A. M., Browne, K. W., & Gordon, A. M. (1989). *Beginnings & beyond: Foundations in early childhood education*. Albany, N.Y: Delmar Publishers.
- Gouws, A. (2012). Reflections on being a feminist academic/academic feminism in South Africa. *Equality, Diversity and Inclusion: An International Journal*, 31(5/6), 526-541.
- Greve, N. (2013, March 8). Number of women in science, technology 'alarmingly low'. *Creamer Media's Engineering News*. Retrieved from <http://www.engineeringnews.co.za>.

Grown, C., Gupta, G. R., & Kes, A. (2005). *Taking Action: Achieving gender equality and empowering women*. London: Earthscan.

Haggerty, S. M. (1995). Gender and teacher development: issues of power and culture 1. *International Journal of Science Education*, 17(1), 1-15.

Haynes, L. (2008). Studying stem: What are the barriers? A factfile provided by the institution of engineering and technology. Retrived from www.theiet.org/factfiles

Himmelfarb, H. S. (1979). Agents of religious socialization among American Jews. *The Sociological Quarterly*, 20(4), 477-494.

Holmes, M. (2008). *Gender and everyday life*. London and New York: Routledge.

Holsinger, D. B., & Jacob, W. J. (Eds.). (2009). *Inequality in education: Comparative and international perspectives*. Hong Kong: Springer Science & Business Media.

Huang, S. Y. L., & Fraser, B. J. (2009). Science teachers' perceptions of the school environment: Gender differences. *Journal of Research in Science Teaching*, 46(4), 404-420.

Jacob, W. J., & Holsinger, D. B. (2008). *Inequality in education: A critical analysis*. In *inequality in education*. Netherlands: Springer.

Jackson, L. W. (2009). *Educate the Women and You Change the World: Investing in the Education of Women Is the Best Investment in a Country's Growth and Development*. In Forum on Public Policy Online. Oxford Round Table, Urbana.

Jackson, S., & Scott, S. (2002). *Gender: A sociological reader*. London: Psychology Press.

- James, T., Smith, R., Roodt, J., Primo, N., & Evans, N. (2006). *Women in the information and communication technology sector in South Africa*. Accessed on line at <http://women-inflict.meraka.csir.co.za>.
- Joseph, C. (2011). *An Investigation of Grade 10 and 11 Boys' Perceptions of Gender, Gender Equality and Sexism in a Secondary School*. Med dissertation, University of KwaZulu-Natal, Pietermaritzburg.
- Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment. *Development and change*, 30(3), 435-464.
- Kabeer, N. (2005). Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1. *Gender & Development*, 13(1), 13-24.
- Kabeer, N. (2010). Women's empowerment, development interventions and the management of information flows. *Ids Bulletin*, 41(6), 105-113.
- Kallaway, P. (Ed.). (2002). *The history of education under apartheid, 1948-1994: the doors of learning and culture shall be opened*. South Africa: Pearson South Africa.
- Kelly, A. (1988). Gender differences in teacher-pupil interactions: A meta-analytic review. *Research in education*, (39), 1-23.

Kimmel, M. S., & Holler, J. Z. (2000). *The gendered society*. New York: Oxford University Press.

Kimmel, M. S., Hearn, J., & Connell, R. W. (Eds.). (2004). *Handbook of studies on men and masculinities*. Thousand Oaks, London and New Dehli: Sage Publications.

Kurtz-Costes, B., Rowley, S. J., Harris-Britt, A., & Woods, T. A. (2008). Gender stereotypes about mathematics and science and self-perceptions of ability in late childhood and early adolescence. *Merrill-Palmer Quarterly*, 54(3), 386-409.

Langen, A. V., & Dekkers, H. (2005). Cross-national differences in participating in tertiary science, technology, engineering and mathematics education. *Comparative Education*, 41(3), 329-350.

Legewie, J., & Diprete, T.A. (2012, 21 February). *High school environments, STEM orientations, and gender gap in science and engineering degree*. Rochester, Social Science Research Network. Retrieved from <http://dx.doi.org/10.2139/ssm.2008733>

Lincoln, Y. S., Guba. E.G. (1985). *Naturalistic inquiry*. Newbury Park, CA: SAGE Publications.

