Exploration of the impact of gender biased texts in Physical Sciences CAPS document on grade 12 female learners in Mogodumo circuit, Limpopo Province.

by

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DISSERTATION

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DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo, for the degree of Masters in Education has not previously been submitted by me for a degree at this or any other university; that it is my work in design and excecusion, and that all material contained herein has been duly acknowledged.

Chuene E.S **October 2021**

DEDICATION

I dedicate this study to my son, Azania, my husband, Pitso, my father, Madimetja, my mother-in-law, Machoene and her partner and all my siblings. The support you have given me is priceless. I thank you all.

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ABSTRACT

Background: Gender bias in the Physical Sciences education favours male learners to the disadvantages of female learners, bringing along sex discrimination. Physical Sciences Curriculum reinforces masculinity, resulting in few females enrolling for science-related subjects. Male learners outperform female learners in Physical Sciences. Also, sex discrimination due to gender bias is visible in the workforce in the fields of Science, Technology, Engineering and Mathematics. Therefore, the purpose of this study was aimed at exploring gender biased texts in the Physical Sciences CAPS document and also its impact on Grade 12 female learners.

Method: A qualitative exploratory phenomenological study design was conducted. In my study, participants were Physical Sciences Grade 12 female learners and their teachers. The total number of participants was 12 (8 female learners and 4 teachers) and the sample depended on data saturation. Also, data were collected using document review (Physical Sciences Curriculum and AssessmentPolicy Statements document and prescribed textbook), classroom observation and interviews with learners and teachers. One-on-one interviews were conducted with participants using interview guides for both teachers and learners. Data collected from interviews were analysed using thematic 8 steps of Tesch's inductive and descriptive open coding technique.

Results: The results from the document review showed the existence of gender bias in the Physical Sciences textbooks and Curriculum and AssessmentPolicy Statement document. Classroom observation showed that male learners were more interested and participated actively in the Physical Sciences lesson as compared to female learners. Both teachers and learners are aware of the existence of gender biased texts in Physical Sciences education. Further, this impacts negatively towards female learners leading to a bad attitude towards sciences and subsequently, to poor performance as compared to male learners. Female learners believe that they were to perform better in Physical Sciences if they were of the male gender.

Conclusion: The existence of gender biased texts in the Physical Sciences Curriculum and Assessment Policy Statements document and prescribed textbooks

reinforce masculinity in the field. There is a need to review the Physical Sciences Curriculum and Assessment Policy Statement document and prescribed textbooks to ensure inclusivity, eliminate sex discrimination and also to achieve balance in the workforce in the science field.

Key concepts

Physical Sciences; Curriculum and Assessment Policy Statements; Female learner; Gender Biased texts; Performance; Inclusive education

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ACRONYMS

4IR: Fourth Industrial Revolution

CAPS: Curriculum Assessment and Policy Statement

CLR: Comprehensive Literature Review

DBE: Department of Basic Education

DoE: Department of Education

MAST: Museum of Astronomy and Related Sciences

NCS: National Curriculum Statement

OBE: Outcomes Based Education

RDM: Research Data Management

RNCS: Revised National Curriculum Statement.

SA: South Africa

STEM: Science, Technology, Engineering and Mathematics

TREC: Turfloop Research and Ethics Committee

UNESCO: United Nations Educational Scientific and Cultural Organisation

USA: United States of America

CHAPTER 1
INTRODUCTION AND BACKGROUND

1.1 Introduction

This chapter introduces the study and also gives background information on gender biased texts in Grade 12 classrooms as a whole, which results in female learners being discriminated against in the Physical Sciences curriculum. Additionally, the chapter shows the underrepresentation of females in science-related occupations worldwide and also indicates poor attitudes and stereotyping as contributing factors to gender differences and poor performance in Physical Sciences by female learners. Again, the background information on inclusive education is provided to assess whether there is equality for all in education irrespective of gender. Furthermore, this chapter outlines the problem statement and purpose of the study. An overview of the research methodology is also outlined. Finally, the chapter provides an outline of the chapters of the study.

1.2 Background

Bias is regarded as a belief, attitude, behaviour or practice that reflects an assumed superiority of one group in comparison to another (Delgado-Rodríguez & Llorca, 2004). Bias can create imbalances of power in society between groups of people and it can also be institutionalised into policies, practices and structures (McPhail, 2002). It is viewed as a negative feature, which should be avoided at all times (Hammersley & Gomm, 1997) as it brings about undesirable results. Bias can be evident in different forms, one of which is in-text (Zittleman & Sadker, 2002). In-text bias can become an obstacle in delivering quality education to all (Blumberg, 2008) regardless of gender. Any hindrance to quality education for all is conflicting with the inclusive education movement, hence the focus of my thesis.

In the context of gender bias, a specific gender is advantaged to the disadvantage of the other, which then brings along sex discrimination (Antecol, Barcus & Cobb-Clark, 2009). Sex discrimination is the exclusion of one gender, mostly females from an entity, organisation or school (Esteve-Volart, 2000). Globally, males are more advantaged to access education and become more literate compared to females

(Benson, 2005). From long ago, females were excluded from accessing education and enrolling for subjects in the science field such as Physical Sciences. In the education sector, sex discrimination due to gender bias is well reflected, particularly in Physical Sciences, which is visible in student enrolment and also in performance as well as in the working science fields (Fausto-Sterling, 2005), wherein females are underrepresented.

Globally, the workforce in the fields of Science, Technology, Engineering and Mathematics (STEM) consists largely of men, with only 28,4% of female employees (United Nations Educational Scientific and Cultural Organization (UNESCO), 2015). However, females are more predominant in the fields of humanities and education. According to the European Commission (2013), in Switzerland, 1.4% of females work in STEM fields compared to 6.6% of males, while in Australia 1.1% of women work in STEM fields compared to 2.8% of males. In Germany, 1,5% of females pursue a career in the science field as compared to 4.8% of males. Only 9% of the female students graduated with Bachelor's degree in Physics in 2013 at a big Switzerland University (ETH Zurich Annual Report, 2013).

Generally, Africans are under-represented in the science fields globally and within African countries. Access to science education is often difficult and uneven resulting in the continent producing scientists and engineers lacking skills to assist in the development of the continent (Hassan, 2001). Due to this incapacity, Africa imports engineers and scientists to assist in its development. Despite efforts by the Kenyan government to ensure that there is equal access to Physical Sciences education by all learners, females are still less represented compared to males (Musau, Migosi & Muola, 2013). A Nigerian quantitative study reported the underrepresentation of Nigerians in the STEM field with a minimal gender difference, wherein male-dominated females (Olasehinde & Olatoye, 2014). In Uganda, the enrolment of females, particularly in hard to reach areas with poor educational infrastructure, is worse. As a result, the number of females reaching university or higher education in general and registering for science-related careers is poorer (Namugaya & Habumugisha, 2017). In South Africa. the representation of blacks, particularly, female scientists, is poor. In 2007, 211 visible scientists were analysed; 37% were females; only 17 of them were black women (Joubert & Guenther, 2017). The number of female scientists is very low

considering that females are more than males in number in South Africa. In 2013, mid-year estimates were that females counted up to 27 million while males counted up to 25 million (Dorrington, 2013). Females being less represented traces its roots from the apartheid system of exclusion and the legacy is still visible to date with fewer female blacks represented in the science fields (Makgatho & Mji, 2006).

According to Reuben, Sapienza and Zingales (2014), gender stereotype is the cause of fewer girls than boys enrolling for science courses of which girls associate the field with masculinity. Stereotypes influence the interests of a person to pursue a particular subject, thus, the stereotypic images of science or scientists may relay a message that the field is for boys (Archer & DeWitt, 2015) and this gender stereotype can affect the performance of girls and boys in sciences (Good, Woodzicka & Wingfield, 2010). Stereotypes develop due to socio-cultural factors and such can differ based on nationality, social status and age (Avraamidou, 2013). With the onset of formal education, occupations like nursing, teaching, secretarial and clerical jobs were said to be for women, while other professions like engineering, mining and carpentry to name a few were said not to be for women (Young, 2011). Gender stereotypes deprive women to study science subjects such as Physical Sciences and technical subjects. In addition, gender differences in occupation preferences are also key predictors of female under-representation in STEM careers (Wang & Degol, 2013).

Students' attitude towards science has been a matter of interest for ages particularly in teaching and learning (Anwar & Bhutta, 2014), especially attitudes towards gender. Muleta and Seid (2016) indicate the existence of gender difference as far as the attitude towards Physical Sciences is concerned. A study involving students from ten countries showed differences between males' and females' attitudes towards science broadens as students move from elementary to secondary school (Kotte, 1992). Kotte (1992) further indicated that the differences in girls' and boys' attitudes in sciences broaden between the age of 10 and 14 years. At secondary school levels, females perceive science as irrelevant to the life and also boring (Muleta & Seid, 2016). Significantly, the males have better attitudes towards sciences in classes and activities, confidence in their ability to do science and interests in activities associated with sciences outside the school environment as compared to their female counterparts (Ornstein, 2006). Under-representation of females in Physical Sciences

education and science-related occupations are attributed to cultural differences of which boys are regarded as being more suited to doing science-related subjects as compared to females (Reilly, Neumann & Andrews, 2019).

Like race, gender discrimination is also constructed in instructional materials or science textbooks for exclusion, stereotyping and isolation of women from science fields (Sadker & Sadker, 2001). Gender discrimination in science classrooms influences students' interests, resulting in females having fewer interests (Tindall & Hamil, 2004). Textbooks are essential tools that attract or deter females from studying science-related subjects (Potter & Rosser, 1992). Science textbooks provide examples and refer to scientists as males to further male dominance in the field (Villar & Guppy, 2015). It is rare to find textbooks that portray females as scientists or engineers; they are, instead, portrayed as teachers, nurses and homemakers (Blumberg, 2008).

Language is also used to exclude women from sciences, wherein the language of gender in sciences emphasises masculinity (Tuana, 1989). The construction of gender in textbooks serves as an obstacle to creating equality in science education (Blumberg, 2008). Textbooks occupy 80% of classroom time and contribute significantly to lowering females' interest and performance (Blumberg, 2008). A Chinese study on assessment showed that 71% of teachers rank a student with a male name as a good science student, while only 20% of teachers rank a student with a girl's name as a good student, demonstrating stereotypes in assessments (Bassi, Blumberg & Diaz, 2016).

Walton (2018) argues that inclusive education traces its origins to the activism of parents of children with disabilities in the Nordic countries in the 1960s and 1970s. Inclusive education is regarded as a rights-based approach that promotes access, participation and achievement of all learners by resisting exclusion within and from school communities (Walton, 2018). Inclusive education seeks to reduce exclusions from schools by promoting accessibility regardless of race or gender and also reduces exclusions within schools by discouraging gender-biased curriculum (Walton, 2018). The notion of inclusive education in Africa as a continent has been slow since the Salamanca statement (Chataika, Mckenzie, Swart & Lyner-Cleophas, 2012).

However, it has been moving faster in other countries like Australia (Forlin, 2006). The Salamanca statement was published by UNESCO in 1994 (Ainsow, Slee & Best, 2019). It aims to carry out the set objective of education for all policy (Ainscowet al, 2019). There are some challenges that Africa is faced with when coming to the implementation of the set policies centred around inclusive education (Pather, 2019). Access for the most marginalised is deemed difficult in poor countries with weak economies and "variants of authoritarianism replacing colonial power" (Pather, 2019). Most African countries still rely on international aid and support to attain capital to enable them to implement set policies (Juselius, Møller & Tarp, 2014). Without such aid, the set policies are as good as non-existent since they may not even get funding to kickstart the implementation stage of inclusive education (Pather, 2019). For it to be implemented fully, inclusive education requires capital and trustworthy implementers who would use the set budget faithfully without being corrupt (Owoye & Bissessar, 2014). South Africa (SA) is one of the African countries that has also adopted the Salamanca statement.

Out-of-School Children is a joint programme by UNICEF and UNESCO to try and put all school-going age children in school especially female learners who often drop out of school due to gender bias, marginalisation or even child labour (UNICEF, 2012). Global campaigns like 'Girls not Brides' protect female learners from being taken out of school and given adult duties before time (Mwambene, 2018). In countries that still practice child marriages like SA, Malawi and Zimbabwe, they have gained a spotlight from their international counterparts and given support to tackle such issues. In Malawi, it is estimated that 50% of girls marry before the age of 18 and 12 percent before the age of 15; in Zimbabwe, the number is lower as compared to those in Malawi, while in SA 6% marry before the age of 18 and 1% before the age of 15. The numbers are alarming and not acceptable to international laws. Clark (2005) articulates for a reform in science education to address the problem of having fewer females in the science subject and consequently, in STEM careers.

SA is a middle-income country that is plagued with high levels of inequality as a result of the former Apartheid regime (McKenzie, 2020). However, the county has engaged seriously in developing and enabling policy to include all learners in the learning system (McKenzie, 2020). During apartheid SA, black people, particularly women,

were excluded from and within the education curriculum. After the democratic elections of 1994, the current government prioritised the transformation of the education system (Department of Education (DoE), 2001). SA like many other developing countries adopted the inclusive education approach after the publication of the Salamanca Statement regarding inclusive education (Artiles, Kozleski, & Waitoller, 2011). The adoption of inclusive education in SA is in line with the New SA Constitution (1996), which laid a foundation by establishing the right of all citizens to basic education, affirming equality and human dignity and outlawing discrimination of any forms including access to science subjects by female learners. In SA, gender parity has been reached when it comes to enrolment in schools and science subjects (DBE, 2009). The struggle is now on acquiring the same quality education for everyone regardless of gender.

Inclusive education has over the years taken a different form through the contribution of many fields and disciplines to denounce exclusion (Slee, 2011). Lately, it has been categorised into two: inclusive education for special education and inclusive education with a broad view (Themane, 2016). One of the three main initiatives of the broad view is the 'school effectiveness and improvement movement; its main objective is to enable all learners to get a quality education (Teddie & Reynolds, 2000). Both male and female learners need to get the same quality of education. Those opposing inclusive education have criticised it as a theoretically flimsy approach that lacks empirical evidence for efficacy (Armstrong, Armstrong & Spandagou, 2011). It is a policy to ensure knowledge production and appropriate teaching, which is inclusive, hence teachers' training and reskilling are identified as the most important (Walton, 2018). Also, the DoE (2010) considers teachers as important stakeholders and drivers of inclusive education, who should ensure that it is implemented. Implementation is the process of executing the set policies of the government (Mkpa, 2005). Each subject has its curriculum policy and one such subject is Physical Sciences, therefore, there is a budget for training teachers in Physical Sciences curriculum to ensure its proper implementation (Volmink & van der Elst, 2017). Proper implementation of the curriculum aligns with the Child-Friendly Schools Framework.

The Child-friendly Schools framework has six characteristics. First, schools must be "rights-based and inclusive. Second, it must be gender-sensitive and promote equity. Third, it ought to be safe, protective and caring. Fourth, teaching must be effective. Fifth, it must promote health. Last, it must forge community links" (Themane, 2016:42). The second characteristic is the basis of this study; schools should be gender-sensitive and promote equity in all aspects. Schools that are governed by a curriculum with gender-insensitive texts can never achieve the mandate of creating a gender-sensitive school that promotes equity. When a female learner is taught under a gender-insensitive curriculum, it adds to the many challenges a girl child is faced with. A girl child in a rural South African school is faced with the following but not limited to a reduced study time due to mandatory house chores, (Kroska, 2003), A lack of basic needs like water and sanitation that should be provided by the school (Themane, 2016), a lack of support from teachers and their counterparts -boys (Beaman, Wheldall & Kemp, 2006) and a lack of support and care from the immediate community (Themane, 2016). Adding on top of the already deep challenges is unjust to a woman at large in SA. Despite this need for females to be fairly represented in the sciences, particularly Physical Sciences, there is a paucity of studies on why the gap between them and their counterparts (boys) remains wide. Such studies may be important to address this gap. The gap becomes even wider when it comes to rural girls, who are disadvantaged by many stereotypes in such communities. Therefore, this study seeks to address this important gap.

1.3 Research problem

Gender biased education brings along sex discrimination and disadvantages the female gender. The association of Physical Sciences with the male gender contributes significantly to women's under-representation in the science field. Gender biased texts perpetuate gender bias in education. Sex discrimination is defined as practices that divide men and women into two groups (Franklin, 2012). Sex discrimination in education separates male learners from female ones and puts them in two perfectly-differentiated groups (Cheung, 2010). Such is the opposite of what human rights in SA represent. Simmonds (2013) avers that Physical Sciences is a useful tool to both individual and nations to survive and develop to meet global economic requirements; it is more important today in the presence of the Fourth Industrial Revolution (4IR), particularly because it is a foundation for various professions, which impact on daily

life activities (Akweya, Twoi & Waweru, 2015). Females are under-represented in the science fields and this is visible in the workplace and also in schools with fewer women enrolling for Physical Sciences compared to males (Koppel, Cano, Heyman & Kimmel, 2003). However, there is an improvement of women in science-related fields with more females graduating with bachelor's degrees in STEM fields than in the past (United States National Centre for Education Statistics, 2010). Despite this progress, males continue to obtain STEM-related bachelor's degrees in a higher proportion as compared to females (United States National Centre for Education Statistics, 2010). Females remain under-represented in the sciences fields and occupations (Hill, Corbett & Rose, 2010). Although gender parity in Science subjects has been reached in South Africa (DBE, 2009), the quality of education to both the male and female genders is still questionable.