Makhaye, L. (2012). *Gender-related Experiences of Female School Principals: A Qualitative Study of Four Schools in Umlazi North Circuit* Doctoral dissertation, University of KwaZulu-Natal, Durban.

Malherbe, J., Kleijwegt, M., & Koen, E. (2000). *Women, society and constraints: A collection of contemporary South African gender studies*. Pretoria: Unisa Press.

Mannathoko, C. (1999). *Theoretical perspectives on gender in education: the case of Eastern and Southern Africa*. In *Education, Equity and Transformation*. Netherlands: Springer .

Masanja, V. G. (2010, October). *Increasing women's participation in science, mathematics and technology education and employment in Africa*. In United Nations Division for the Advancement of Women: Expert group meeting: Gender, science, and technology. Butare, Huye, Rwanda: National University of Rwanda & University of Dar es Salaam.

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.

Mda, T. V., & Mothata, M. S. (Eds.). (2000). *Critical issues in South African education after 1994*. Kenwyn, South Africa: Juta and Company Ltd.

Measor, L. (1983). *Gender and the Sciences: Pupils' Gender-based Conceptions of Schools Subjects* in Hammersley, M. Hargreaves, A. (eds). *Curriculum Practice: Some Sociological Case Studies*. Lewes: Falmer Press.

Miles, M. B., & Huberman, A. M. (1984). *Qualitative data analysis: A sourcebook of new methods*. London: SAGE

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. London: SAGE.

Mlambo, Y. (2011). *Science is for boys. The challenges of being a woman in science*. Consultancy Africa Intelligence. Retrieved from www.consulancyafrica.com.

Mngadi, N. (2016). *Factors facilitating pest infestation in two low-income urban areas of Cape Town, South Africa: an urban health observation study*. Doctoral dissertation, University of Cape Town.

- Moletsane, R., Mitchell, C., & Lewin, T. (2010, May). *A critical analysis of gender violence and inequality in and around schools in South Africa in the age of Aids: Progress or retreat*. In Paper presentation at the UNGEI E4 conference: Engendering, Empowerment, Education and Equality in Dakar, Senegal.
- Moletsane, R., & Reddy, V. (2011 March). *Gender equality in the mathematics and science school curriculum*. HSRC policy brief. Retrieved from www.hsrc.ac.za
- Moletsane, R., & Reddy, V. (2011 March). *Women's participation in industrial science, engineering and technology*. HSRC policy brief. Retrieved from www.hsrc.ac.za
- Moloi, M. Q., & Chetty, M. (2011, September). *Progress in gender equality in education: South Africa*. Paper presented at Policy Brief number 6 Southern and Eastern Africa Consortium for Monitoring Educational Quality, South Africa. Retrieved from www.sacmeq.org
- Monyemore, F. M. (2012). *Teachers' views on gender equity in primary schools in Diepkloof, Soweto*. Master of Education dissertation, Randse Afrikaanse Universiteit, Johannesburg.
- Moorosi, P. (2007). Creating linkages between private and public: Challenges facing woman principals in South Africa. *South African Journal of Education*, 27(3), 507-522.
- Morojele, P. (2013). Rural teachers' views: What are gender-based challenges facing Free Primary Education in Lesotho? *South African Journal of Education*, 33(3), 1-18.
- Morojele, P. (2014). Towards Gender Equitable Schooling: Insights from Rural Teachers' Voice in the Local Context. *Stud Tribes Tribals*, 12(1), 103-111.