This is the reason the researcher became interested in exploring the impact of gender-biased texts in the school curriculum on female learners that are doing Physical Sciences as their subject of learning. For example, when teaching, if one learner has mass and the other does not, as a result of being different on gender, that is unfair to the one gender without mass (Onojah, Abimbola, Obielodan, OLumorin, Aderogba & Adeyanju, 2020). Mass is the "actual physical object of the subject matter such as an instructional material" (Abe, Bello & Flamzat, 2019). It is what teachers use in class to show learners that have no idea of what the lesson is about. Mass is given through the use of pictures, videos or even to take learners out on an excursion to see what is being taught about, for example, if a teacher is talking of the seating arrangement in a stadium, some learners may not be able to visualise it since they have never seen it before. But, showing those learners a video of the inside of a stadium would be giving them a mass of what the lesson is portraying to them. Learning is "a task, training experience and a performance measure (Good, Bengio, Courville & Bengio, 2010). It can also be defined as acquiring skills or knowledge through being taught, experience or study (Ngiam et al,2011). One of the barriers to learning is having a lack of mass (Coccanari & Lanata, 2012). For one to learn, one should have a mass of what is being taught. The problem emerges when one learner has the upper hand in understanding a concept because of having mass while the other learner does not as a result of being different in gender. Generally, this may lead to one gender performing better than the

other without mass. A study in Nigeria showed a lack of mass and misunderstood words as the two most common barriers to learning (Abimbola, 2013).

A misunderstood word is a word that learners think they understand, only to find that they do not understand it according to the context the teacher brought it in (Abe, Bello & Hamzat, 2019). A misunderstood word can also be a word that is not understood from the onset (Abimbola, 2013). If a word is associated mostly with male learners, female learners are most likely to misunderstand it, thus, lose track of the whole lesson. If a teacher uses a word that is understood by male learners and not female learners, it disadvantages female learners. When learners do not understand a word, they get upset, worried or tired (Abimbola, 2013). If a learner feels upset in class, the likelihood of having a negative attitude developing increases.

In the United States, in 2009, males had a higher average National Assessment of Educational Progress (NAEP) scale scores in Physical Sciences than females (Cunningham, Hoyer & Sparks, 2015). The performance of males was higher than that of females so was the interest in Physical Sciences (Cunningham, Hoyer & Sparks, 2015). Males acquired a higher score of 163 in Chemistry while females acquired a score of 156. Also, males acquired a score of 170 in Physical Sciences while females acquired 165 (Cunningham, Hoyer, Sparks, 2016). Chemistry had a higher difference as compared to Physics. A study in America has highlighted that males are more focused, thus, perform better in science subjects (Spelke, 2005). Again, in America, from 1990-2011, there was evidence of gender difference favouring males to females in Physical Sciences in grade 12. The gender differences in high achievers in Physical Sciences were even greater with a factor of 2:1. Of 9 high achievers, 6 were males and only 3 were females.

Drupsteen & Guldenmund (2014) alluded that after doing their research, it was proved that females had anxiety and lower comprehension when faced with gender-insensitive texts and pictures. When they were in a gender-insensitive environment, their performance dropped. When female learners are in a gender-sensitive environment, their performance improved and they got rid of anxiety. Male learners were put under the same controlled variables and they too produced the same results as female learners. Hence, both genders are given an upper hand if they are taught

in an environment that favours them. Furthermore, both the male and female genders are disadvantaged if they are put under an environment that does not favour them. If the curriculum is still male-oriented such that it is at the disadvantage of female learners, then, their interest in the subject will be dampened.

Male learners are performing better than female learners all over the world. The following data proves this claim. Data on achievement in Science Olympiads in the United States projected a high gender difference that favoured male learners (Steegh, Hoffler, Keller & Parchmann, 2019). In Germany, male learners are also showing a high achievement compared to female learners. Females that achieve the required set score were between 0-14% of the total number of learners that managed to attain the minimum score in their national Science Olympiad (Ellison & Swanson, 2016). In the Australian Science Olympiads, female learners that took part in the Olympiad were under-represented (Venville, Rennie, Hunbury & Longnecker, 2013). Such a representation calls for concern. In the International Science Olympiads, participants must have performed first, nationally, in their own countries. Females that participate in international Science Olympiads are very low (Ekmekci, Sahin, Gulacar & Almus, 2018). This shows that the majority of high achievers from the Science Olympiads are males. Having a difference in performance because of gender is against the inclusive education movement.

As discussed in the preceding paragraph, there is a gap when it comes to the quality of education learners in the same class get, especially, when it comes to gender. The under-representation of females in the science field is an old nightmare to many researchers and the phenomenon has been studied, which among other things has discovered that stereotypes, attitudes and lack of motivation, significantly contribute to less female representation in science fields (Alan, Ertac & Mumcu, 2018). There appear to be no studies that have looked into this problem as a possible contributing factor (gender-biased texts in the curriculum) to this misrepresentation of female learners in the Physical Sciences as a subject and consequently, poor performance in it. It is this gap that my study sought to close.

1.4 Purpose of the study

The purpose of the study is discussed according to the aim, objectives and research questions.

1.4.1 Aim

This study aims to explore the existence and possible impact of gender-biased texts on female learners in Physical Sciences teaching and learner support materials in Grade 12.

1.4.2 Objectives:

1.4.2.1 To establish the existence of gender-biased texts in Physical Sciences CAPS document and prescribed textbooks.

1.4.2.2 To describe gender-bias during Physical Sciences classroom facilitation.

1.4.2.3 To assess the impact of gender-biased texts on Physical Sciences female learners.

1.4.3 Research questions

1.4.3.1 Is there any correlation between gender-biased texts and the overall performance of female learners in Physical Sciences?

1.4.3.1.1 Do gender-biased texts exist in the Physical Sciences CAPS document and prescribed textbooks?

1.4.3.1.2 Does gender-bias exist during Physical Sciences classroom facilitation?

1.4.3.1.3 What is the impact of gender-biased texts on Physical Sciences female learners?

1.5 Significance of the study

This study was significant in contributing to addressing factors that contribute to male dominance in the science field by changing the face of scientists and paving way for female participation in the field. This work seeks to dismantle the current view of who scientists should be by uprooting the core of the problem, locally, the curriculum policy

of Physical Sciences so that it resembles that of a gender-neutral curriculum. Furthermore, the study is significant as follows:

Department of Education

The findings of this study may assist the DoE to achieve its mission of ensuring inclusive education for all learners by pinpointing gender-biased texts in the Physical Sciences CAPS document and any other documents which aid in teaching. It may also assist the DoE to expand the Salamanca Statement in the country's context by including and shielding female learners in STEM subjects. Now, that the country is en-route to education as prescribed by White Paper 3, 2001 (DoE, 2001).

Female learners

The findings of this study may assist in increasing the participation of females in science subjects by making recommendations and strategies to minimise the impact of gender-biased text for the realisation of equal opportunities for all. The female learner will be taught using texts that are clearly understood to avoid a learner from getting upset or bored as a result of a teacher using a word that may not be understood by female learners (Abe, Bello Hamzat, 2019). Also, the lack of understanding for a female learner as a result of not having mass will be a thing of the past. The input of female learners in Physical Sciences may improve since they will now be taught while having mass and having mass increases the chances of one studying.

Inclusive education

The findings of this study may help in improving and shaping the overall ideology or practices of inclusive education. Currently, inclusive education centres around disabled learners. This study could contribute to the broader view of inclusive education. It may add to the "gender-sensitive and promotion of equity" category to explore it further.

Research

The findings of this study may prompt other researchers to explore more on the gender-bias in the CAPS document in other subjects towards inclusive education.

Teachers

Also, the findings of this study may assist in making teachers aware of gender-biased texts in the CAPS document so that they approach the issue with sensitivity to minimise its effect on girls. Teachers are the agents of change in the education sector. If they are on par with the changes made, they will implement them. Implementing a change that favours both the male and female learner equally, gives both learners an equal chance at achieving in sciences; such learners' ability will be a true reflection since no one would be having the upper hand.

1.6 Research methodology

In my study, I employed a qualitative research method. It is defined as a method that seeks to gather rich and descriptive data in a certain context or phenomenon so that, that which is being researched may be understood better (Maree, 2015). It is fitting for this study as it will give a deeper understanding of the impact gender-biased texts have on female learners. A phenomenological exploratory research design focuses on the lived experiences of a particular group (Mekgoe, 2007). A phenomenological exploratory research design was employed as it highlights the lived experience of female learners in their Physical Sciences classroom. The teachers that will be interviewed will also be sharing their lived experiences about using the CAPS document as they are the primary agents of implementing any set policy in education in South Africa. The observation that would be carried out will allow the researcher to get the first-hand experience under the environment that learners are put under daily in their Physical Sciences class.

Observation is the deliberate noticing and up to par assessment of participants' behaviour in a setting that feels natural to them (Cowie, 2009). An observation schedule will be employed to guide the researcher as to what to look for while observing (Lord, Risi, Lambrecht, Cook, Leventhal, DiLavore, Pickles & Rutter, 2000). As the class will be carrying on as normal, the researcher will be acting as a non-participant observer, taking down notes to be analysed later. The interviews will also be used to gather information from both teachers and learners separately. Document analysis will be employed too to peruse through the CAPS document and supporting documents such as textbooks used. The schools that are to take part in my study are situated in the Ga-Chuene area of the Limpopo Province. They will be accessible by

the researcher. Purposive sampling will be utilised as the researcher is interested in only female learners doing Physical Sciences in grade 12. In the four schools chosen, only 2 female learners will be chosen.

1.7 Outline of the dissertation

Chapter 1 is an introductory chapter that introduces the study, gives background on gender-biased in Physical Sciences education and also shows that females are globally under-represented in the science field. Also, the chapter discussed stereotypes and poor attitudes among females, which significantly contribute to the underrepresentation of females in the science field. Besides, the chapter provides the research problem as well as the purpose of the study, which includes the aim and objectives. The introductory chapter also provides an outline of subsequent chapters of the study, highlighting hints of the content of chapters to follow.

Chapter 2 discusses the literature review and outlines the methodology of the literature review and theoretical framework which guides the overall study. Also, the chapter discusses gender-biased education in detail including highlighting the importance of inclusive education for all and denounces exclusive education. Factors that contribute to the under-representation of females in the science field are also discussed.

Chapter 3 discusses the research methodology used in my study. A qualitative phenomenological exploratory design is discussed as applied in the study as well as the study site, population and sampling. Data collection, analysis and quality are also outlined including ethical considerations.

Chapter 4 outlines the presentation of the results of this study. Multiple methods were employed to collect data which are interviews, observations and document analysis. As such, results are presented accordingly.

Chapter 5 discusses the results of this study as presented in chapter 4. Literature support is used in the discussion of the results. The overall implication of the study and conclusion closes the chapter.

1.8 Conclusion

In concluding this chapter, the notion of inclusive education has been illustrated to be vast in terms of its context. It may include any marginalised groups to make it actively participate in the set country's education sector to contribute maximally towards the country's growth. The Salamanca Statement has proven to be the root of most country's adoption of the inclusive education policy. Gender equity in education is an issue worthy to be researched as it will close the gender gap in science education. The difference in STEM careers by gender is alarming since it has been long since the adoption of gender equity in most countries. The curriculum and textbooks as the primary carriers of information to learners need to carry only gender sensitive texts to accommodate all learners equally. Globally, the female learner is still lacking behind in terms of Physical Sciences performance; the use of gender-biased texts may be one of the reasons.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The previous chapter looked at the background of the study, background on inclusive education, the research problem, purpose of the study and an outline of the study. Firstly, this chapter outlines the definition of the concepts used in this study. Secondly, the chapter outlines a review of the literature on gender-bias in the education curriculum, particularly, in Physical Sciences. The chapter discusses the history of women in sciences at a global level, in the African continent and will also give the South African representation of women's perspective. The chapter also discusses the dawn of inclusive education in South Africa, with a focus on inclusive education with a broad view. Additionally, the chapter discusses the case of Physical Sciences in the Curriculum and Assessment Policy Statement (CAPS) document and before CAPS. Moreover, the theoretical framework which guided the study is also outlined and lastly, the significance of the study is discussed.

2.2 Conceptualisation of gender-biased texts

Exploring is one manner of investigating a phenomenon in question, to survey through it and to learn more about it (Stebbings, 2001). Other words used for exploration are to probe and inquire into among others. This study seeks to explore the impact of gender biased texts in the policy document of the Physical Sciences, CAPS, on female grade 12 learners. Bias is defined as a belief, attitude, behaviour or practice that reflects an assumed superiority of one group in comparison to another (Kaiser & Wallace, 2016). In this study, bias refers to the dominance of the male over the female gender. The circuit is the geographic area within the education district that has been demarcated by the member of executive council education (Department of Basic Education (DBE), 2010). In this study, the circuit will refer to the Mogodumo Circuit of Education located in Lebowakgomo in the Limpopo Province. CAPS is defined as a single, comprehensive and concise policy document introduced by the DBE for all the subjects listed in the National Curriculum Statement for Grade R-12 (Du Plessis, 2013). In this study, CAPS is regarded as the Physical Science curriculum of Grade 12 learners. A more archetypal definition of curriculum comes from Lawton (2012) who

argued that, rather than it being “that which is taught in classrooms,” curriculum is “essentially a selection from the culture of society, certain aspects of our way of life, certain kinds of knowledge, certain attitudes and values are regarded as so important that their transmission to the next generation is not left to chance”. The word ‘curriculum’ is dependent on the ideological and theoretical learnings of the researcher (Scott, 2001).

Gender is defined as the attitudes, feelings and behaviors that a given culture associates with a person’s biological sex (American Psychological Association, 2012). In this study, gender refers to male and/or female.

The grade is the part of an educational programme, which a learner may complete in one school year or any other education programme which the Member of the Executive Council may deem equivalent thereto (South Africans Schools Act, 1996). In this study, grade refers to grade 12. Inclusive education is a policy to ensure knowledge production and appropriate teaching which is inclusive, hence teachers’ training and reskilling are identified as the most important (Walton, 2018). In this study, inclusive education refers to equal representation of females and males in Physical Science education. A learner is a person who attends an early childhood development centre, school or adult basic education training centre (DBE, 2010). In this study, a learner refers to a person who attends science training and education in secondary schools in grade 12. A teacher is a qualified person who helps learners to acquire knowledge and competence by facilitating learning (Demirkasimoğlu, 2010). In this study, a teacher is regarded as a qualified person who teaches Physical Sciences in grade 12.

2.3 Literature method and sources

A literature review is explained as a systematic and explicit approach to the identification, retrieval and biographical management of independent studies, usually, drawn from published sources for locating information on a topic, synthesising conclusions, identifying areas for future studies and developing guidelines for clinical practice (Brink, van der Walt & van Rensburg, 2016). In my study, the literature review

was done to learn from others, generate new ideas, to summarise the known and gaps on the subjects related to the objectives of this study.

2.3.1 Literature sources

The purpose of the literature review was to assess what different researchers have discovered concerning the problem being studied. The literature review was conducted utilizing books, DoE reports, databases, journal articles such as Google Scholar, PubMed, Science Direct, J STOR Scholars, Portal Journals to mention a few. The literature search enabled the researcher to explore the impact of gender-biased texts in the Physical Science CAPS document on female learners.

The Comprehensive Literature Review (CLR) laid out by Onwuegbuzie and Frels (2016) was used as the method of literature review in this study. This method of review gave credibility to the research. The information was rigorously evaluated and also prepared in a moral and culturally progressive way. The following steps were followed:

Step 1: Investigating convictions and themes.

Step 2: Starting the search.

Step 3: Putting away and arranging data.

Step 4: Choosing/selecting information

Step 5: Growing the pursuit media, perceptions, archives, experts and auxiliary information.

Step 6: Examining and synthesizing data.

Step 7: Displaying the CLR report in a composed shape.

Inclusion criteria for literature sources

- Articles, books, journals and reports on gender-bias in the Physical Sciences education and CAPS document.
- Articles, books, journals and reports on inclusive education.
- Articles, books, journals and reports on gender stereotypes and sex discrimination.

Exclusion criteria

- Articles, books, journals and reports which are not published in English.

2.4 Gender bias in education

Bias creates dominance over the other and can be institutionalised into policies, working papers, documents and structures (Bunea, 2017). In the context of education, bias can be realised in educational resources, policies and educational discourse for dominance, discrimination and oppression of rights to education of certain persons (Anyon, 2005). The presence of bias in science literacy is a challenge affecting the involvement of students in science fields (Ragusa, 2013). Bias in science textbooks influences students' career interests in the fields of STEM, hence resulting in male dominance in the science fields since science is associated with masculinity (Hango, 2013).

Milgram (2011) reported that teachers all over the world raised worries related to differences of scientific abilities existing between girls and boys because of several factors such as discouraging messages to girls from enrolling for science fields and inadequate academic support. In support of Milgram (2011), various studies reported that differential educational treatment occurs within and during the facilitation of sciences learning (Simon, Wagner & Killion, 2017). Studies had indicated that gender inequality in science education and that teachers' expectations of praises and criticism differ between girls and more, with boys being encouraged to succeed (Gasant, 2012). An Australian study indicated that from the 1980s and onward, science education needed to be inclusive irrespective of disability or gender to improve science literacy (Dawson, 2000)

It is important to understand what influences the discrimination in science education for effective implementation of the science curriculum to ensure inclusivity between males and females (Simon, Wagner & Killion, 2017). Textbooks are essential in the facilitation of education and may direct the thinking of a person (Apple, 1990). Stereotypic images in the science textbook make girls not to pursue science-related courses. A study by Good, Woodzicka and Wingfield (2010) indicated that female

learners had higher comprehension after viewing non-stereotypical images compared to those that are stereotypical. The stereotypical nature of science textbooks reinforces bias which disadvantages and making girls not to enrol and choose careers related to sciences (Hill, Corbett & St Rose, 2010). Women face oppression in multiple forms: those of race, disability and gender (National Science Foundation, 2003), hence, in Africa and SA in particular, women were excluded from sciences as black Africans and also based on gender. On that basis, it can be safely concluded that the education curriculum and the system are influenced largely by power (Brantlinger, 2006).

2.5 Gender-sensitive and rights-based curriculum

As per UNESCO, 2016, a gender-sensitive curriculum is one that promotes equal treatment of both boys and girls to achieve their full potential. This includes how both boys and girls are depicted in textbooks, question papers and all other study aids. Gender-sensitive learning materials that are to be used in a gender-sensitive curriculum should utilise unisex examples as much as possible (Maluwa-Banda & Kholowa,2002). Teachers as curriculum leaders/enforcers (Simmonds, 2017) should be taught and workshopped in the area so that they deliver a gender-sensitive education to learners. An ideology of gender sameness seeks to extend to women the same equal rights and privileges that men are enjoying through identifying areas of unequal treatment and eliminating them via legal reforms (Pilcher & Whelehan, 2004). In Malawi, there has been progress at the policy level to produce a gender-sensitive curriculum (Maluwa-Banda, 2004). The Malawian government has stated that from the year 2000 to 2015, the state would focus more on gender imbalance and inequality in the education system at all levels (Government of Malawi, 2000). However, the challenge remained at the implementation stage of the set curriculum (Maluwa-Banda, 2003). Malawian's government's aims and goals in education include Vision 2020, which includes a curriculum that is gender-sensitive at all levels of the education system (Government of Malawi, 2000).

In SA, everyone has a "right to a basic education and further education" (The Constitution of the Republic of South Africa, 1996. P 12). The right applies to both boys and girls and the quality of education should be the same for both genders. Also,

"*everyone is equal before the law and has the right to equal protection and benefit of the law"* (The Constitution of the Republic of South Africa, 1996:5). Thus, no gender should benefit more than the other in curriculum policies set out in the country. However, the rights of girls in some SA schools are still being violated (Diko, 2004). Apartheid SA, among other segregations, promoted gender stereotyping, discrimination and the neglect of women and the girl learner (Gradín, 2018). However, the new curriculum that promotes democracy and human rights is endeavoured to address the past gender inequality (DBE, 2015) although girls are still being sexually abused in different settings including schools (Leach, Fiscian, Kadzamira, Lemani & Machakanja, 2003). That is a violation of their human rights.

2.6 The history of women in Science

In the United States, gender parity has been reached in the enrolment numbers between both girls and boys in primary, secondary and tertiary (Hill, Corbett & Rose, 2010). However, there is still a huge gender gap in science and engineering careers; the gap widens, even more, when it gets to top positions in such institutions (Lacey & wright, 2009). Before the year 2000, females used to lag behind males in the enrolment in mathematics and science-related courses. However things have since changed and female enrolment is the same or nearly equivalent to males (Coley, 2001). Sexual orientation's contrasts in science accomplishment on the national assessment of educational progress and science courses are taken between boys and girls in the United States of America (USA) were minimal (Coley, 2001). In India, the school system of Kerala still shows a stereotyped representation of women in textbooks (Fousiya & Mohamedunni, 2016). Also, their curriculum is still gender-based, hence the low performance of females as compared to males. In rural China, there seems to be a gender gap in the science and technological subjects, favouring boys as compared to girls (Lu, 2018). The Brazilian government has taken up the challenge from UNESCO to encourage worldwide efforts to overcome gender disparities by developing the Museum of Astronomy and Related Sciences (MAST) to try to curb the gender disparity in their educational system (Spinelli, Germano, Fernades, Benitez-Herrera & Silva, 2019).

In Tanzania, one of the African countries, females are still lagging behind males in science education (Kasembe & Mashauri, 2011). It was found that females learners have a negative attitude towards science education in both the Physics and Chemistry part in Tanzanian secondary schools (Seba, Ndunguru & Mkoma, 2013). Also, boys enjoyed the Science subject more than girls when in class (Zhu, 2007). Those seem to be contributory factors as to why girls are still performing lower than males even though taught under the same conditions in that country. Other factors noted for the underperformance in Science have been recorded as female learner's perception towards science and their experiences in science classes. There was a study done in Ikungi District of Tanzania that sought to mitigate the low performance of girls in science subjects and it recommended that the government should teach parents and the community the importance of raising both the boy and girl child the same so that they may, in turn, view themselves as equals and recommend that the government should get rid of all cultural beliefs hindering girls schooling (Zakaria, 2016).

The Malawian government has put several policies to bring about gender-equity and also initiatives that encourage girls to take up science-related subjects, however, girls are still under-represented in the science field (Mbano & Nolan, 2017). One such programme is a bridging course designed for females with low marks in Science and mathematics (Mbano & Nolan, 2017). A study in nigeria has shown that women are under-represented and holds middle and junior level jobs in science while men occupy higher positions (Udeani & Ejikeme, 2011). There has been a call to holistically include women in sciences by promoting deserving women into higher positions in science careers, also by the provision of scholarships and other incentives to females, as well as "increasing participation of young girls in Science and Technology at secondary and tertiary institutions" (Udeani & Ejikeme, 2011:1).

In 2016, 16% of members of the South African Institute of Physics were women (Diale, Buchner, Buthelezi, Gledhill, Grayson & Kgabi, 2009). That is a significantly smaller percentage as compared to those of males at 84%. However, there are organisations aimed at alleviating such imbalances such as the Women in Physics in South Africa Project (WiPiSA), which aims to "*stimulate an increased interest in Physics among girls and women"* (Diale et al, 2009:169). In 2018, there was a conference held in Johannesburg, SA, the 2nd International Women in Science Without Borders (WiSWB)

conference. The conference highlighted three issues among a plethora of others faced by women in Sciences. Firstly, it was the gender wage gap. Females still get less pay as compared to their male counterparts with the same job description and qualifications (Van Staden, Ahmed, Getachew, Gledhill, Kanjere & Khuluse-Makhanya, 2019). Secondly, there are cultural perceptions of young girls. Boys are still valued more as compared to girls in most South African families since a girl is expected to marry and take care of the in-law's homestead (Stoet & Geary, 2019). Thus, girls are discouraged to go for careers in the health sciences (Van Staden et al, 2019). Lastly, there was a need for women in the sciences (Van Staden et al, 2019). The marginalisation of women delays the country's progress. Had women been playing at the same level in sciences as men, they would have added to the field their knowledge, which would have taken the field further than it is today. Sadly, challenges faced by women in sciences also include a lack of funding for their research (Prozesky & Mouton, 2019).

2.7 Towards an Inclusive education

Ciyer (2010) defines inclusive education as the steps taken to react to different needs of children through enhancing participation in classrooms and reducing exclusion from education. It has been over 10 years since inclusive education is being advanced in both developed and developing countries. However, the process is faced with challenges negatively impacting the full participation of all children particularly those with disabilities and girls (Khan, Ahmed & Ghaznavi, 2012). Inclusive education communicates the commitment to furnish each child with quality education in mainstream schools (Khan *et al.*, 2012). In brief, an inclusive education system permits providing carrying educational services to the child, as opposed to carrying the child to the educational services. Mainly, children with special needs are out of school purely because the school environment is generally exclusionary. Some of these children are registered learners but are excluded from learning (Khan *et al.*, 2012). The exclusionary practices also include female learners who often miss school due to a plethora of factors, not limited to, the inability to afford sanitary towels (Oster & Thornton, 2011), teenage pregnancy (Panday, Makiwane, Ranchod & Letsoalo, 2009), child-headed households (Newlin, Reynold & Nombutho, 2016), and child marriages (Lloyd & Mensch, 2008). Inclusive education does not cater for a child to

be left out of the schooling system due to any factors such as inclusive education with a broad view (Slee, 2011).

Inclusive education with a broad view looks at many other ways of excluding learners from the schooling system, apart from disability. However, these days, many countries have prioritised inclusive education and are doing their best to offer an inclusive education (Khan *et al*., 2012). Teachers play an important role in enabling the implementation of inclusive education. If teachers can resist teaching and give attention to all learners including those with special needs, it will affect the realisation of the inclusive education system (Ocloo & Subbey, 2008). The teachers must address the needs of all students in the classroom regardless of gender or disability (Forlin & Cole, 1993). Florian and Linklater (2010) propose that for inclusive education to be successful, teachers should be prepared through comprehensive training, which will certainly boost their confidence and improve their attitudes.

Inclusive education seeks to challenge exclusionary practices historically evident in the education system (Stofile, 2008). It refers to changing the environment to meet the diverse needs of excluded learners to facilitate the participation of those learners currently excluded from the education system (Mutisya, 2010). Different kinds of inclusion need to take place in the education system, be it the disabled (Hodgson & Khumalo, 2016), rural learners who are still left out of the system or gender discrimination evident in some curriculum (Fousiya & Mohamedunni, 2016) among others. Inclusive education will put everyone on the same pedestal. Inclusive education pinpoints barriers to learning which may be "*within the learner, within the centre of learning, within the educational system and/or within the broader social, economic and political context"* (Stofile, 2008:7). It also requires all the diversified members of society to access the same enrolment opportunities, which has been achieved in South Africa (DoE,2001), now, the outcry is for all the enrolled learners to acquire the same quality of education in context.

An innovation that is regarded as a planned change to improve practices (Skogen, 2001), is encouraged and should be at the centre of inclusive education (Suleymanov, 2015). According to Suleymanov, (2015), inclusive education is not restricted to just

position; it may be understood to be encouraging the education of learners with special needs. Inclusive education goes further to include curriculum adaptation, adapted teaching methods, modified assessment techniques and accessibility arrangements. Therefore, inclusive education can be regarded as a multicomponent strategy (Mitchell, DeLange & Thuy, 2008; Suleymanov, 2015).

2.8 Physical Sciences and Curriculum and Assessment Policy Statement (CAPS) and before CAPS.

2.8.1 Physical Sciences as subject

Physical Sciences is defined as a subject that focuses on investigating physical and chemical phenomena through scientific inquiry by applying scientific models, theories and laws. It seeks to explain and predict events in our physical environment (DoE, 2003). Physical Sciences is key to individual and nations' development because it is a significant part of the establishment for many occupations (Akweya, Twoli & Wawem, 2015). Physical Sciences education is used for the development of innovatively educated citizens who see how science, technology and society impact each other and can utilise knowledge in their ordinary activities (Beyessa, 2014) such as the food we eat, clothes we wear, materials used, medical diagnosis and treatment, computers and other information technologies (DoE, 2003).

In South Africa, female Physical Science learners are less likely to pass grade 12 than their male counterparts (Letsoalo, Maoto, & Masha, 2019). The national enrolment for Physical Sciences in the year 2018 was 193 869 (DBE, 2019). The difference in enrolment between the years 2017 and 2018 is 4 091 learners (DBE, 2019), showing that the number of learners enrolling in Physical Sciences has decreased. The national pass rate of Physical Sciences in the year 2018 was 48.7% (DBE, 2019), which is lower than half of the number of learners that wrote. The performance in Physical Sciences as a subject is concerning.

Numerous countries have offered consideration regarding the effective implementation and practice of science education at their secondary schools (Beyessa, 2014). The Malaysian government declared a new education policy to reinforce the education standards in science and technology to be competitive with

developed countries and promised to attain a status of a developed nation in 2020 (Mahathir, 1991). The commission for Africa report prescribes to individual countries within Africa to make an explicit move that reinforces sciences, engineering and technology capacity since such learning and abilities assist African nations to locate African answers to African challenges (Yizengaw, 2008). Also, the Ethiopian government decided and presented what is currently known as a 70:30 professional mix of which 70% will be science and technology streams while 30% will be Social Sciences and Humanities streams at higher education. This highlighted that the government has given due thought to science education (Semela, 2010). South Africa currently uses a curriculum known as CAPS for all subjects including Physical Sciences.

2.8.2 Curriculum and Assessment Policy Statement

A curriculum is defined differently and the word comes from the Latin word "*currere*" meaning "racecourse" (Marsh & Stafford, 1988). This is, indeed, the case since a learner has to run the race in a year and finish it in the set time, which can be seen as the minimum number of marks to be obtained by a learner. In a race, there is a specific route to take; one is not allowed to take short cuts. This is the same as the curriculum. Learners are given a specific scope to master, for the assessment and then declared competent per subject. The curriculum can also be defined as the content being studied by a learner **(**Beauchamp, 1977). Mulenga (2018:5) refers to curriculum as "what is taught in school". Thus, my study will use the word curriculum as the "content" that a learner is taught per subject. Many teachers in New York believe that making education curricula relevant to learners' lives increases interest and learning (Hullemal & Harackiewicz, 2009). In Jamaica, the inverse relationship between social outcomes and educational outputs favours males rather than females (Barbara, 2004).

In South Africa, the current curriculum used across all public and some private schools is CAPS. It is regarded as a revision of the previous NCS, which gives teachers detailed guidelines on what to teach and assess learners on, grade by grade and subject by subject basis (Penuel, DiCiakomo, Horne & Kirshneret, 2017). It outlines what is to be taught to learners in a class, the terms to be used and the prescribed experiments among others. CAPS came to be being after the review of the Revised National Curriculum Statement (RNCS) Grade R-9 (2002) and the National Curriculum

Statement Grades 10-12, by the then Minister of Education, Angie Motshekga, in 2009 (CAPS, 2012). Every subject has its own NCS document that comprises CAPS, the National Policy pertaining to the programme and promotion requirements of the NCS Grades R-12 and the National Protocol for Assessment Grades R-12. CAPS in Physical Sciences outlines what is to be taught by term.

Physical Science CAPS specifies prescribed activities and timeframes teachers need to follow and not allowing creativity on the part of teachers and learners since it makes learners mere recipients of knowledge (Umalusi, 2014). Comparing Physical Sciences CAPS and NCS, there is no significant change in Physical Sciences content. However, there is a change in terms of context, theoretical framing and approach and organising principle (Umalusi, 2014). The sequencing and progression of Physical Sciences are inconsistent and interrupt the required flow. For example, the grade 10 Physical Sciences interrupts the flow of certain Chemistry topics with the arbitrary insertion of unrelated Physics (Umalusi, 2014). Only less than 5% of South African schools are well equipped to implement Physical Sciences experimental work as required by CAPS. There is an increased reduction of integration of the Physical Sciences content with everyday knowledge and also low-level integration between subjects in the CAPS document. The reduced integration in CAPS between subjects provides a philosophical contradiction in Physical Sciences as the subject which consists of two sub-subjects namely Chemistry and Physics (Umalusi, 2014).

2.8.3 Before the Curriculum and Assessment Policy Statement (CAPS)

South Africa was once in a dark space, where people were separated by gender, race, age, socioeconomic status, and many other discriminatory factors. Fortunately, during the 1994 historic elections, the country gained democracy (Johnson & Schlemmer, 1996). The Bantu Education Act of 1953, later named the Black Education Act of 1953 had one main objective, which was to racially segregate educational facilities from pre-school to university (Chisholm, 2000). During the apartheid era, the black child was given the Bantu education, whose main objective was to train the black child for the unskilled labour (Nkomo, 1995). Luckily, when the country gained independence, it did away with the old discriminatory school act. It was replaced by the South African School Act (SASA) 1996 (SASA, 1996). The new policy governing education was

called curriculum 2005; it was launched in 1997 hinged on the learner-centred-approach with the teacher as a facilitator (Chisholm, 2015).

The policy got a large degree of criticism from both the public and professionals as most articulated that teachers were not trained to be facilitators but to be teachers (Pudi, 2006,). It also had a high discrepancy when it came to resources and their implementation. Schools in the rural and under-resourced areas struggled to implement, while historically resourced schools were coping. Hence, this still perpetuated discrimination brought about by the Apartheid system. It was termed Outcomes Based Education (OBE) (DoE, 2001b). However, the government heeded the call by the public and had the policy reviewed. The review of the policy led to the implementation of the RNCS, which was implemented in 2004 (Ramrathan, 2015). The RNCS was also reviewed and led to the formulation of the NCS, which had the primary role of lessening the administrative burden of educators and ensuring consistency and efficiency for teachers when delivering a lesson in class and its implementation in 2007. Both the NCS and the RNCS had less of outcomes assessment and assessment criteria as compared to the OBE. NCS also had its critiques.

Critics of NCS were not satisfied with the content knowledge learners exited the basic education system with. There was another review of the curriculum, now reviewing NCS, the committee came up with a CAPS document, which was implemented in 2012 to date (Duplessis & Marais, 2015). The South African educational policy has been reviewed, getting better each time. However, the current struggle is with gender-sensitive language in the policy statement.

There continue to be deep curriculum roots that underpin the problem of gender and differential achievement, where particular knowledge has historically been and continues to be associated with different groups (Blackmore, 2017). The different discourses of particular disciplines have signalled to learners their relevance to them and legitimised learners' choices of particular subjects. Hence, many studies have shown how subjects within the categorisations of the sciences, mathematics and technologies have long been considered more relevant and legitimate for males as

appropriate spheres of learning, whereas subjects within the categorisations of languages (mother tongue and foreign languages), humanities and arts are considered more relevant and appropriate for girls (Elwood & Gipps, 1999).

2.9 Theoretical Framework

The theoretical framework is based on a propositional statement which helps the researcher to organise the study and provides a context in which he/she examines a problem and gathers and analyses data using existing theory (Brink, Van der Walt & Van Rensburg, 2012). The theory which guided this study is feminism, which is regarded as an ideology that raises questions in the gendered world and also to the patriarchy, capitalism and the sexist assumptions that men are superior to women (Delmar, 1986). It is uncomfortable with the patriarchal norm. Feminism draws its importance in the understanding of issues women face (Chireshe & Chireshe, 2009). As a complex phenomenon, feminism grapples with the interrogation as to how the call for fairness, rightness and equality can be restored between both the male and female genders (Okin, 2005). It does not request for women to be seen as a higher gender than males but it requires gender equality. Critics of feminism base their assumptions on the thought that a person's perspective powers what that person questions about the world, how that person goes about responding to those questions, how that person relates those answers and how that person explains how that person knows what the person knows" (McCaughey, 1993).

McNutt (2015) stated that if the world would give women a chance to showcase their abilities at the same accord as men, they could accomplish more in both spheres of public and private. Those that got the chance to, women are already excelling at parenting, in marriage and academia (Isgro & Castañeda, 2015). So, if all women could be given the same chance, the world would 'move faster' than ever. Different kinds of feminist theories stemmed from feminism, which amongst others are as follows:

- The Radical feminist theory
- Liberal feminist theory
- Cyberfeminism theory
- Marxist feminist theory
- Socialist feminist theory

- Feminist Science theory.

2.9.1 *The Radical feminist theory*

The Radical feminist theory asserts that patriarchy manifests itself in the oppression and victimisation of women and it came into existence after the second world war (Moitra, 2017). Men have long seen themselves as a gender higher than any other. The radical feminist movement asserts to raise and fight that notion until there is visible equity between males and females. There is a need for a radical change in all social and economic aspects.