- Morrell, R., Epstein, D., Unterhalter, E., Bhana, D., & Moletsane, R. (2009). *Towards gender equality: South African schools during the HIV and AIDS epidemic*. Durban: University of KwaZulu-Natal Press.
- Naidoo, K. (2010). *A case study of learners' gender constructions in a physical sciences classroom*. Doctoral dissertation, University of KwaZulu-Natal, Durban.
- Ndemuweda, V.V.N. (2011). *An exploration of the learning experiences of Life Sciences teachers through professional development initiatives: A case study of the Ohangwena region, Namibia*. Unpublished Med dissertation, University of KwaZulu-Natal, Durban.
- Nicholson, L. (1994). Interpreting gender. *Signs*, 20(1), 79-105.
- Nyamidie, J.K.E. (1999, September). African proverb of the month. *Afriprov.org*. Retrieved from <http://www.afriprov.org/african-proverb-of-the-month/25-1999proverbs/146-sep1999.html>
- O'Brien, M. (1983). Feminism and education: A critical review essay. *Resources for Feminist Research*, 12(3), 3-16.
- Republic of South Africa. (1998). *Employment Equity Act, No. 55 of 1998*. Government Gazette, 400(19370).
- Prinsloo, S. (2006). Sexual harassment and violence in South African schools. *South African Journal of Education*, 26(2), 305-318.
- Punch, K. F. (2009). *Introduction to Research Methods in Education*. London: SAGE.

- Rarieya, J., Sanger, N., & Moolman, B. (2014). *Gender inequalities in education in South Africa. Policy Brief Paper*. Human Sciences Research Council. HSRSC: Pretoria.
- Reuters, T. (2013). *FindLaw*. Thomson Reuter's business.
- Ridgeway, C. L., & Correll, S. J. (2004). Unpacking the gender system, a theoretical perspective on gender beliefs and social relations. *Gender & society*, 18(4), 510-531.
- Roberts, C. M. (2010). *The dissertation journey: A practical and comprehensive guide to planning, writing, and defending your dissertation*. London and Singapore: Corwin Press.
- Rop, C. (1998). Breaking the Gender Barrier in the Physical Sciences. *Educational Leadership*, 55(4), 58-60.
- Rose, B., & Tunmer, R. (1975). *Documents in South African Education*. Johannesburg: Donker.
- Ruiters, G. (Ed.). (2008). *Gender Activism: Perspectives on the South African Transition, Institutional Cultures & Everyday Life. Proceedings of the Rosa Luxemburg Seminar*. Grahamstown: Rhodes University, Institute of Social and Economic Research.
- Ryle, R. (2015). *Questioning gender: A sociological exploration*. Los Angeles, London, New Delhi, Singapore and Washington DC: Sage Publications.
- Sahin, E. (2013). Gender Equity in Education. *Open Journal of Social Sciences*, 2, 59-63.
- Sanders, J. (1997). *Teacher Education and Gender Equity*. Washington DC: ERIC Digest.
- Scantlebury, K., Baker, D., Sugi, A., Yoshida, A., & Uysal, S. (2007). Avoiding the issue of gender in Japanese science education. *International Journal of Science and Mathematics Education*, 5(3), 415-438.

- Shabaya*, J., & Konadu-Agyemang, K. (2004). Unequal access, unequal participation: some spatial and socio-economic dimensions of the gender gap in education in Africa with special reference to Ghana, Zimbabwe and Kenya. *Compare*, 34(4), 395-424.
- Shambare, R. (2011). MDGS and gender equity in higher education in South Africa. *International Journal of Management and Innovation*, 3(2), 46-55.
- Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for information*, 22(2), 63-75.
- 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.
- Silverman, D. (2010). *Doing qualitative research: A practical handbook*. London: SAGE.
- Sikes, P. J., & Measor, L. (1992). *Gender and schools*. USA: Tycooly Publishing.
- Skelton, C., Francis, B., & Smulyan, L. (Eds.). (2006). *The Sage handbook of gender and education*. London and California: Sage.
- Statistics South Africa. (2013). *Millennium Development Goals, country report*. Statistics South Africa, Pretoria: Government Press.
- Statistics South Africa. (2014). *Statistical release P0302. Mid-year population estimates*. Retrieved from www.statssa.gov.za/publications/P0302/P03022014.pdf

Strickland, C. W. (2006). *A teacher knowledge study: Five female teachers' understanding of gender*. ProQuest. PhD thesis, University of Alabama, Tuscaloosa, Alabama, USA.

Stromquist, N. (1991). *Women's literacy and the quest for empowerment*. *Reading the Word and the World*, keynote address to a seminar organised by the Vrouwenberaad Ontwikkelings-samenwerking, The Netherlands, November.

Stromquist, N. P. (2008). *The gender socialization process in schools: A cross-national comparison*. Paper commissioned for the EFA Global Monitoring Report.

Sweetman, C. (1997). *Men and Masculinity*. UK and Ireland: Oxfam.

Tacsir, E., Grazzi, M., & Castillo, R. (2014). *Women in Science and Technology: What Does the Literature Say?* Inter-American Development Bank. Retrived from <http://www.iadb.org>

Thorne, B. (1993). *Gender play: Girls and boys in school*. Buckingham: Rutgers University Press.

UNICEF. (2003). *Gender and Education for All—the Leap to Equality. Monitoring report*. Paris: UNESCO.

UNICEF (2005). *Education for All. The quality imperative. Global monitoring report*. Paris: UNESCO.

UNICEF. (2006). *The state of the world's children 2007: Women and children: The double dividend of gender equality*. UNICEF.

United Nations Children's Fund (UNICEF). (2006). *Report on Girls' Education Movement - South Africa*. Pretoria, South Africa: UNICEF.1-8.

United Nations Development Programme in Mozambique. (2000). *Mozambique, National Human Development Report*. Mozambique: UNDP.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2000, 26-28 April). *The Dakar framework for action: Education for All-meeting our collective commitments*. Paper presented at World Education Forum, Dakar, Senegal, and Paris.

United Nations. (2000). *United Nations millennium declaration*. New York: United Nations.

United Nations. (2010). *Global information network*. New York: United Nations.

Unterhalter, E. (2005). *"Fragmented frameworks? Researching women, gender, education and development"*. In: *Beyond Access: Transforming Policy and Practice for Gender Equality in Education*. Aikman, S., and Elaine Unterhalter (Eds.). UK: Oxfam Publications.

Van der Linde, H. J., Van der Wal, R. W. E., & Wilkinson, A. (1994). Practical work in science teaching in developing communities. *South African Journal of Education*, 14(1), 48-52.

Wainwright, D. (1997). Can sociological research be qualitative, critical and valid? *The qualitative report*, 3(2), 1-17.

Walliman, N. (2005). *Your research project: a step-by-step guide for the first-time researcher*. London: SAGE.

Walters, S., & Manicom, L. (Eds) (1996). *Gender in popular education: Methods for empowerment*. Bellville: CACE Publications.

Weitz, S. (1977). *Sex roles: Biological, psychological, and social foundations*. USA: Oxford University Press.

Wolpe, A., Quinlan, O., & Martinez, L. (1997). *Gender equity in education: A report by the gender equity task team, department of education, South Africa*. Pretoria. DoE.

APPENDICES

Appendix A: Ethical Clearance Certificate



INYUVESI YAKWAZULU-NATALI

03 June 2015

Ms Nokuthula G Mdlolo 208523148

School of Education

Edgewood Campus

Dear Ms Mdlolo

Protocol reference number: HSS/0401/0ISM

Project title: Exploring Physical Sciences teachers' views and understandings of gender equity in science education in the KwaZulu-Natal Province of South Africa.

Expedited Approval

In response to your application dated 21 April 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

Please note: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue.

Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

/px

cc Supervisor: Dr CCN Mthiyane & Dr J Naidoo

cc Academic Leader Research: Professor P Morojefe

cc School Administrator: Ms B Bhengu, Ms T Khumafo & Mr S Mthembu

Humanities & Social Sciences Research Ethics Committee

Dr Shenuka Singh (Chair)

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X54001, Durban 4000

Telephone: +27 (0) 31 260 3587/18350/4557 Facsimile: +27 (0) 31 260 460~ Email: ximbap@ukzn.ac.za / snymanm@ukzn.ac.za /

mohuno@ukzn.ac.za

Website: www.ukzn.ac.za

~ 111D ~ 2010 ~

100 YEARS OF ACADEMIC EXCELLENCE

Howard College Medical School • Pietermaritzburg • Westville

Appendix B: Ethical clearance obtained from DOE Province of KwaZulu-Natal



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

English: Nomsigile Ngubane

Tel: 033 392 1004

Ref: 3458/09

Ms NG Mdlolo
PO Box 2987
Pietermaritzburg
3200

Dear Ms Mdlolo

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING PHYSICAL SCIENCES TEACHERS' VIEWS AND UNDERSTANDINGS OF GENDER EQUITY IN SCIENCE EDUCATION IN THE KWAZULU-NATAL PROVINCE OF SOUTH AFRICA"**, in the KwaZulu-Natal Department of Education institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 01 April 2015 to 30 April 2016.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kheogole at the contact numbers below.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