2.9.2 *Liberal feminist theory*

Liberal feminism theory stems from rationality and autonomy and it promotes a gender-neutral concept (Groenhout, 2002). It asserts that there should be a higher political structure that prevents humans from harming each other and that the political structure must maintain a well-ordered society (Groenhout, 2002). However, there is rubble between radical and liberal theories. Radical feminism rejects liberal feminism as it states that liberals are offering women a small piece of the pie, which is even poisoned (Schaeffer, 2001). Men have historically owned the political realm; thus, radicals assert that the same men cannot set women free fully.

2.9.3 *Cyberfeminism theory*

The cyber-feminism movement incorporates gender and information technology (McAdam, Crowley, & Harrison, 2020) practically and theoretically. While men have historically dominated in the use and development of internet and information technology, cyber-feminists encourage women to take up space in the cyber field (Paasonen, 2011). Infusing gender and information technology can be a powerful tool in developing countries, hence the need to include both men and women in the cyber field to maximise the yield stemming from the cyber world.

2.9.4 *Marxist feminist theory*

According to Hartsock (1998), marxism is defined as a science of society consisting of certain fundamental components. Marxist feminism incorporates the standpoint of marxists and feminists (Lokaneeta, 2001). It prides itself in demolishing the

exploitation of women through capitalism (Luxton, 2014). Women would, then, be paid according to the work they have done, deservingly. The notion of paying men more for the same job as women is discarded by marxist feminists. Women need to be paid exactly what they deserve, treated the way men are treated and remunerated as equally as men.

2.9.5 *Socialist feminist theory*

Socialist feminism theory refutes the idea of a male breadwinner, whereby wives and children are dependent on the male breadwinner, thus, weakening the woman's position in the household, establishing men's dominance and women's subordination and exposing single women with children to vulnerability (Barrett & McIntosh, 2005). It is an ongoing project that advocates for the emancipation of women in society from the men's control and other women who still think women are supposed to be taken care of by a man. This is dangerous for children whose fathers are late and those raised by single mothers.

2.9.6 *Feminist Science theory*

Longino (1987) defines feminist science theory as an attempt to rectify bad science by challenging those who still cling to the positivist vision of science. According to (Weber, 2006), the phrase that science and technology were a "masculine culture" was thought of as a wrong phrase since it alienated women from participating in what they called "Big Science", meaning nuclear plants of the time. Feminist science should be thought of as a process, for it is carried out in different generations until the set standard is reached (Longino, 1987). It is a standard where both women and men would be contributing and benefiting equally from science.

2.9 Conclusion

This chapter has described some of the historically male-oriented texts used in the Physical Sciences CAPS document. It also shared the history of females in the sciences in South Africa, other countries in Africa and outside of Africa. It later shared some light on inclusive education. A rights-based and gender-sensitive curriculum was explained in detail before getting into the case of Physical Sciences. The world is trying to move towards an inclusive curriculum, hence the researcher is interested in

exploring the current curriculum in the Physical Sciences to see if it is in line with such a move.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter outlined and discussed the literature review of this study. This chapter discusses the research methodology used in this study which includes research paradigms, research approach, design and setting. The chapter also discusses how the population was sampled, how data was collected and analysed. The pilot study carried out is also described in the subsequent sections. Research data management, data quality as well as bias and ethical considerations are discussed in the ensuing sections. A conclusion is given at the end of the chapter.

3.2 Research paradigms

The term paradigm has been differently understood and used by different researchers. Neuman (2000) refers to a paradigm as ontology, epistemology and research methodology. Another understanding is that a paradigm is a methodology used in research, a belief about how we get to know and criteria for validation (Antwi & Hamza, 2015). The two broad approaches of reasoning narrated by researchers are the inductive and deductive research approaches, whereby the inductive is linked to the qualitative method and the deductive is linked to the quantitative method (Trochim, 2006). Soiferman (2010) defines the inductive approach as a move from the specific to the general while the deductive approach moves from the general to the specific. Another definition given by Creswell and Plano Clark (2007) is that the inductive approach moves from the bottom to top and the deductive approach moves from top to bottom. The researcher has employed the inductive approach.

The inductive approach is associated with the interpretivist-constructivist perspective (Maxwell, 2006). It sees the world as interpreted, experienced and constructed by people while interacting with each other and the broader social systems (Tuli, 2010). The researcher is, thus, concerned with a deeper understanding of a phenomenon in its unique context rather than generalisation (Ulin, Robinson & Tolley, 2004). There is a great degree of interaction between the researcher and participants.

3.3 Research approach

There are three research methods that researchers are currently employing namely the quantitative, the qualitative and the mixed methods. A quantitative method is selected for deductive purposes whereby theory justifies the set variables, the purpose statement and the direction of the intently expressed research questions (Creswell, 2002). The purpose of the quantitative method is to project one's findings onto a greater scale on the population employing an objective process (Borrego, Douglas & Amelink, 2009). Data collected allows the researcher to make inferences. Conclusions are derived from data collected and measures of statistical analysis (Thorne & Giesen, 2002).

A qualitative method is defined as a scientific approach to gathering non-numerical data, used when little is known about a phenomenon or when the nature, context and boundaries of a phenomenon are poorly understood and defined (Brink, Van der Walt & Van Rensburg, 2016). The qualitative method is characterised by the collection and also analysis of "textual data" and by its emphasis on the circumstance within which the research is undertaken (Thorne & Giesen, 2002). There exists a great deal of difference between the quantitative and qualitative methods, which are but are not limited to the role of theory, sampling and generalisability and assumed nature of truth (Thorne & Giesen, 2002).

The last method stems from a mixture of quantitative and qualitative methods and is a mixed method (Kourieos & Evripidou, 2013). The mixed method is the third research method (Tashakkori & Creswell, 2007). It is defined as a method that mixes some of the aspects of the quantitative and qualitative methods at some stage of the research process in the study to get a clearer understanding of the research problem (Creswell, 2008). There are challenges to employing mixed methods and they may be dire to novice researchers (Ivankova & Creswell, 2009). The choice of research method is led by the research questions a researcher has, thus, a qualitative method was employed in this study. The method was relevant in answering research questions and the set objectives, particularly in gathering information about the existence of gender biased texts in the Physical Sciences curriculum and its impact on female learners.

3.4 Research design

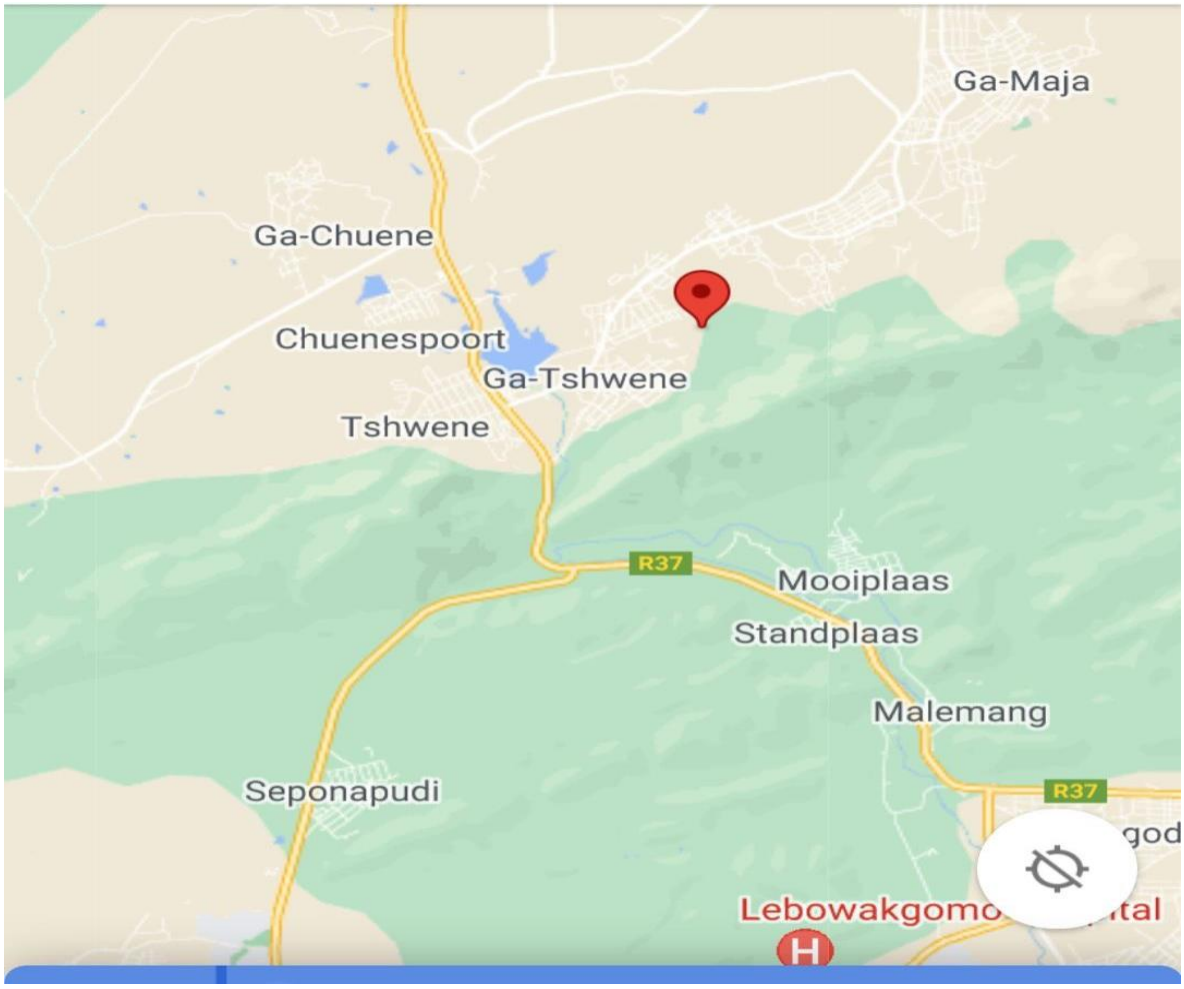
There are several research designs employed in the qualitative method. A research design is an overall plan for gathering data in a research study (Creswell, 2009). Under the qualitative method, there are several types of designs namely participatory action research, grounded theory, case study, narrative research and phenomenological design (Creswell, Hanson, Clark-Plano & Morales, 2007). Participatory action research is employed when there is an issue in a community that needs to be addressed so that there may be changes (Baum, MacDougall & Smith, 2006). It is mostly employed in social science; its participants are members of the community in question and the same members are included in the analysis of data (McIntyre, 2007). Grounded theory is employed when an issue has no theory that can address it; it is mostly used in sociology. It involves many participants while using interviews and data analysis is done via open, axial and selective coding (Charmaz & Belgrave, 2007).

The case study is employed when a researcher has a case that is bound to a specific place and time that informs a specific problem (Gerring, 2004). It is used mostly in law and psychology, by using multiple data collection methods like interviews (Wilson & Onwuegbuzie, 2016), observations and document analysis (Flewitt & Cowan, 2019). The narrative study is employed when a specific story assists in understanding a problem; it is mostly used in the humanities (Riessman, 2008), with one or more participants interviewed or using document analysis. The data analysis used is a chronology and 'restorying'. Phenomenological exploratory research design describes the meaning of the lived experiences of a phenomenon or concept for several individuals (Cresswell et al, 2007). It is used in education and psychology for interviewing participants that have shared the experience in question, observation and document analysis can also be employed. Textual descriptions, themes, bracketing amongst other data analysis methods are used. The phenomenological exploratory research design was employed in this study. The research design was relevant since it helped the researcher to explore the impact of gender biased texts in Physical Sciences education on female learners as narrated by the participants themselves and those implementing the curriculum.

3.5 Study site and profile of the schools.

Study setting is explained as the physical location in which data collection takes place or study is conducted (Burns & Groove, 2011). This study was conducted in four selected schools in Mogodumo Circuit of the Capricorn District, Limpopo Province of South Africa. The circuit is located at Lebowakgomo area and serves primary and secondary schools around Lebowakgomo and Ga-Chuene area. According to Mogodumo Circuit's website, there are 11 secondary schools within the circuit; however, this study will focus on four secondary schools which are school A, School B, school C and school D. The two schools that participated in the pilot study, school X and Y also fall under the Mogodumo circuit. The location of all the schools that participated in the study is shown below.

Image 3.1 A map of Ga-Chuene area covering the schools where the study was conducted.



Map retrieved from Google Maps.

Profiles of the schools

School A is a Christian private school, a fee-paying school and is also a boarding school. It caters to both male and female learners and offers NSC. Schools B, C and D are all quintile 2 schools, offer NSC and cater to both male and female learners. However, school D is one of the historical schools.

3.6 Population and sampling

The population is a complete set of persons or objects that possess some common characteristics that are of interest to the researcher (Brink, Van der Walt & Van Rensburg, 2012). The population, in this study, were Grade 12 Physical Sciences female learners and their teachers. According to Mogodumo Circuit (2019), the total number of female learners doing sciences in grade 12 is estimated at 125, therefore, the learner population was 125. Also, there are 14 Physical Sciences teachers, therefore, the population for teachers was 14.

Sampling is defined as the researcher's process of selecting the sample from a population to obtain information regarding a phenomenon in a way that represents the population of interest (Brink *et al.,* 2012). Polit & Beck (2010) indicated that there is no fixed rule of sample size in qualitative studies. However, the sample size is dependent on data saturation. Data saturation is explained as sampling to the point at which no new information is obtained and redundancy is achieved (Brink *et al.,* 2016). For learners, data saturation was reached at participant number 8, while for teachers, it was reached at participant number 4. Purposive sampling was used to select both learners and teachers. Purposive sampling is a type of non-probability sampling which is primarily based on the judgment of the researcher concerning participants or items which might be common or representative of the study phenomenon or who are especially knowledgeable about the question at hand (Burns & Groove, 2014).

Inclusion criteria

- Grade 12 female Physical Sciences learners in the selected schools in Mogodumo Circuit.

- Grade 12 Physical Sciences teachers

Exclusion criteria

- Grade 12 female Physical Sciences learners who may be out of school for several factors like giving birth during the period of data collection process of this study.
- Grade 12 Physical Science teachers who may be on maternity and/or study leave.

Data collection recruitment

The researcher recruited participants from selected schools. For those who were immediately available, interviews were conducted right away and follow-up appointments were arranged with those willing to participate and were not immediately available for interview. Each interview took about 25-40 minutes. A quiet room conducive for interviews was used to ensure privacy and confidentiality during the interviews, however, noises from people outside were heard but never disturbed or compromised interviews.

3.7 Data collection

Data collection is a procedure for gathering information from participants utilising a predefined data collection instrument (Burns & Grove, 2009). Data was collected by the researcher in three ways namely document review, observations and interviews as discussed below.

Document review

Content analysis is a widely used qualitative research technique for studying documents and communication artefacts, which might be in the form of texts of various formats, pictures, audio or video. Data collection through content analysis of the following documents was done for gender-biased texts:

- Physical Sciences CAPS document
- Physical Sciences textbook

Observation

Data were collected through observation in the classroom to gain insights into gender-bias during the facilitation of Physical Sciences learning. The researcher acted as a non-participant observer to have enough chance to observe the interactions in the classroom freely without any influence. The learners were not aware of the observation taking place; only the teacher was aware. This was to try to get the real atmosphere during the lesson and this was done to avoid the Hawthorne effect. The Hawthorne effect is a type of reaction that participants give when they are expecting a researcher (Monahan & Fisher, 2010). In this case, the learners may act in a way that is not natural for them for the sake of "good results" for their class. The researcher used a checklist for observation (see annexure G). Physical Sciences classes in the Mogodumo circuit take about 35 minutes to an hour; therefore, in each case, the researcher spent the whole period observing.

Interviews

Informed consent was obtained from participants before the commencement of data collection. Data collection was done until data saturation was reached. Data were collected using two semi-structured in-depth interview guides (one for learners and the other for teachers). A semi-structured interview is explained as an interview where a participant is expected to answer a set of predetermined questions (Kallio, Pietilä, Johnson & Kangasniemi, 2016). The interview guide was written in English and Sepedi as the home-language of the participants. The central question for the learner's interview which was asked to all learner participants the same way was as follows:

- *'Kindly describe what you consider to be gender-biased text and its impact on you as a female learner?'*

The central question for teachers' interview was as follows:

- '*Kindly describe what you consider to be gender-biased texts in the Physical Sciences CAPS document and prescribed textbooks?*'

Probing was further done. Data were collected and analysed before continuation until saturation of data. The interviews were conducted in English and Sepedi. Both learners and teachers were recruited at their respective schools. Teachers who were immediately available for the interviews were interviewed after completing consent forms, while learners who were willing to participate and were 18 and above were also given consent forms to sign and to take home to their guardians if they are under 18. The schools were requested to give an appointment date and they did observe that. Each learner interview took an average of 25-40 minutes, while the teacher interview took an average of 30-40 minutes. A quiet room conducive for interviews was used to ensure privacy and confidentiality during the interviews and to minimise disturbances.

There was one interview guide written in English and Sepedi and was recorded using a voice recorder. The interviews were conducted in Sepedi as the dominant language in the area.

Field notes: Field notes are explained as mental recordings, written or jotted records of evocative words or phrases as well as any audio or photographic evidence of the researched field observations and experiences that serve as cues once the researcher has left the field (Phillippi & Lauderdale, 2018). The researcher observed non-verbal communication such as gestures and facial expression from the participants and at the same time observed their attitudes to eventually compile notes about the quality of life of patients. The researcher also noted portraits of participants, which involved describing physical appearance, mannerism and style of talking. Field notes were written to back up audiotapes and a voice recorder was also used to collect data from participants.

Data collection procedure and the role of the researcher

Participants were allowed to talk mostly with the researcher listening most of the time. Minimal remarks were made by the researcher to allow participants to tell more. Open-ended questions were asked at a time allowing participants to respond in their way. The researcher's role was to facilitate the interview and therefore, to allow participants to move freely from questions to questions. Also, the researcher directed the interaction and the enquiry using semi-structured questions contained in the interview

guide. The researcher observed non-verbal communication such as facial expressions and gestures from participants. As the interview went on, field notes were taken by jotting down any observed action. Flexibility, empathy and objectivity were maintained by the researcher throughout the interview. Good listening by the researcher permitted participants to talk more, uninterrupted. The researcher as the interviewer remained open to the experiences of participants rather than attaching their meaning to participants' discussion (Burns & Groove, 2014). The researcher used bracketing, intuiting and reflective remarks during the interviews.

Bracketing: In qualitative data analysis is explained as the process of putting aside what is known about the study topic to allow the data to convey undistorted information (Brink et al., 2012). The researcher laid aside what is known about gender biased texts in Physical Science education and their impact on female learners to avoid preconceived ideas and beliefs. Intuition is explained as the accumulation of attitudes including beliefs and opinions derived from experience or literature (Brink *et al.,* 2016). The researcher adhered to the questions in the interview guide and remained 'naïve' for the avoidance of her views. A reflective diary was kept by the researcher throughout the study. The following communication techniques to clarify and get more details of the interviews were used as a guide to get rich data (Vinjamuri, Warde & Kolb, 2017)

Probing: It is explained as an open-ended attempt to obtain more information about something to elicit contextual details, clarifications and additional information (Kedroske, Koblick, Chaar, Mazzoli, O'Brien, Yahng, Vue, Chappell, Shin, Hanauer & Choi, 2020). Probing was used to obtain information from participants about gender biased texts in Physical Sciences education and their impact on grade 12 female learners. The researcher used statements such as "*may you please tell me more*" or "*please, let's talk more about that"* to encourage participants to give extra information about the impact of gender biased texts and how to minimise its impact.

Making minimal response: It is explained as the verbal counterpart of occasional head nodding used during interviews to assure participants that the researcher is listening (De Vos, Delport, Fouché & Strydom, 2011). The researcher used verbal cues such as *"Hmmm…..mmmm", "yes", "I see",* to encourage the participants to say

more. At times, the researcher nodded to communicate that she understood what the participants were saying.

Paraphrasing: It is explained as restating an author's ideas in other words that capture the meaning (Na & Nhat Chi Mai, 2017). It also implies understanding and consequently, refers to a direct quotation for theoretical content that is part of a scholarly paper. The researcher stated participants' words in another form with similar meaning. For example, when a participant says "*I cannot pass the subject because I'm not of male gender"* the researcher would paraphrase it and say, "*do you mean the impact of gender biased texts is up to that extent?"*

Clarifying: It is explained as a technique that is used to get clearness on vague statements (De Vos *et al.,* 2011). When the researcher needed more clarity from participants regarding the impact of gender bias texts in Physical Sciences education, a statement such as "*could you please tell more about that…."* was used.

Reflection: It is defined as a process that requires integrating a wide range of perceptions to realise what is known within self; interacts with the process of response to challenge and authenticate personal knowledge (De Vos, Delport, Fouché& Strydom, 2011). For this study, I reflected on something interesting the participant had said. I reflected on the feelings and non-verbal behavior to get participants to expand more to get a deeper meaning. Statements such as "so you believe the existence of gender biased texts is the reason for girls' underperformance?".

Responsive listening: It is explained as the ability to detect change over time in a construct that has changed, commensurate with the amount of change that has occurred (Polit & Beck, 2010). The researcher attended to verbal and non-verbal messages such as eye contact, body language, gestures, posture and underlying thoughts and feelings of the participants. The researcher listened attentively to the participants as they relayed the existence of gender bias in Physical Sciences Education.

Silence: It is explained as remaining quiet for some time (De Vos *et al.,* 2011). The researcher allowed participants to express their emotions for a particular time while the researcher remained quiet.

Reflective summarizing: It is explained as the point at which the researcher summarises the participants' ideas, thoughts and feelings verbalised so far to see if the participant is understood. Statements such as "*so what you are saying is?"* The reflective summary has a structuring function and stimulates participants to give more information. The researcher tied together several views that had been communicated. Major cognitive and affective themes were brought together. Member checking was done with patients for the confirmation of the information gathered whether it was what they meant.

3.8. Pilot study

Pilot study refers to a small scale or dummy run of the major study (Brink et al., 2012). It is done the same way a major study would be carried out, with the same procedures, the same methods and with the participants from the same population where the major study will be sampled from (Connelly, 2008). The purpose of a pilot study is to grant the researcher with an opportunity to iron out any flaws that the proposed study might have methodologically, procedurally or even in the data collection instruments (In, 2017) . This also prevents the researcher from making a fatal flaw in the major study that will be costly in time and capital (Lowe, 2019). School X and school Y were selected to do a small scale run of the major study.

There were 6 participants that participated in the pilot study, 1 educator from each of the two schools and 2 female learners from each of the 2 schools. Purposeful sampling was done, focusing on Physical sciences educators and female learners. The schools fell under Mogodumo circuit but were not part of the major study. Participants in the pilot study were afforded an opportunity to fill in the consent form before the commencement of the study. The use of a cell phone during interviews with educators seemed to unsettle them, so it was later changed to the traditional voice recorder with less features so that the educators in the major study may also not be unsettled. All 4 learners found it difficult to understand some of the terms used, hence data collection instruments were edited to simplify the words, both in English and Sepedi.

Data collected in the pilot study was not included in the presentation and analysis of the major study, nor in the addressing of the proposed questions. It was merely utilised

in the improvement of the methodology, procedure, and data collection instruments of the major study. The pilot study proved to be enormously helpful.

3.9. Data analysis

Data analysis is regarded as categorising, ordering, manipulating and summarising data and describing them in meaningful terms (Brink *et al.,* 2016). The data which were collected during individual semi-structured in-depth interviews were analysed using thematic 8 steps of Tesch's open coding as described by Creswell (2003) qualitative data analysis method as described by Creswell (2013). Thematic networks analysis is explained as a process that involves extracting basic, organising and global themes from text and then representing those themes as web-type maps with relationships among them illustrated (Lawless, & Chen, 2019). A consensus meeting was set between the researcher and the independent coder to discuss and agree on final themes and sub-themes based on the ones which emerged when analysing independently. The 8 Steps of Tesch's inductive and descriptive open coding technique (Creswell, 2013) was used by following the steps below:

Step 1 – Reading through the data

The researcher got a sense of the whole by reading all the verbatim transcripts carefully. This gave ideas about the data segments and how they look like/mean. The meaningsthat emerged during reading were written down and all ideas as they came to mind. The researcher carefully and repeatedly read the transcripts of all the participants and understood them. An uninterrupted period to digest and think about the data in totality was created. The researcher engaged in data analysis and wrote notes and impressions as they came to mind.

Step 2 – Reduction of the collected data

The researcher scaled-down the data collected to codes based on the existence or frequency of concepts used in the verbatim transcriptions. The researcher, then, listed all topics that emerged during the scaling down. The researcher grouped similar topics and those that did not have association were clustered separately. Notes were written on margins and the researcher started recording thoughts about the data on the margins of the paper where the verbatim transcripts appear.

Step 3 – Asking questions about the meaning of the collected data

The researcher read through the transcriptions again and analysed them. This time, the researcher asked herself questions about the transcriptions of the interview based on the codes (mental picture codes when reading through), which existed from the frequency of the concepts. The questions were, “Which words describe it?” “What is this about?” and “What is the underlying meaning?”

Step 4 – Abbreviation of topics to codes

The researcher started to abbreviate the topics that had emerged as codes. These codes need to be written next to the appropriate segments of the transcription. Differentiation of the codes by including all meaningful instances of a specific code’s data were done. All the codes were written on the margins of the paper against the data they represented with a different pen colour as to the one in Step 3.

Step 5 – Development of themes and sub-themes

The researcher developed themes and sub-themes from coded data and the associated texts and reduced the total list by grouping topics that relate to one another to create meaning for the themes and sub-themes.

Step 6 – Compare the codes, topics, and themes for duplication

The researcher, in this step, reworks from the beginning to check the work for duplication and to refine codes, topics and themes where necessary. Using the list of all codes, she checked for duplication. The researcher grouped similar codes and recoded others that were necessary so that they fitted in the description.

Step 7 – Initial grouping of all themes and sub-themes

The data belonging to each theme were assembled in one column and preliminary analysis was performed, which was followed by the meeting between the researcher and co-coder to reach a consensus on themes and sub-themes that each one has come up with independently.

Step 8 – Recoding if necessary

A necessity to recode emerged as some of the themes reached independently were merged. Notes were jotted down to record ideas as they came to mind. The audio-recorded data were transcribed verbatim and the researcher and the independent-coder completed the independent analysis and then, held a consensus meeting to clarify discrepancies and identification of similar findings.

3.10 Research data management

Research Data Management (RDM) is explained as the organisation of data from its entry to the research cycle through to the dissemination and archiving of valuable results (Chigwada, Chiparausa & Kasiroori, 2017). The RDM, in this study, was ensured by keeping the participants' voice records in a safe cabinet, which is locked. The discs which were copied were locked in the cabinet together with the notes taken by the researcher. The information downloaded to the researcher's laptop was saved as the researcher does not share the laptop with anyone and a password is installed to limit unauthorised access to the laptop. The data will be kept and saved for at least five years. Thereafter, the data will be destroyed using a shredding machine among others.

3.11 Data quality

Data quality is explained as the degree to which data including research processes such as data collection and statistical accuracy, meet the needs of the users (Vale, 2010). Data quality was ensured through trustworthiness. Trustworthiness is the process of ensuring credibility, transferability, confirmability, dependability and authenticity of the research findings (Gunawan, 2015). The stated criteria's insurance was as follows:

Credibility: It refers to confidence in the fact of the information and the interpretation thereof (Brink *et al.,* 2012). In this study, credibility was ensured through prolonged engagement, triangulation, member checks, adoption of research established methods, iterative questioning, tactics to help ensure honesty in participants, peer reviews and examination of previous research findings. The prolonged engagement was ensured by the researcher familiarising herself with the study site before the interviews were conducted and also by staying in the field for a prolonged period

during data collection. This was possible since the researcher was part of the Mogodumo circuit educators. Triangulation was ensured by asking questions differently and also using different methods to collect data. The method used to collect data was an in-depth interview, document review and observations. Member checks were done after data was analysed by taking the emerging findings of the study back to the participants for confirmation of the adequacy of the data and its conclusion.

Adoption of research established methods was ensured by employing specific procedures such as a line of questioning pursued in data collection sessions and methods of data analysis were derived from methods that were successfully utilised in previous comparable studies. Meanwhile, iterative questioning was done through probing to elicit detailed data. It helped the researcher to rephrase questions to matters which were previously raised by the participants.

Tactics to help ensure honesty in informants was done by the researcher encouraging the participants to give honest answers by indicating that there were no right or wrong answers to the questions to be asked. The researcher also emphasised independence to allay fears. Peer reviews were employed by the researcher by taking the research guide to the supervisor for feedback before commencing with data collection. Examination of previous research findings was done by the researcher through relating the findings to an existing body of knowledge during the discussions of the findings.

Transferability: It refers to the ability to apply the findings in different contexts or to other participants (Brink *et al.,* 2012). It also refers to the ability of the findings of the study to have meaning to other individuals outside of the study (Pilot & Beck, 2010). The findings of this study are transferable since it communicates the same content all over South African schools that use the CAPS document. It was ensured through the thick description and data saturation. The thick description was ensured through probing and encouraging participants to give a sufficient and detailed description of exclusionary practices. Data saturation was ensured through collecting data until a point wherein additional participants were no longer providing new information and were becoming repetitive.

Confirmability: It refers to the ability for congruency of data in phrases of accuracy, relevance or meaning (Brink *et al.,* 2016). It was ensured by involving an external

person as an independent coder. Written field notes and the use of voice recordings were also produced to confirm the data. The researcher showed how conclusions and interpretations were established by quoting exact phrases from the participants that were part of a particular theme. In this fashion, the researcher's viewpoints were blocked from being part of the conclusions.

Dependability: It refers to the provision of evidence such that it can produce similar results in the event it were to be repeated with the same or similar participants in the same or similar context (Watkinson, Goodman-Scott, Martin, & Biles, 2018). The researcher depended on the voice recorders and thick descriptions of methodology for the success of this study. Dependability was further ensured by using *Stepwise replications.* It was ensured through a clear description of research methods to enhance the possibility of repeating the study by another researcher.

3.12 Bias

Bias is an influence that produces an error or distortion, which could affect the quality of evidence in both quantitative and qualitative studies (Brink*et al.,* 2012). *Researcher bias* which can occur when the researcher influences the responses of the participants by making gestures and imposing opinions was minimised by not giving learners and teachers a pep-talk before the interview. *Translation bias* which could have resulted during the translation of English interview questions to Sepedi was minimised through the use of a language translator. *Triangulation* wherein a couple of resources, which include in-depth interviews, document review and observations of information, was used to counterbalance biases and also offered an opportunity to identify biases if they occurred.

3.13 Ethical considerations

The ethical considerations are discussed as follows:

Seeking permission: Ethical clearance to conduct the study was obtained from the Turfloop Research and Ethics Committee (TREC) with reference TREC/489/2019/PG (see Annexure A). The permission to conduct the study was obtained from DoE of Limpopo Province with reference 2/2/2 and Mogodumo circuit (see Annexure B). A letter of request to schools was granted (see Annexure C), a skeleton permission letter

from principals (see Annexure D), consent forms (see Annexure E), interview schedule (see annexure F), observation checklist (see Annexure G), document analysis checklist (see Annexure H) and lastly, a letter of gratitude to the schools (Annexure I).

Informed consent: Permission to participate in the study was obtained from the participants through the use of informed consent. Participants were made aware of the significance, aims and objectives of the study including their rights to terminate their participation when they felt their rights were being violated or anytime they felt like it.

Voluntary participation: Participants were informed that the participation was voluntary and that they were not forced to participate. Participation was the sole decision of participants who decided to or not to participate after they were informed about the aims and objectives of the study including the advantages and disadvantages of participating.

Confidentiality, privacy and anonymity: *Confidentiality* was ensured through availing the information obtained from the participants only to people who were involved in the study, that is, the researcher and supervisor. *Privacy* of the participants was maintained by interviewing students in school offices and not in the public or streets. *Anonymity* was ensured by guaranteeing that the participants were not being identified with their names.

Research integrity: The researcher is a qualified educator whose highest qualification is Bachelor of Education honours, majoring in Physical Sciences. The researcher adhered to the sampling procedures as outlined in the research method of this study when collecting data. Also, I adhered to the ethical principles by reporting results accurately and honestly without manipulation. Moreover, where bias could exist, it was avoided as discussed in the bias subsection to prevent influencing participants to respond in a particular way**.**

Principle of non-maleficence: It is regarded as the actions of the researcher to prevent unnecessary harm or injury (De Vries & Verhagen, 2008). The participants were attended to in a way that avoided any possible physical and emotional harm

through the consistent use of process consent questions such as, '*I am going to ask a sensitive question, may I continue?'.*

Principle of beneficence: It is regarded as the protection of participants from physical and psychological harm and exploitation (Polit & Beck, 2010). No harm was done to the participants. No exploitation was done nor reported by any of the participants. The researcher ensured that all participants understood that taking part in the study was voluntary and non-remunerative. No participant was given any other roles like editorial or administrative duties other than participating as prescribed in the study.

Principle of autonomy: It is regarded as the ability to reason and think about one's own choices, to decide how to act and to act on that decision, all without hindrance from other people (Rathor, Rani, Shah, Leman, Akter & Omar, 2011). It was ensured through confidentiality, autonomy and privacy. The participants, especially learners, were given a chance to speak their minds and answer questions as they saw fit. No one was forced or pruned to answer in a certain manner.

Principle of justice: It is regarded as the right to fair treatment and selection of participants (Brink *et al.,* 2016). Participant selection was done fairly because the eligibility criteria were strictly followed and no discriminatory selection occurred. Participant selection was easily done since the selection criteria were self-explanatory and did not require a lot of thinking it. Justice towards research as a whole was employed.

3.14 Conclusion

This chapter discussed the qualitative phenomenological exploratory study design used in this study. A sampling of the participants, which depended on data saturation was discussed as well as data collection through observation, document review and interviews. Data analysis and quality, as well as data management, were discussed. Ethical principles and bias were also discussed. The next chapter outlines the results.

CHAPTER FOUR
PRESENTATION OF RESULTS

4.1 Introduction

The previous chapter discussed the methodology for the study. This chapter presents and interprets the results of the study. Multiple methods were used to collect data which included a review of the Physical Sciences CAPS document and prescribed textbook, observations in the classroom and lastly, through the one-on-one interview conducted with the learners and the teachers. Presentation of the results is as follows: (1) Summary of the results of the review of Physical Sciences Curriculum and Assessment Policy Statement (CAPS)'s document and prescribed textbook; (2)Summary of the results from classroom observations and (3) Summary of the results from a one-on-one interview conducted with the learners and the teachers. The conclusion seals off the chapter.

4.2 Presentation and interpretation of Results

4.2.1 Results of the review of Physical Sciences CAPS Document and prescribed textbook

Table 4.1: Summary of the results of the gender biased texts in Physical Science CAPS Document

Gender-bias words in CAPS document	**Page number in the document**
Stage rocket	Page 99
Brakes	Page 99
Seatbelt	Page 99
Airbag	Page 99
Soccer ball	Page 99
Arrestor beds	Page 99

Table 4.1 shows the gender-biased texts in the Physical Sciences CAPS document and the page number at which the words are found.

Table 4.2: Summary of the results of the gender-biased texts in the prescribed Physical Sciences textbook.

Images		**Text**	
Gender-specific images	**Number of times showed in the textbook**	**Gender text**	**Number of times used in the textbook**
Female	4 times	He	None
Male	12 times	She	None
		Neutrality	Always

Table 4.2 shows that images depicting the male gender are used 12 times and those depicting females are only used 4 times. Also, neutral texts are always used.