UMgungundlovu District

Nkabinathi S.P. Sishi, PhD
Head of Department: Education
Date: 13 May 2015

KWAZULU-NATAL DEPARTMENT OF EDUCATION

POSTAL: Private Bag X9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa
PHYSICAL: 347 Burger Street, Anton Lembedge House, Pietermaritzburg, 3201. Tel: 033 392 1004
EMAIL ADDRESS: kwazulu.education@education.gov.za / Nomsigile.Ngubane@education.gov.za
CALL CENTRE: 0850 586 860, Fax: 033 392 1203 WEBSITE: www.kzneducation.gov.za

Appendix C: Informed consent letter for school principals



INFORMED CONSENT LETTER FOR SCHOOL PRINCIPALS

Dear Principal

SUBJECT: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT YOUR SCHOOL

My name is Nokuthula Mdlolo. I am teaching at Jabula Combined School. Currently I am studying part time at the University of KwaZulu –Natal in Pietermaritzburg towards a Master’s Degree in Education. My field of specialization is Teacher Development Studies. As part of my course I have to complete a research project. I am conducting a study which explores Physical Science teachers’ views and understandings about gender equity in science education.

1. To explore Physical Science teachers’ understandings of gender equity in science education.
2. To examine Physical Science teachers’ personal, and professional experiences of gender equity in science education.
3. To explore Physical Science teachers’ views and beliefs about gender equity in science education.

I have identified Physical Science teacher/s at your school as having potential to provide me with invaluable insights that can assist facilitate this study. I therefore kindly request your permission for teachers at your school to participate in this study. Participation will take the form of individual interviews, which will last for approximately an hour. Teachers will be asked to reflect on their educational experiences of learning Physical Science at school level and at university/college, in relation to gender. Teachers will also be asked to reflect on their experiences of teaching science and the extent to which they think gender is an important issue in the performance and participation of learners.

I wish to assure you that I will not use any teaching time during the entire research process. I will make use of the afternoons to collect data from the participants. I would like to inform you that the participation in the research project is voluntary. Should you agree to my request, I wish to assure you that you are free to withdraw your permission at any time of the study should you wish to do so. During the entire research process, I will ensure that the information about your school and your teachers remain anonymous and confidential. This information is not going to be revealed at any stage to anyone. I also wish to assure you that any information given by teachers cannot be used against the school, and the information collected will be used for purposes of this research only. The data collected will be stored in a secure storage and be destroyed after five years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number _ HSS/0401/015M). If you have any questions or concerns about your rights as a study participant, or are concerned about an aspect of the study or the researchers then please contact:

UKZN humanities & Social Science Research Ethics officials listed below:

Ms Phumelele Ximba Tel. Number 031 260 3587, Email: ximbap@ukzn.ac.za and

Mr P Mohun Tel No: 031 260 4557, Email: mohunp@ukzn.ac.za

This research project is being done with the knowledge of my lecturers and supervisors Dr Jacqui Naidoo and Dr Nonhlanhla Mthiyane. I will be glad to respond to any questions that you have about the project.

I can be contacted at:

Email: nokuthulagoodness02@gmail.com;

My Supervisors are:

Dr Jaqueline Naidoo

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Tel: (033) 260 5867

Email: naidooj@ukzn.ac.za

and

Dr Nonhlanhla Mthiyane

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Tel: (033) 260 6131

Email: mthiyanen@ukzn.ac.za

Thank you for your contribution to this research.

Yours sincerely

N. G. Mdlolo

DECLARATION

I ----- (full names of the
participant), the principal of -----
----- hereby confirm that I understand the contents of this document and the nature of the
research project, and I give permission for teachers at my school to participate in this study. I
understand that I am at liberty to withdraw my permission at any time, should I do wish.