4.2.2 Results from classroom observations

Table 4.3: Summary of the results: classroom learning

School A		**School B**		**School C**		**School D**	
Topic	Momentum-impulse	Topic	Momentum-impulse	Topic	Momentum-impulse	Topic	Momentum-impulse
Subtopic	Newton's second law expressed in terms of momentum	Subtopic	Impulse	Subtopic	Conservation of momentum	Subtopic	Application of impulse
Participation and interests per gender							
School A		**School B**		**School C**		**School D**	
Male	More interested and participated actively	Male	More interested and participated actively	Male	More interested and participated actively	Male	Interested and actively participated after the teacher gave a further explanation on the subtopic
Female	Less interested and passively participating	Female	Less interested and passively participating	Female	Less interested and passively participating	Female	Interested and actively participate after the teacher gave further explanation on the subtopic
Teachers attitudes towards learners							
School A		**School B**		**School C**		**School D**	
Balanced		Balanced		Balanced		Balanced	

Table 4.3 shows that momentum-impulse was the topic in all the schools. However, various subtopics were discussed; School A subtopic was Newton's second law expressed in terms of momentum; School B subtopic was impulse; School C subtopic was Conservation of momentum while School D subtopic was the application of impulse. The male learners showed more interest and actively participated than female learners in schools A to School C and there was a balanced interest and participation of both male and female learners in School D.

Results from the notes obtained from the classroom observations.

In School A, there was a presence of subtle gender bias on the side of the educator. The educator called all the male learners with their surnames rather than names while addressing female learners by their names. The difference in addressing the learners is in its effect on gender bias. In African culture, calling a person by their clan names or surnames is regarded as more respectful than using forenames.

In School B, there was also the presence of subtle gender bias on the part of the educator. The educator when asking "difficult" questions, male learners were supplied with probing questions to direct them into getting the correct answer while female learners were given the correct answer on the onset. The difference in treating learners seemed unnoticeable by the educator but it existed. There was also one incident where the teacher gave non-academic feedback to a female learner and none to the male learners.

In School C, the gender bias on the part of the educator was almost unnoticeable until the educator walked towards the learner's desks. There was a longer pause next to the male learners as they were attempting their calculations while the opposite was true for female learners. The educator also used the generic "man" in most of the words used, that is, chairman, instead of chairperson.

In School D, the educator asked both girls and boys questions equally and rotationally. But the boys got more high order questions than girls. It was evident that the teacher was aware of gender bias and tried to avoid it by rotating the questions but unconsciously 'gave' tougher questions to boys and easier questions to girls.

4.2.3 Summary of results of a one-on-one interview with participants

Participants, in this study, comprised of female Physical Science Grade 12 learners and their teachers. Four different schools took part in the study in the Mogodumo circuit, Capricorn District, Limpopo Province. The participants included 2 female learners per school and a Physical Sciences teacher per school. Therefore, results from interviews are divided into two: learners' and teachers' results.

4.2.3.1 Learners' results

Table 4.4: Demographic profile of female Physical Sciences learners

Participant number	Age	Archivers level
Participant 1	18	Top achiever
Participant 2	18	Bottom achiever
Participant 3	18	Top achiever
Participant 4	19	Bottom achiever
Participant 5	18	Top achiever
Participant 6	18	Bottom achiever
Participant 7	19	Top achiever
Participant 8	20	Bottom achiever

Table 4.4 shows that 4 participants are top achievers while 4 are bottom achievers. Also, 5 participants were18 years old, followed by 2 participants who were 19 years old and only 1 is 20 years old.

Table 4.5: Summary of findings collected through semi-structured interviews with learners

Themes	Sub-themes
1. Gender bias in the Physical Sciences CAPS	1.1 Existence of gender bias in CAPS document and textbooks 1.2 Existence of gender bias during classroom facilitation
2. Teacher's influence	2.1 Awareness of gender bias by teachers 2.2 Attitudes of the teachers to the learners 2.3 Teaching style
3. Impact of gender bias	3.1 Attitudes and interest 3.2 Reinforcement of masculinity 3.3 Performance
4. Towards inclusive education	4.1 Use of gender-balanced wording and pictures 4.2 Use of female scientists as role models

Table 4.5 shows the themes which emerged from the interviews with learners and the sub-themes associated with each theme.

4.2.3.2 Teachers' results

Table 4.6: Demographic profile of teachers

Participant number	Age	Gender	Years of experience in teaching
Participant 1	24	Female	2 years
Participant 2	42	Female	15 years

Participant 3	42	Female	22 years
Participant 4	45	Male	16 years

Table 4.6 shows that 3 Physical Sciences teachers are above 40 years with a minimum of 15 years working experience and only 1 teacher is 24 years with 2 years working experience.

Table 4.7: Summary of findings collected through semi-structured interviews with teachers

Themes	**Sub-themes**
1. Awareness of gender bias in Physical Sciences CAPS	1.1 Existence of gender bias in curriculum 1.2 Existence of gender bias texts in class and other instructional materials.
2. Factors influencing the existence of gender bias in the curriculum	2.1 Authors 2.2 Lack of consultations
3. Impact of gender bias on the curriculum	3.1 Teaching 3.2 Enrolment and participation of learners by gender 3.3 Performance of learners
4. Towards inclusive education	4.1 Curriculum amendment and substitution of gender bias words 4.2 Use of female scientists during the facilitation of learning 4.3 Involvement of all education stakeholders in curriculum amendment

Table 4.7 shows four themes that emerged from interviews with teachers. Also, the sub-themes associated with each theme are indicated.

Results obtained from interviews

Presence of gender-biased texts in CAPS

The teacher participants concurred that texts are gender-biased. Even the CAPS document is found wanting in this regard. Teacher participant 1 confirms:

> *There are gender biased texts in the CAPS documen*t.

Furthermore, out of 8 learners, 5 indicated that teachers are aware of the existence of gender bias texts. The following quotes support the claims of Learner participants 1 and 2 respectively:

> *Our teacher one day told one boy to stand up and explain to the whole class how a car operates especially the use of the accelerator, clutch and breaks. So, I think our teacher wanted us all to understand*.

This clearly shows that the teacher does think that the information is understood more by male learners by them being male. Learner participant 2's articulation was:

> *I think so because our teacher did ask us all if we understood the terms and when the boys answered by saying yes, she asked the girls if we understood too, and we said no. Then, she started explaining to us first what the words meant before teaching.*

This shows that the male learners had a head-start; they understood the context under which the class was being taught except for female learners.

Authors

There is a feel among teacher participants that although there are curriculum amendments, the panellists may be generally more male oriented. Teacher

participants indicated that designers of the curriculum impose their gender-biased ideas in the curriculum as supported by the following quotes of participants:

> *The people that write or amends the curriculum should be objective; the gender should be balanced and they should have 21st-century skills (Teacher participant 1).*

The teacher thinks that there were more males than female learners, hence there still exists some form of gender imbalance in the form of gender-biased texts. On the same note, Teacher participant 3 had this to say:

> *The people writing the CAPS document should be inclusive in thinking towards inclusivity of both genders*."

Amendment

The Physical Sciences CAPS document and other learning aids such as textbooks should be amended. Teacher participant 1 had this to say:

> *The department of education should go to all teachers and send a survey for them to fill. Technology is making things easier these days and analysing such surveys may be done technologically. Then, they will use the inputs from us teachers that are implementing the curriculum. There should be an amendment to the curriculum*.

Replacement of gender-biased texts by more gender-neutral texts.

Rockets have a close link to boys as they are featured in cartoons meant for boys, even the colour goes towards boyish colours which are darker. The use of male-oriented terms suggests and causes a negative view of science towards female learners. This is confirmed by utterances of teacher participant 1 who says:

> *Firstly, the word "rocket", when we got to it, boys in the class seemed to be more interested than the girls. They were very excited actually but the girls were just clueless on the topic and relied on the boys to give answers in class.*

When it is paper one (Physica) topics, which uses more gender-insensitive texts, boys participate more than girls. While paper two (Chemistry) is welcomed, equally, by both genders, teacher participant 2 had the following utterances,

> *The word 'collision', although I don't get why because it sounds like a neutral word to me. But at the same time, I think it is because I explain the term using 'cars'*.

Although most objects can collide and be used as examples to teach the concept, however, because the CAPS document uses cars as examples, the teacher is choosing the readily available word which is a car, when associating the word collision with an object. Teacher participant 3's articulation was**:**

> *In momentum topic, most words used in there to explain those concepts I think that they are not under gender-generalisation category. When the impulse is explained, we tend to use cars as examples. And girls are not as interested in that topic as boys. I also realised that the word air-bag was not so common amongst girls as it was amongst boys.*

Teacher participants suggest that a rocket can be replaced by a balloon because they can both be used to demonstrate the same concept. Both boys and girls seem to align themselves in the same degree as a balloon. Also, it will teach the same concept as the rocket. This is also supported by Teacher participant 1 and 3 respectively:

> *Balloon, both boys and girls seem to align themselves in the same degree when mentioning a balloon. Also, it will teach the same concept which the rocket teaches.*
> *For the word rocket, a balloon can be used. I once saw an article on it while doing some of my reading.*

This is also supported by the following quotes from Teacher participants 1 and 4 respectively:

The textbook I use uses a 'soccer ball' as an example to teach projectile motion. When we get to it, boys too seem to be enjoying and participating more in class than girls. They should rather *use a ball, there should be no distinction as to which ball is being used. Girls will visualise their netball's ball, and boys will visualise their soccer ball. A win-win situation, while teaching one concept.*

Soccer ball, traditionally, soccer is for boys and netball is for girls. It should be replaced by a ball, just a ball with no difference as to which type of a ball.

When it comes to the word collision, teachers have different objects that could be used to bring out the effect of a collision. For as long as those objects will portray the desired effect.

Collision should just be used as it is, but I think there should be other objects used to explain the word to all learners like using 2 balls going in opposite directions on the same path. They will still collide. One can use different materials for the balls, one that will make them bounce right back after a collision and one material that will make them stick after a collision. That way, the concept of elastic and inelastic collision will still be taught (Teacher participant 2).

A collision can be explained using different objects besides cars; hence those objects can be picked to explain the concept of a collision, objects that are gender sensitive. But the word collision by itself sounds gender-neutral (Teacher participant 3)

Female learners were also given a chance to voice their first-hand views. This is what they had to say about male-oriented texts. Learner participant 2 reported:

Examples in momentum are given using cars and trucks and I think boys like them more than us girls, plus, they have more knowledge of them than us girls.

In projectile motion, our teacher brought question papers that have questions talking about a soccer ball and as girls, most of us don't know what happens on a soccer field. We love netball and boys love soccer. I think if they give a question on netball, boys may not understand more too.

Female learners were also given a chance to voice their first-hand views. This is what they had to say about male-oriented texts. Learner participant 2 reported:

The quote shows that even learners can point out words that they feel are more male-oriented. On the same note, Learner participant 5 had this to say:

Rockets, boys seem to be more excited than us girls when we get to that part.

When asked which word they thought was gender insensitive towards them, learner participant 7's articulation was:

Car, I think boys love cars more than us girls, hence they understand them more and enjoy being taught about them more.

Use of female scientists during the facilitation of learning

Teacher participants indicated that female scientists can be used as role models in addition to the male scientists during the facilitation of learning Teacher participant 3advises:

*There should be science weeks that are attended by all learners and should have a balance of presenters when it comes to gender. T*here should be both male and female scientists that motivate all learners. Female science learners could relate themselves to female scientists and not feel out of place.

Similarly, Teacher Participant 4's articulation was:

The textbooks show more male scientists like Sir. Isaac Newton. They should try to incorporate some of the female scientists to balance the equation.

Involvement of all education stakeholders in curriculum amendment

Teacher participants indicated that towards inclusive education, it is important to involve all stakeholders of education as supported in the following quote from Teacher participant 2:

The department of education should reach out to many teachers by surveying to ensure their participation in larger numbers.

This means that all teachers willing to participate will give their thoughts unlike being represented by one person that would give their own opinions, masking them under the "teacher union" umbrella. Teacher participant 3's articulation was:

Also, there the government should consult the teachers, parents and learners. The truth is that they only consult union leaders, SGB leaders and student leaders. They don't take enough time to consult with a majority of the stakeholders and get the actual issues and real suggestions from the ground. They always get "filtered" information.

Gender bias and stereotype

A gender stereotype is a belief about characteristics associated with either men or women that expose gender discrimination (Castillo-Mayén, 2014). Gender imbalances and stereotypes in Physical Sciences textbooks may demotivate and lower the interests of female learners in enrolling and pursuing careers in the sciences (Ndlovu, 2019). Inclusive education denounces gender discrimination and promotes equal chances for schooling (Liasidou, 2012) so do feminists. It cannot be said enough that textbooks are an essential resource in Physical Sciences education. It would be better to have a balance in images and/or texts which depict both males and females to

eliminate the giving of the wrong impression that Physical sciences is for the male gender. The existence of gender bias may have the following impact:

Reinforcement of masculinity

Learner participant 4 indicated that the existence of gender bias in the curriculum reinforces masculinity and misconceptions that sciences are for males as affirmed by the following quote:

> *I feel like I made the wrong choice in subjects like maybe the sciences subjects are meant for boys*. Such utterances by female learners imply that they may have made a wrong choice by choosing the science subjects, saying that the subjects are more suited for boys and not them (girl).
>
> *Boys are understanding more than us girls and they even get higher marks than us in topics that they understand more like in momentum. I think the teacher should change how they teach and use scenarios that will be equally understood by both genders (Learner participant 8).*

Gender stereotypes in the Physical Sciences curriculum are the reasons why fewer girls than boys study science courses and as a result, girls regard Physical Sciences as a male field (Reuben, Sapienza & Zingales, 2014). My findings also confirm the association of Physical Sciences with masculinity. The gender stereotypes can affect the performance of girls and boys in sciences (Good, Woodzicka & Wingfield, 2010).

Teaching

Participants indicated that teaching is impacted by the existence of gender bias in the curriculum as supported by the following quotes:

> *We tend to think before we teach since we are consciously aware of some gender biased texts, we tend to balance things out and the time we take to balance things out should be the time we take to teach or revise. Thus, teaching is indeed affected*. So, this is implying that if the CAPS document did not have gender biased texts, teaching would improve since more time would be spent

on the actual teaching and not trying to make a lesson plan become gender-sensitive *(Teacher participant 1).*

Learners know their rights these days. If they think that you are being prejudice, they will tell you. So, we as teachers try as much as possible to limit the gender bias from the curriculum and textbooks. In doing so, the lesson is wasted on trying to be politically correct while we should be focusing on teaching only. Had the curriculum been gender-sensitive, I would not waste time trying to be gender-sensitive even during my lesson preparation (Teacher Participant 3).

The time it takes to remedy the gender bias of the curriculum is costly to the teacher, the learner and the DoE because that time could be used for something greater.

Participation of learners by gender

The participants indicated that participation in Physical Sciences is impacted by the existence of gender bias in the curriculum. This is confirmed in the following sentiments:

Female learners tend to refrain from giving answers; they will turn their attention to other learners (males) that seem to be in the know when it comes to that topic. Their participation decreases (Teacher participant 3).
Female learners are naturally bubbly in my class but when it comes to such topics, they become mute. I will even ask them what is wrong, if they are not participating, as usual, that doesn't sit well with me (Teacher participation 4).

The researcher witnessed much participation from male learners as compared to female learners on average. Teacher participants reported that the existence of gender bias disadvantages female learners to the point that their class participation is minimal compared to boys' participation. Therefore, my study confirms findings by Raimi and Adeoye (2002) who indicated a significant difference between male and female learners in terms of their interests in Physical Sciences. Females had fewer interests in Physical Sciences, thereby impacting girls' participation during learning.

Attitudes and interests

Gender bias in Physical Sciences education lowers interests of female learners and also lead to the adoption of negative attitude leading to poor performance (Abayomi, 2015). My study also confirms that gender bias leads to lower interest and ultimately poor performance as supported in the following quotes

> *I feel discouraged because I feel like if I had the same understanding as the boys did, I will be able to take part during the lesson as them (Learner participant 3).*
> *I feel sad, I wish I also knew the things boys knew, especially the rockets and car things. It is as if I will never pass this subject (Learner participant 8).*

Physical Sciences education like other subjects require commitment, positive attitudes and love for better performance. A scientific attitude is an important aspect of a personality and leads to great achievements in science subjects (Wimsey, 1998). It is a poor attitude in physical science subjects that prompts poor performance among female science learners. A study by Leibham, Alexander & Johnson (2013) reported that despite both boys and girls regarding sciences as important, female learners have fewer interests in sciences compared to boys (Frenzel Goets, Pekrun & Watt, 2010). The lack of interest of female learners was also confirmed in my study since participants reported a lack of interest and poor attitudes. Also, the researcher's classroom observations, in this study, confirmed that male learners were more interested than their female counterparts in sciences. Negative attitudes are not a winning mentality but self-defeating and often lead to poor performance. Learners with positive attitudes towards sciences are more likely to perform better (O' Connell, 2000). Therefore, learners who participated in my study are less likely to perform better in Physical Sciences due to fewer interests and poor attitudes.

Performance

Participants indicated that performance in Physical Sciences is impacted by the existence of gender bias in the curriculum. Out of 8 learners, 6 indicated that the

existence of gender bias in the curriculum impacts their performance and also believe that boys outperform girls in science education. The claims of the participants that boys can outperform females in Physical sciences is supported in the following quotes

> *I think male learners have more advantage than us but only on that topic - momentum and impulse (Learner participant 1).*
> *No, I don't think so but only on the momentum section. But the rest of the subject is fair (Learner participant 7).*

Furthermore, the participants indicated that they were to perform better in Physical Sciences education if they were boys. The claims of the participants that they were to perform better if they were of the male gender is supported by the following quotes from the participants:

> *Yes, if I were a boy, my headspace would be filled with things like cars and parts of cars. I wouldn't need to take so much time to understand what some objects are all about before understanding a concept (Learner participant 7).*

This study found the use of gender-neutral pronouns. There were no "she" or "he" in all the documents analysed. The Bruneian study reported promotion of gender bias through the use of the pronoun 'he' most often compared to the word 'she' and only in two instances of usage of the words 'he or she" for neutrality (Elgar, 2004). Therefore, this study differs from that of Bruneian since there were no gender-biased pronouns but only neutrality. Therefore, the current Physical Sciences textbooks only promote gender bias through images and texts and there is balance with regards to pronouns. One of the teacher participants also confirmed this by saying:

> *In the olden days, our textbooks had pronouns but lately, there are no longer pronouns used in our subject*. This is proof that education is being transformed to suit females, however, feminism calls for total fairness, rightness and equality is not only the use of pronouns but in a holistic manner.