SIGNATURE OF THE SCHOOL PRINCIPAL

DATE

Appendix D: Informed consent letter for Physical Science teachers



INFORMED CONSENT LETTER FOR PHYSICAL SCIENCE TEACHERS

Dear Participant

My name is Nokuthula Mdlolo. I am teaching at Jabula Combined School. Currently I am studying part time at the University of KwaZulu-Natal in Pietermaritzburg towards a Master's Degree in Education. My field of specialization is Teacher Development Studies. As part of my course I have to complete a research project. I am conducting a study which explores Physical Science teachers' views and understandings about gender equity in science education.

This study aims to achieve the following objectives:

1. To explore Physical Science teachers' understandings of gender equity in science education.
2. To examine Physical Science teachers' personal, and professional experiences of gender equity in science education.
3. To explore Physical Science teachers' views and beliefs about gender equity in science education.

I have identified you as one of the respondent Physical Science teacher in Umgungundlovu District as having potential to provide me with the information for my study. Your participation will take the form of individual interviews, which will last for approximately an hour. You will be asked to reflect on your educational experiences of learning Physical Science at school level and at university/college, in relation to gender. You will also be asked to reflect on your experiences of teaching Physical Science and the extent to which you think gender is an important issue in the performance and participation of learners.

I would like to inform you that participation in the study is voluntary. Should you agree to my request, I wish to assure you that you are free to withdraw participating in the study at any time should you wish to do so. During the entire research process, I will ensure that the information about your school and yourself remain anonymous and confidential. This information is not going to be revealed at any stage to anyone. I also wish to assure you that any information you will give cannot be used against you and your school, and the information collected will be used for purposes of this research only. The information collected will be stored in a secure storage and be destroyed after five years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number _ HSS/0401/015M). If you have any questions or concerns about your rights as a study participant, or are concerned about an aspect of the study or the researchers then please contact:

UKZN humanities & Social Science Research Ethics officials listed below:

Ms Phumelele Ximba Tel. Number 031 260 3587, Email: ximbap@ukzn.ac.za and

Mr P Mohun Tel No: 031 260 4557, Email: mohunp@ukzn.ac.za

This research project is being done with the knowledge of my lecturers and supervisors Dr Jacqui Naidoo and Dr Nonhlanhla Mthiyane. I will be glad to respond to any questions that you have about the project.

I can be contacted at:

Email: nokuthulagoodness02@gmail.com;

My Supervisors are:

Dr Jaqueline Naidoo

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Tel: (033) 260 5867

Email: naidooj@ukzn.ac.za

and

Dr Nonhlanhla Mthiyane

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Tel: (033) 260 6131

Email: mthiyanen@ukzn.ac.za

Thank you for your contribution to this research.

Yours sincerely

N. G. Mdlolo

DECLARATION

I ----- (full names of the participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I voluntarily agree to participate in this study. I understand that I am at liberty to withdraw participating in the study at any time, should I do wish.

If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	willing	Not willing
Audio equipment		

SIGNATURE OF PARTICIPANT

DATE -----

Appendix E: Information sheet about the research project



Information sheet about the research project

Dear Sir/ Madam

My name is Nokuthula Mdlolo. I am teaching at Jabula Combined School. Currently I am studying part time at the University of KwaZulu –Natal in Pietermaritzburg towards a Masters Degree in Education. My field of specialization is Teacher Development Studies. As part of my course I have to conduct a research project. My research is about the issues of gender equity in Science Education in KwaZulu-Natal Province, South Africa.

Purpose of the research project

The focus of the study is to explore Physical Science teachers' views, beliefs, experiences and understandings of gender equity in science education in Umgungundlovu District, KwaZulu-Natal province.

Activities that will be done during the research project

If you agree to participate in research project, you will be involved in the interview process. The interview will be between you and me.

Procedures

This research project will take about three months. If you agree, I would only see you once or twice for interviews. The interview can take place anywhere you feel comfortable and private. The interview will be about your views, experiences, beliefs and understandings of gender issues in science education. The researcher will come with research assistants if necessary. If you agree, I would like to record the interview on my audio tape recorder. This will help me to capture our discussion so that I will get the all the accurate data after the interview is finished. I will also take

notes during the interview. The interviews will take about 40 to 60 minutes. The information from audiotape will then be transcribed into written words.