According to Evans and Davies (2000), textbooks are agents for the transmission of society's values and attitudes and serve as powerful tools in shaping learners' views of society. The content and illustrations found in textbooks cultivate positive or negative attitudes in learners about self-image, gender roles and career (Evans & Davies, 2000). Literature regards Physical Sciences textbooks as an important resource in education and that it can influence learners' interests in science education (Elgar, 2004). Alexanderson, Wingren and Rosdahl (1998) reported that most surveyed textbooks were written by males and as a result, consolidated the stereotypical sex patterns in the text and images used. My study confirms that the Physical Sciences textbook used in facilitating learning is stereotypical against female learners and displayed 12 images of males as compared to only 4 female images. Also, the use of more male images in textbooks was reported in Brunei Physical Sciences textbooks in Southeast Asia (Elgar, 2004), which perpetuates the stereotype that Physical Sciences as a subject is meant for boys.

There was a hint of bias from teachers towards female learners during class observations. Although the bias was not easily visible, it was spotted by the researcher. The bias spotted was subtle. Subtle bias is a matter of perspective rather than intent (Selmi, 2002). The educator that has subtle bias is, usually, not aware that they are being biased towards learners because that is how they have been "wired to think and behave" either by society, religion or culture. Also, teachers are not always aware of the gender bias projected by themselves in classrooms (Siegle, 2001). Educators focused more on boys while teaching and that is regarded as bias (Sadker & Sadker, 2001). Factors influencing the existence of gender bias are:

Attitudes of teachers

Learner participants indicated that teachers' attitudes towards all learners of various gender are balanced In other words, the teacher's attitude towards learners is not based on the learners' gender. Learner participants 3 and 6 had this to say respectively:

Our teacher's attitude towards the whole class is okay. There is no way that you can differentiate how the teacher talks with a male or a female learner. We are all treated the same.

Our teacher is fair to all of us; we are treated the same whether we are male or female. If we do good, we get celebrated equally; also, if we are naughty in class, we get punished equally.

According to Zohra & Imene (2019), a teacher's personality has a definite effect on learners. My study showed that teachers' attitude towards learners is not biased to any particular gender of learners. Therefore, the female learners will be positively influenced to keep on studying Physical sciences and ultimately perform better like boys because of their teacher's equal treatment. The gender equity awareness and other gender awareness campaigns in South Africa and the rest of the world may have had a positive impact on teachers. Their attitude towards female science learners has improved greatly.

4.4 Conclusion

This chapter presented the results of this study. The data was collected using three methods namely document analysis, observation and interviews. As such, the presentation of results is done orderly as per each data collection method. The next chapter will discuss the results as presented in this chapter.

CHAPTER 5
DISCUSSION OF RESULTS

5.1 Introduction

The previous chapter presented the results of the study as collected using three different methods which are document analysis, class observations and interviews with Physical Sciences learners and teachers. This chapter discusses the results from the three methods as presented in chapter 4. Literature support is used in the discussion of the results. Limitations of the study are also discussed before the conclusion of the chapter.

5.2 Main findings

The purpose of this study was to explore the existence and impact of gender biased texts in Physical Sciences CAPS document on grade 12 Physical Sciences female learners. The overall results show that there exists gender-biased texts in the CAPS document and prescribed textbooks. Also, it was discovered that gender biased texts harm female learners in different aspects. The presence of gender-biased texts is one of the factors that discourages female learners from participating in Physical Sciences as a subject and in pursuing science careers, hence obtain average marks in Physical sciences instead of excelling. This becomes clearer when analysing individual themes.

5.2.1 Theme 1. Awareness of gender bias in Physical Sciences CAPS

Becoming aware of gender imbalances in science is important since it affects not just the individuals in question but also groups, teams and the society. Also, being aware involves non-judgement, empathy and compassion. However, they also allow creativity (Pietri, Johnson, Ozgumus & Young, 2018). Awareness about the existence of gender bias texts in Physical Sciences by teachers may assist them in minimising its impact on female learners. Teachers are the main stakeholders in the education sector and serve as agents of transformative change in imparting knowledge to the learners (Durrani & Dunne, 2010). As an important stakeholder, teachers should ensure that no gender discrimination takes place in the classroom. However, gender-bias in the sciences curriculum may prohibit teachers from totally ensuring inclusivity. Yet, awareness of the existence of gender bias in the science curriculum may assist them in developing skills to teach in a way that female learners would not be

disadvantaged. Thus, teachers' awareness of gender bias as reported by learner participants may help teachers to educate differently, particularly, since they are considered as agents of the peace who should at all times ensure all-inclusivity.

Existence of gender bias in curriculum

The CAPS document proved to carry gender-biased texts. The word "soccer ball" is generally regarded as a word accommodating most boys and a few females. In South Africa, soccer has been historically a sport for boys (Friedman, 2013). Girls do play soccer, however, those that do are sometimes mistaken for being 'tomboyish'. Tomboys are regarded as girls that show behaviors that are generally considered to be normal for boys (Reay, 2001). Hence, most girls do not bother aligning themselves with soccer for fear of being called "tomboys". Thus, in South Africa, soccer is seen from the societal stance, a sport for boys (Mayeza, 2017). The use of "soccer ball" is, thus, enticing male learners in the class, getting them excited about learning Physical sciences while it is doing the opposite for female learners. Girls get excited by the word "netball". In the South African secondary schools, netball is played mostly by girls.

On a nine-point scale, certain toys were checked as to whether they were masculine or feminine. In a study carried out by Blakemore and Centers (2005), toys that rated greater than 7 were regarded as strongly masculine. Soccer ball rated 7.73, a truck rated 7.65 while a car rated 7.13. The statistics show that cars are more male-oriented, hence the parts of a car like seatbelts, brakes, airbags and gears will entice boys more than it would girls in the class, hence my study agrees with the findings by Zittleman and Sadker (2003) which also found the existence of gender bias texts in the Physical Sciences curriculum. Such words as seatbelts, brakes and airbags are found in the CAPS document. Our results show that the South African curriculum differs from the Malawian curriculum which has so far ensured gender-balanced sensitiveness in their curriculum (Maluwa-Banda, 2003). Therefore, the CAPS document appears not to be gender-sensitive and does not promote equal treatment of both boys and girls to achieve their full potential (UNESCO, 2016). As a result, the curriculum is not in line with the constitution of the republic which promotes equality (Constitution, 1996).

The word rocket is also featured in the CAPS document. Rocket is defined by NASA (2008:1) as “a vehicle, typically cylindrical containing liquid or solid propellants which produce hot gases or ions that are ejected rearward through a nozzle and in doing so, create an action force accompanied by an opposite and equal reaction force driving the vehicle forward. Because rockets are self-contained, they can operate in outer space”. Rockets have a close link to boys as they are featured in cartoons meant for boys, even the colour goes towards boyish colours which are darker. The use of male-oriented terms suggests and causes a negative view of science towards female learners.

In chapter 4, teachers gave Texts which are perceived to be perpetuating gender bias were also shared by the Physical Sciences teachers. They also gave gender-sensitive alternative texts to replace the gender-insensitive texts. The recommendations made by the teachers to replace the gender biased texts should be considered in shaping the educational curriculum. Various studies have reported that females are less represented in sciences related occupations as compared to their male counterparts (Ivie & Ray, 2005). Other studies have also reported that gender-biased education may be the reason why female learners are not enrolling and performing well in science subjects (Zachmann, 2018). Therefore, in shaping inclusive education, there is a need to review the Physical Sciences CAPS document and teaching materials so that that they do not violate the rights of female learners and also to improve female representation in STEM careers. Suggested gender-neutral texts to replace the already mentioned male-oriented texts from teachers are presented in a table below:

Table 5.1 Suggested words to replace the current gender bias ones

Currently used words	Suggested Words
Rocket	Balloon
Collision (using cars)	Collision (using gender-neutral objects like tables, rolling chairs, bags, etc)
Soccer Ball	Ball

Table 4.8 above shows the words which teachers suggested that may replace the gender-biased ones.

Blumberg, 2008, states that there are several countries that have detected the thorn in female learners' education through gender bias through the science curriculum. However, there are obstacles in addressing the issue, the main obstacle is the lack of resources (Sadker & Silber, 2007). The second obstacle is that most governments regards the existence of gender bias in curriculum as a "small issue" (Blumber, 2008). Results of this study has proven the existence of gender-biasness in the South African curriculum, this needs to be addressed in this lifetime.

Existence of gender bias texts in class and other instructional materials

Some educators practices gender bias in classes unaware (Zittleman & Sadker, 2002). Teachers might not be aware of the act at the onset but as a teacher, such differences in treatment towards learners in a class are perpetuating gender bias. Frawley (2005) has classified the act of giving learners different level questions by gender as gender bias. Some educators give uneven distribution of time and energy in class, with much given to male leaners at the expense of female learners (Raina, 2012). Teachers must equip themselves with the skill to recognise and eliminate gender bias of all sorts because it can limit students' ambitions and accomplishments (Frawley, 2005). In South Africa, it may be difficult for teachers to equip themselves with such skills since the bias is rooted in the curriculum, hence the call for a curriculum review. There are harmful effects of gender bias in the curriculum and the classroom (Bauer, 2000). They are but not limited to low self-esteem, low self-confidence and low achievement (Sadker 1999). Hence the conclusion that female learner performance is affected in the presence of gender biasness in class and even from textbooks.

Nigerian sciences and mathematics textbooks for different grades have demonstrated the existence of male bias (Zakka & Zanzali, 2015). South African Physical Sciences textbook also have the existence of male-biased texts. According to Blumberg (2015), teaching in a classroom is facilitated through the use of textbooks and learners use

most of their classroom time interacting with textbooks. Therefore, the gender-biased texts and pictures in textbooks and policy documents should be replaced with more gender-balanced texts and pictures towards inclusive education, particularly, considering the influence of textbooks in classroom settings.

5.2.2 Theme 2. Factors influencing the existence of gender bias in the curriculum

Authors

Gender bias in Physical Sciences is a known problem, which has a societal origin in occupational interests (Tindall & Hamil, 2004). South Africa as a country initially had its curriculum drafted in a sexist manner, and during the two reviews, the curriculum 2005 and the Revised National Curriculum Statement, there was a team focused specially on making the curriculum gender-sensitive (Chisholm, 2003). In light of this, there still exists gender-biased texts in the Physical Sciences curriculum statement as evident from the results presented in chapter 4. Authors of the curriculum who are members of the society may impose their stereotypical views on science documents resulting in many females believing that the science field is for males (Potter & Rosser, 1992). The curriculum serves as a guideline for textbooks. Most of the science textbooks including the South African prescribed Physical Sciences textbook and CAPS document have gender bias to the disadvantage of females, which could be attributed to the authors imposing their stereotypical views.

Lack of consultations

Chisholm (2005) states that there are three dominating groups that had a huge influence on the curriculum amendments, the ruling party, teacher union representatives and university-based intellectuals. There are groups from the public that would greatly assist in this regard, the learners, individual educators and parents. As costly as that may be, it will be for a greater good and will last for the longest time to come.

5.2.3 Theme 3. Impact of gender bias on the curriculum

Teaching

Educators use textbooks in class to deliver their lessons. Since it is evident that the current Physical Sciences textbooks are biased against female learners, the lesson delivery will also be structured in a way that perpetuated gender imbalance in class. An analysis of the prescribed textbooks in the subject showed more male scenarios as compared to those of female ones. The invisibility of female scenarios perpetuates the narrative that Physical Sciences as a subject is meant for boys. This invisibility needs to be addressed if any progress is to be made about leveling the playground or if both male and female learners are to be taught and assessed on an equal level (MacNell, Driscoll, & Hunt, 2015). This would be in line with the call to address some of the issues feminists raise. Textbooks are used to deliver content to learners.

Textbooks are regarded as essential in facilitating learning and that it may direct an individual to think in a particular way (Swanepoel, 2010). Therefore, the stereotypical images and texts in Physical Sciences textbooks reinforce gender bias and leading to Physical Sciences girl learners not to perform well as compared to their male counterparts (Hill, Corbett & St Rose, 2010). The review of the Physical Sciences CAPS document and prescribed textbooks, in this study, also revealed gender bias in the science curriculum. A study by Okwo and Otunba (2007) has associated Physical Sciences with masculinity to the disadvantage of female learners. Therefore, the stereotypical images and texts in the sciences curriculum, as well as studies confirming masculinity in sciences, maybe the reason female learners believe that they can perform better if they were boys. A Nigerian study reported that boys perform better than girls in Physical Sciences and the difference in gender performance was attributed to the presence of gender bias in the sciences curriculum (Olasehinde & Olatoye, 2014). My study agrees with the Nigerian study since teachers indicated that the existence of gender bias in the curriculum favours boys, who perform better than girls.

Enrolment and participation of learners by gender

There still exists a gender gap in science subjects regardless of the many interventions taken up by most nations, males still dominate in the STEM careers (Sinnes & Løken, 2014). For one to have a career in the STEM field, one has to take up science subjects in secondary schooling. Hence, this shows that the enrolment of female learners in science subjects decreases like a funnel from primary schooling through secondary schooling and ultimately in tertiary institutions (Botella, Rueda, López-Iñesta, & Marzal, 2019). It is recorded that female learners drop science subjects in secondary school, and some that eventually get in top positions in STEM careers, ends up resigning (Guo, Tsang & Ding, 2010). This is prove that there is a direct correlation between female learners in science and female scientists.

Performance of learners

Female learners in the Gauteng province of South Africa are less likely to perform better than their male counterparts (Good, Woodzicka, & Wingfield, 2010). Although the enrolment of females (54%) was higher than that of males (46%) in 2010, males still outperform females in Physical Sciences. This is a concern to the researcher. Gender biased texts have a role to play in these undesirable findings (Good, Woodzicka & Wingfield, 2010). The performance difference isn't notable until secondary schooling (Marx & Roman, 2002). The difference in performance is attributed to many factors, including the presence of gender-biased texts in the delivered curriculum (Good, Woodzicka & Wingfield, 2010).

Infringement on rights

The South African Constitution bans discrimination of any form and promotes gender equity (RSA Constitution, 1996). Also, inclusive education denounces discrimination and promotes gender equity in all spheres of education including in science education. Gender equity and inclusive education ensure that boys and girls have equal opportunities in basic education, promotes girl participation in Physical Sciences education and also protects girls against any violence and discrimination in the classroom environment particularly during the facilitation of science learning (Moloi & Chetty, 2011). The results show that teachers' attitudes towards female learners were undesirable. This is confirmed in a study by Kabeer (2010) who states that teachers

often have different expectations and attitudes towards boys and girls in a classroom on the basis that boys need science careers more than females and that is an infringement of female learners' rights. Teacher's attitudes towards learners may increase learner's interest in science subjects (Abayomi, 2015). Hence, if teachers are treating learners the same way, regardless of gender, female learners may feel wanted and welcomed in class. Can teachers treat learners of different gender equally though the CAPS document perpetuates gender-imbalance?

An unbiased classroom environment that promotes inclusivity is key to learners achievement, therefore, the unbalanced teacher attitudes to female learners as reported in this study does not promote inclusivity, develop confidence but instead, it demotivates female learners to do well in Physical Sciences.

The Physical Sciences curriculum is not yet transformed to encourage inclusivity but promotes inequity (Kabeer, 2010). This is also the case with the South African curriculum which utilises words that are associated with masculinity to the disadvantage of female learners (Moletsane & Reddy, 2011). This contradicts the South African Constitution which promotes equality, therefore this can be regarded as a violation of human rights. Despite the teachers' efforts to be warm and friendly to all learners, the curriculum pushes them towards gender bias. Studies have reported that gender bias texts demotivate female learners (Islam & Asadullah, 2018). This was also evident in this study since male participants were more interested and participated actively compared to females when gender-biased topics were discussed. The relationship between gender bias and student performance is indirectly proportional (Sibiya, 2019). The more the prevalence of gender bias in classrooms, the lower the performance of learners that are being biased against.

5.2.4 Theme 4. Towards inclusive education

Curriculum amendment

The use of artificial intelligence is being brought into play at this section. The issue of resources being the part of the problem in rolling out a nationwide consultation before amending the curriculum can be solved using online questionnaire that would be analysed digitally, saving both money and time. Thus, each teacher would be given a chance to have a say in policy amendments since teachers are the implementers of policies adopted by the government. White paper 6 supports the idea that educators amongst other stakeholders should take part in the revisiting of all policies concerning education (DoE, 2001). Learners would be given a chance to share their viewpoints as well, since the curriculum is implemented on them.

There should not be an array of males at the review panel to strike a gender balance. There is a need for both men and females who understand the implications of feminism so that they may advocate for it in all policy reviews. Both females and males are equal human beings, therefore, gender balance should be a norm. Gender balance is a basic human right that should be considered in the science curriculum and textbooks (Karama, 2020). Textbooks play an important role in presenting gender ideologies since learners spent more time in the classroom interacting with textbooks (Ariyanto, 2018). Therefore, the Physical Sciences curriculum or CAPS document, as well as textbooks, must reflect gender balance to eliminate bias and stereotypes in society. Learners in classrooms are what we call the society of tomorrow; if we do not address gender imbalances in the classrooms, in a way, we are teaching them to be gender bias citizens.

Use of female scientists during the facilitation of learning

Creating more equal educational opportunities for learners begins in the classroom and teaching. Equally, attracting females in science fields requires the involvement of female scientists to use as role models in the classroom room during the facilitation of learning (Hill, Corbett & St Rose, 2010). This would help in eliminating negative male gender bias, particularly, when girls seeing people of their gender or who look like

them excelling in sciences (Milgram, 2011). So, teachers during the teaching of Physical Sciences must use more female scientists as role models to improve girls' participation and performance.

According to Hill, Corbett and St Rose (2010), consistent use of female scientists as role models may help counter negative stereotypes by attracting and retaining girls in the field since they would see people of their gender being successful and doing well in sciences. In attracting girls to sciences, learning materials such as posters, flyers and images reflecting female scientists should be developed and used during the facilitation of learning (Milgram, 2011). Therefore, the use of female scientists in the Physical Sciences CAPS documents and textbooks may as well help in retaining female participation in sciences.