Voluntary participation

It is of importance for you to understand that your participation in the research is voluntarily. It is entirely up to you to take part in the study. You are free to stop participating in the research project at any time you want to or if there is anything preventing you from participating during the research.

Confidentiality

The information you provide will remain confidential between me, you and my research supervisors Dr Jacqui Naidoo and Dr Nonhlanhla Mthiyane. This study is confidential meaning that nothing that happens or said during the interview process will be given to other people except for my supervisors. To ensure that your identity and school remain anonymous, you will be given a pseudonym (not your real name).

Research findings

From this research I will produce a dissertation. This research is part of the completion of my Masters Degree in Education at the University of KwaZulu-Natal. The dissertation will be kept at UKZN library and will be available on internet.

Before you agree to participate or not participate, I would like you to read carefully through the information and contract agreement sheet to make that you understand it properly. You can ask me any question if there is anything that you do not understand. You can email or text I on my email address and on my cell number that is on the information sheet.

I can be contacted at:

Email: nokuthulagoodness02@gmail.com;

My Supervisors are:

Dr Jaqueline Naidoo

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Room 47

Tel: (033) 260 5867

Email: naidooj@ukzn.ac.za

and

Dr Nonhlanhla Mthiyane

University of KwaZulu-Natal (Pietermaritzburg campus)

School of Education

Room 50

Tel: (033) 260 6131 Email: mthiyanen@ukzn.ac.za

Appendix F: Interview schedule

Critical questions and objectives

Objective one

To explore Physical Sciences teachers' understandings of gender equity in science education.

Critical question one

How do Physical Sciences teachers understand gender equity in science education?

- a. What do you understand about the word gender?
- b. What do you understand about the word sex?
- c. What is your understanding of gender equity?
- d. Follow up with: Your understanding of gender equity in science education
- e. There's a lot said in the media and TV and by government about the need for gender equity in science and in science education. What's your view on this? (Do you believe this is an important topic? Please elaborate on your answer).
- f. Would you say there have been gender equity in science education in general? What is your understanding of gender equity issues in science education, please elaborate.
- g. What do you think are the reasons for less women in science related fields/occupations in South Africa?

Objective two

To examine Physical Sciences teachers' personal and professional experiences of gender equity in science education.

Critical question two

What are Physical Sciences teachers' personal and professional experiences of gender equity in science education?

A. Experiences of gender at home as a child.

- a. Tell me about your family – how many siblings did/do you have, and where you grew up.
- b. How many were boys and girls were there?
- c. Growing up in your family, would you say there was any time where there was division of labour, or treating children differently according to whether they were boys or girls?
- d. Please give examples. Why do you think this was so?
- e. How did this make you feel?
- f. F. Do you think, you received the attention you deserved from your family? Why / Why not? Please explain.
- g. G. Looking back, would you say you were in any way discriminated against because you were a girl/boy in your family? In the community where you grew up? If so, please give examples you can still remember.

B. Experiences of gender as a learner in primary and secondary school

- a. Thinking back to your primary school days.
- b. Would you say there were any differences in how girls and boys were treated (by teachers and principals generally) in the schools you attended? For example, in terms of:
- c. Expectations to succeed at school – teaching and learning
- d. Activities to be done, sports, cleaning, doing work for teachers, punishment, rewards, etc.
- e. Would you say you were ever treated differently just because you were a girl/boys?
- f. How about other learners in your school / classes?
- g. Why do you think this was so?
- h. Were there subjects that were done by boys only or girls only? Would you say there were any gender differences in terms of attitudes to science? In terms of participation? In terms of performance? (Both at primary and high school) Why do you think these differences existed / did not exist
- i. As a science learner did you ever feel in a way that your teachers were maybe gender biased in the curriculum or whatever. What was the gender of these teachers?
- j. Thinking back now, would you say there was a difference between male and female science teachers in the way they: Taught science, Treated learners in terms of gender?

- k. Why did you choose to continue with science and be a science teacher? Were there any events or people that influenced your decision to be a science teacher?
- l. Was teaching your first career choice? Why /why not?
- m. Can you remember any form of gender-based violence while you were at primary/secondary school? Would you say it was as prevalent as it is today? Why/why not?

C. Experiences of gender in school science

- a. Why did you choose science subjects at school? Is it because of the influence you told me about or do you have another one?
- b. Can you please list the tasks that were given by your science teacher to boys and girls during teaching and learning? Did your science teacher treat boys and girls differently in any way during lesson? During practical work? (Probe for the cleaning of apparatus, etc.)
- c. So how did you feel about the role of assigning the tasks?
- d. Was there any form of differences in the way boys and girls participated during science lessons and practicals? Why do you think this was so? How did this make you feel?
- e. Who were participating the most during science lessons between boys and girls? Why do you think girls/boys were not participating as much? How did you find the participation between boys and girls?
- f. What was your confidence level in sciences?

D. Post school education experiences (University or College experiences)

- a. Where did you train to be a teacher and what was the highest qualification obtained?
- b. Was there any training on gender offered during your teacher training at the University or College? If yes, what were you trained about on gender?
- c. What is your personal view of gender equity issues in post school science?
- d. From your own experience, is there gender equity in higher education institutions?
- e. Did female and male students receive equal treatment from lecturers? Explain or give examples.

E. Teacher education and curriculum

- a. Now we have a new curriculum which is CAPS, what do you think of the curriculum in terms of gender in science education? Do you think the curriculum recognises gender equity in science as important? Please explain. is there anything specific about gender? Are there any aspects that address issues of gender in the science curriculum? How do you feel about this?
- b. During professional development activities organised by the DoE, is gender ever a focus?
- c. Is there a need for gender awareness teaching in high schools? Please explain.
- d. Do you think there's a need for teacher education to provide training for gender awareness among teacher trainees? Why or why not?
- e. What do you think should be done to promote gender equity in science education in schools? Please explain.
- f. Are you aware of anything in the school curriculum that discourages females from participating in science at their best level? What could that be? Please explain as much as possible
- g. Are you aware of anything in schools, especially high schools which discourages females from participating in science at their best level?

F. Experiences as a physical teacher in school and in the classroom

- a. In your school, would you say male and female teachers are treated any differently by (a) the school management (b) learners (c) the school governing body? Please elaborate on your answer
- b. Have you ever felt that there has been unequal treatment of some teachers based on their gender- for example in meetings, are all views treated with equal respect and importance? What do you think are the reasons and how do you feel about differences in respect given to teachers according to their gender, if this happens in your school?
- c. What tasks are reserved for males or females only in the whole school, in the classroom both learners and teachers? What do you think are the reasons and how do you feel about division of tasks according to teacher/learner gender, if this happens in your school?

- d. In your experience, does gender affect participation of learners in science? For example, in choosing science, are there any gender differences in terms of who chooses to continue with science in Grade 10? Please try to give reasons for what you have experienced about gender and learner participation in science.
- e. In your experiences, are there any gender differences in how learners perform in science? Please give examples.
- f. In your view, (and based on own experience if any) are there any teaching strategies that hinder the participation of girls in science? Any that promote it
- g. Do you think there is gender inequity in high schools? Please give reasons for your answer.
- h. Before this interview, did you ever think gender is an important issue in the teaching and learning of science?
- i. If so, is there anything you do to address issues of gender in your science classrooms?
- j. From matric examinations trends, do you think there are differences in academic ability and performance between girls and boys in Physical Sciences and Mathematics? From your answer, what do you think are the reasons for the differences or no differences?

Objective three

To explore Physical Sciences teachers' views and beliefs about gender equity in science education.

Critical question three

What are Physical Sciences teachers' views and beliefs about gender equity in science education?

- a. In your own view, do you think there is gender imbalance in science education? Do you think there are fewer female teachers and learners in science education in high schools compared to males? Please elaborate on your answer.
- b. In your own view, is there male domination in science education? What are examples of what you consider as male domination in science education?

- c. According to your own views and beliefs, does the way people are socialised have a contribution to the current gender equity status in science and in science education?
Please elaborate.
- d. Do you believe men should have power over women in terms of authority and control?
- e. Females are now given equal opportunities as their male counterparts. What is your view on this?

Appendix G: Turnitin Originality Report

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