Involvement of all education stakeholders in curriculum amendment

Curriculum development is regarded as the encompassing and continual process during which any form of planning, designing, dissemination, implementation and assessment of curricula may take place (Schneiderhan, Guetterman & Dobson, 2019). The amendment of the curriculum like its development should include the involvement of the stakeholders for its effective implementation. According to Terblanche and Bitzer (2018), curriculum change in South Africa has become a major feature of teaching over the past 10 years. Curriculum change should be characterised by consultation of stakeholders to minimise gender bias in the science curriculum. The existence of gender bias in the Physical Sciences CAPS document and textbooks can be attributed to proper consultation. Therefore, consultation is key to eliminate gender bias in the curriculum. To eliminate gender bias in the Physical Sciences curriculum, it is important to include teachers and learners, particularly girls in the amendment and towards inclusive education.

5.3 White paper 6 in context

One of the long term goals of White Paper 6 is to uncover and address any kind and type of barriers to learning and to attain high-quality education for all learners equally (DoE, 2001). Having gender-insensitive texts in the schooling system is derailing the plan of white paper 6, which is to build an inclusive education for all regardless of gender, ability, socioeconomic status, race or any other differentiating aspects. One of the short-term goals is to focus on addressing weaknesses and deficiencies of the current education system including the revision of all policies, legislations and structures of the education sector (DoE, 2001). White paper 6 was established in 2001; it set a timeline of 8 years to attain policy revision. However, still in 2020, the CAPS document contains gender-sensitive texts. There is a long term goal of wrapping up all set goals. Hopefully, this paper will find the right position-holders who will read, digest its recommendations and consider including only gender-sensitive texts in their policies. The duration of the long-term goal is 20 years from 2001. The current year is 2020, leaving only one year to the set timeline for the policy makers to review the all set goals. Hence, the policy is set but its implementation in South Africa is slow.

5.4 Representation

In this study, the participants comprised female Physical Science Grade 12 learners and their teachers. The discussion of representation includes a demographic profile of both learners and teachers. According to Statistics South Africa (STATSSA, 2016), children aged 13 to 18 years are expected to be in secondary school and those above 18 years should be for post-secondary school education. This is also confirmed in my study although only 3 participants were above the age of 18 years, which could imply that they either started school late or repeated a grade. A study by Clark (2005) reported that women are less represented in natural sciences and engineering; they are better represented in social sciences, arts and humanities which includes the teaching profession.

My study confirms better representation of females in humanities, teaching in particular since 3 out of 4 Physical Sciences teachers who participated were females. Also, my study agrees with a study about teacher participation in Physical Sciences which reported that most of the Physical Sciences teachers were between the ages

24-59 years and with an average of 1-30 years working experience. This also agrees with my study since most of our participants had working experience of between 2-22 years; they fall within the range of 1-30 (Mbowane, de Villiers & Braun, 2017).

5.5 All learners matter (regardless of gender)

The purpose of this thesis is not to emasculate male learners in schools but to shed light on the current "masculine curriculum" in South Africa to make it a gender-sensitive curriculum. The call is not towards a "feminine curriculum" but a gender-sensitive curriculum. Countries like Australia and North America have in the past moved to address the gender imbalance in their education and the process emasculated male learners (Martin & Kazyak, 2009) All learners, females and males, are equally important and none should suffer at the expense of the other. If the curriculum is feminised, boys stand a chance to lose out of education and if the curriculum is left as masculine, girls will continue to lose out (Streitmatter, 1994), hence the call to have a gender-sensitive curriculum. Since *feminists* (people who work for the political, social and economic equalities of the sexes) started advocating for equality among the sexes, there seems to be a noticeable change. However, more still needs to be done for both sexes to truly be given equal opportunities.

The South African government has a huge gender problem in schools. Apart from the presence of pregnancy-related school dropouts (Grant & Hallman, 2008) and teachers being biased against female learners (Kimotho, 2019), there also exists gender bias in the curriculum as proven by this study. There have been fifteen thousand five hundred and four pregnancies reported in schools in the year 2015 alone (Gcelu, 2019). This is an alarming number since school-going children are encouraged to abstain until they finish their studies; pregnancy tends to disrupt one's education (Stoner, Rucinski, Edwards, Selin, Hughes, Wang, Agyei, Gomez-Olive, McPhail, Kahn & Pettifor, 2019). Teenage pregnancy is rated as one of the most disturbing in girl's education in South Africa (Panday, Makiwane, Ranchod & Letsoalo, 2009). Mwamwenda (2013) reiterated that there is an element of bias from teachers towards female learners, whether intentional or accidental. The struggle is still rife against a female child in South Africa.

5.6 Implications of the study

This research has attempted to provide an exploration to link gender biased texts in the curriculum and their impact on female learners in grade 12. This research was carried out through observation and interviews for the researcher to get the first-hand experience of the class environment and the narration by both teachers and female learners. For example, now the researcher has raised the question to all teachers interviewed as: *Am I not biased against female learners*? *Am I not using gender-insensitive texts? How can I better my teaching to benefit all sexes just as the feminists would prefer?* Teachers that participated have been challenged to pay it forward meaning to generously make other teachers aware of the bias in the CAPS document. They should humbly ask them to spread the word to limit or even cancel out any kind of bias in the Physical Sciences classroom, thus, creating awareness. They need to ask uncomfortable questions to the curriculum reviewers until there is a notable positive change in the South African Physical Sciences curriculum. The results of this study show a greater need for curriculum review, that involves all stakeholders, including feminists. The findings in this research further suggest that there is a need for a self-worth campaign designed to capacitate female learners for them to stop seeing themselves as inferior to their male counterparts by being female. Thus, if the current generation of learners is taught that academically, gender has no role to play, they will pass this knowledge on to the next generation. Once they believe that, it would be automatic that they can also excel in other spheres of life, politically, economically, socially, academically and in history-making.

As a researcher, the only way that can help remedy the current situation female learners are facing is for the government to be made aware of such hindrances towards the girl child in the classroom from teachers, learners, parents and civilians. Institutions that train teachers should have a course on feminism as a study and process that seeks to service all genders equally in classes. Bias, subtle bias, stereotypes and personal perceptions amongst others should be warned against before student teachers could be given a chance to teach in the field so that they may teach with the right skills and knowledge. Above all, there should be a curriculum review to remedy the crisis female learners are facing in classes.

5.7 Conclusion

The chapter outlined results of Physical Sciences CAPS and textbooks review, classroom observations and also qualitative interview results with teachers and female learners. Literature was used to support the discussion. Also, the participants' direct quotations were used. Results revealed the existence of gender bias in the Physical Sciences CAPS document and prescribed textbook. Besides, results of classroom observation show that teachers created a generally welcoming environment in the classroom. Gender bias in the curriculum makes boys more interested in the Physical Sciences subject than girls. Moreover, the results also revealed that teachers are aware of gender bias in the curriculum. Learners indicated that the existence of gender bias demotivates them and believe that boys can outperform them as well as believing they can perform better if they were of the the male gender. My study has highlighted the issue of a gender-sensitive curriculum. Without it, there cannot be an inclusive education for all. Thus, feminists still have a lot on their plate.

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Appendices

A- Ethical clearance.

B- DBE Limpopo and Mogodumo circuit approval

C- Letter of request to schools.

D- Permission letter from principals (skeleton)

E- Consent forms

F- Interview schedule

G- Observation checklist

H- Document analysis checklist

I- Letter of gratitude

J- Language editing certificate

A- Ethical clearance

University of Limpopo
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TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING:	**05 November 2019**
PROJECT NUMBER:	**TREC/489/2019: PG**
PROJECT:	
Title:	Exploring impact of teachers' exclusionary practices on performance in Physical Sciences among grade 12 female learners in Mogodumo circuit of Capricorn South District Limpopo Province
Researcher:	ES Chuene
Supervisor:	Prof MJ Themane
Co-Supervisor/s:	N/A
School:	Education
Degree:	Master of Education in Curriculum Studies

PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

Finding solutions for Africa

B- Permission from DBE Limpopo and Mogodumo circuit

PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

Ref: 2/2/2 Enq: Mabogo MG Tel No: 015 290 9365 E-mail:MabogoMG@edu.limpopo.gov.za

Chuene E.S
Box 421
Polokwane
0700

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.
2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"EXPLORING IMPACT OF TEACHERS EXCLUSIONARY PRACTICES ON PERFORMANCE IN PHYSICAL SCIENCE AMONG GRADE 12 FEMALE LEARNERS IN MOGODUMO CIRCUIT OF CAPRICORN SOUTH DISTRICT LIMPOPO PROVINCE "**
3. The following conditions should be considered:

3.1 The research should not have any financial implications for Limpopo Department of Education.

3.2 Arrangements should be made with the Circuit Office and the School concerned.

3.3 The conduct of research should not in anyhow disrupt the academic programs at the schools.

3.4 The research should not be conducted during the time of Examinations especially the fourth term.

3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).

3.6 Upon completion of research study, the researcher shall share the final product of the research with the Department.

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: CHUENE E.S

CONFIDENTIAL

Cnr. 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X9489, POLOKWANE, 0700
Tel: 015 290 7600, Fax: 015 297 6920/4220/4494

4 Furthermore, you are expected to produce this letter at Schools/ Offices where you intend conducting your research as an evidence that you are permitted to conduct the research.

5 The department appreciates the contribution that you wish to make and wishes you success in your investigation.

Best wishes.

Ms NB Mutheiwana
Head of Department

17/1/2020
Date

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: CHUENE E.S

CONFIDENTIAL

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

PRIVATE BAG X 25
CHUENESPOORT
0745
0156335086

DEPARTMENT OF EDUCATION
CAPRICORN SOUTH DISTRICT
MOGODUMO CIRCUIT

ENQ: MASHALA T.E
CELL: 082 954 1267
EMAIL: joemashala2@gmail.com

FROM: OFFICE OF THE CIRCUIT MANAGER
MOGODUMO CIRCUIT
TO: CHUENE E.S

ACCEPTANCE TO CONDUCT RESEARCH AT SCHOOLS WITHIN MOGODUMO CIRCUIT

1. The above matter refers.
2. The Circuit Management allows you to conduct your research at schools within Mogodumo Circuit.
3. Kindly comply with school policies at all times when you are at school premises.
4. Use the information given for research only.
5. We urge all principals to assist her with all the information she requires for her research.

Yours in Education

.....

MABOA T.I
CIRCUIT MANAGER

2020.02.05
DATE

C- Letter of request to schools

Enq. Chuene E.S
081 752 9153

P.O Box 431
Polokwane
0700

To the Principal of …(name of school)…
Receive my warm greetings.

I am Chuene Elisa Sebina, I.D 9202150848086, an educator at Thogoa Secondary school in Mogodumo circuit, Sekhukhune South District.

I am a Master's student at the University of Limpopo, currently doing my second year and in the data collection phase.

Your school has been selected purposively because of its demography and historical performance.

I humbly request permission to collect data within your premises, with your educators and learners under your care. Observations will also be carried out in Physical Sciences classes. Anonymity will be practised at its highest order.

Kindly
Chuene E. Sebina

…….

D- Permission letter

I ……. (full names), the principal of …….. (school) give Chuene Elisa Sebina permission to conduct her data collection at the above-mentioned school. She should adhere to all the promises she made.

Signature

……

Date

……

Contact number

……

School stamp

E- Consent form

(English version)

University of Limpopo

Statement concerning participation in a Research Project

Name of study: Exploring the impact of teachers' exclusionary practices on performance in Physical Sciences among grade 12 female learners in Mogodumo Circuit, Limpopo Province.

Information box:

Thank you for agreeing to participate in this study. My name is Sebina Elisa Chuene. I am a researcher from the University of Limpopo. Thhis study aims to explore the impact of gender biased texts in Physical Sciences CAPS document on grade 12 female learners in Mogodumo Circuit, Limpopo Province.

The study is non-invasive. A Voice recorder will be used to collect data.

In this study, participation is voluntary and you may withdraw from it at any time and without giving reasons. This will not influence the academic progress and/or academic progress of your learners attending Physical Sciences or any other classes in the schools in Mogodumo Circuit, Limpopo Province.

Should you have any queries, kindly contact:

Chuene E.S (081 752 9153)

I have read the aims and objectives of the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurised to participate in any way.

I understand that participation in this study is completely voluntary and that I may withdraw from it at any time and without giving reasons. This will have no influence on me and/or my learners' academic progress attending Physical Sciences or any other classes in the Schools in Mogodumo Circuit, Limpopo province.

I know that this study has been approved by the Turfloop Research and Ethics Committee (TREC) at the University of Limpopo. I am fully aware that the results of this study will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I hereby give consent to participate in this study.

……..	…….
Name of participant/guardian	Signature of Participant/guardian
……	……
Place	Date
…….	……
Name of witness	Signature of witness

Consent form

(Sepedi version)

Yunibesithiya Limpopo

Tlhaloso mabapi le go tšea karolo mo diphatišišong

Leina la diphatišišo: Tshekatsheko ye e tseneletšeng go ditlamorago mo dithutong tša kgethologantšho ka mantšu mo dithutong tša mahlale (Physical Sciences) bukaneng ya CAPS go baithuti ba mphato wa marematlou mo Profenseng ya Limpopo.

Tlhaloso ya ditaba:

Ke leboga ge le tšere karolo mo diphatišišong tše. Leina la ka ke Chuene Sebina. Ke moithuti, ke dira diphatišišo le Yunibesithiya Limpopo. Lebakakgolo la go dira diphatišišo tše ke go ka tsinkelela ditlamorago tša kgethologantšho ya barutiši mo dithutong tša baithuti ba makgarebe ba go dira marematlou mo sedikothutong sa Mogodumo mo profenseng ya Limpopo.

Diphatišišo tše gase tša go ntšha kotsi. Re tlo šomiša motšhene go gatiša poledišano.

Go tšea karolo mo diphatišišong tše gase kgapeletšo. Motho o tšeakarolo ge a rata feela, ebile a ka lesa mo sebakabakeng ntle lego rogakwa goba go lefišwa. Go tšea karolo mo diphatišišong go ka sebe le seabe dithutong tša gago ka moka.

Ge eba gona le se sengwe le sa se kwešišing, le ka ntswara ka mogala mo nomorong ye: 081 752 9153 (Chuene Sebina)

Ke hlaloseditšwe lebaka la go dira diphatišišo, ebile ke ile ka fiwa sebaka sa go botšiša dipotšišo le go fiwa nako ye e lekanetšego go ka naganiša gore nka tšea karolo na. Maikemišetšo a diphatišišo tše di kwagetše ebile kea di kwešiša. Ga gona motho yoo a nkgapeleditšego go tšea karolo mo diphatišišong tše.

Kea kwešiša gore go tšea karolo mo diphatišišong tše ke kgetho ya motho le gore nka tlogela go tšea karolo mo sebakabakeng ntle le go fa lebaka. Kea tseba gore seo se ka sebe le ditlamorago tše mpe gonna goba go barutwana baka dithutong tša mahlale goba thuto efe goba efe mo sedikothutong sa Mogodumo mo Profensing ya Limpopo.

Kea tseba gore diphatišišo tše di dumeletšwe ke balefapha la Turfloop Research and Ethics Committee (TREC) kua Yunibesithing ya Limpopo. Ke a tseba gore di phatišišo tše di tlo šomišwa fela modithutong le gore di ka phatlalatšwa tša bonwa ke bohle. Ke dumelelana le seo, ge feela go ena le kgonthišišo ya gore leina la ka goba la barutwana ba ka leka se tšweletšwe.

Ka gore ilalo, ke fa tumelelo ya go tšea karolo.

……	……
Leina la ngwana/motšeakarolo/mohlokomedi	Goitlama
……	……..
Lefelo	Letšatši
……..	……
Leina la tlhatse	Goitlama

F- Interview schedule

Title: exploring the impact of gender-biased texts in the curriculum on grade 12 Physical Sciences female learners in Mogodumo circuit, Capricorn District, South Africa.

Purpose: The South African government has in the past revised their policies to accommodate all races and gender, however, there has been some complaints against the gender-sensitivity of the current policy, CAPS. This study seeks to explore the impact gender-biased texts have on female grade 12 Physical Sciences learners.

Aims:

1. To explore the impact of gender biased texts on female Physical Sciences learners.

Objectives:

1. To find out if teachers are aware of the gender-biased texts in the Physical Sciences CAPS document.
2. To find out if there are gender-biased texts in other documents that aid in teachingPhysical Scieneces.
3. To assess the impact of gender-biased texts on Physical Sciences female learners.

School A-
School B-
School C-
School D-

8 female learners participated, 2 from each school, one top achiever and one low achiever. Purposive sampling was used to select learner participants. Four teachers participated, 3 females and 1 male. Random sampling was used to select Physical Science teachers from the schools offering the subject in Grade 12.

Questions for the learner participants.

1. Do you have a chapter or section or topic that you think maybe gender-biased in Physical Science class?

1.1 Yes or no?

1.2 If yes, which ones are they?

1.3 If yes, which words/texts do you think perpetuate gender-bias the most? Please list them with an explanation as to why you think they might be perpetuating gender bias.

2. Do you think yourPhysical Sciences teacher is aware of those gender-biased texts?

   If yes, what are they doing to accommodate female learners?

3. Do you think boys may outperform girls in your class because of this?
4. If you were a boy, do you think you would pass your momentum-impulse section more than you do now?
5. How do you feel during the lesson when those gender-biased texts are being used in class? And why?
6. Kindly describe what you consider to be gender-biased text and its impact on you as a female learner.

Questions for teacher participants

Questions

1. Do you think that there are gender-biased-texts in the CAPS document?
2. If yes, which ones and please elaborate as to why.
3. Which texts do you think will be fit to replace the ones stated in number 2 above?
4. Are those texts only in the CAPS document as you teach?
5. Do you think that the Physical Sciences curriculum is gender-senitive? If no, what do you think should be done to make it gender-sensitive?
6. Do you think that the Physical Sciences textbook is gender-sensitive? If no, what do you think should be done to make it gender- sensitive?
7. Which stakeholders do you think should be consulted in case of an amendment of the curriculum and/or the textbook?
8. Kindly describe what you consider to be gender-biased texts in the Physical Sciences CAPS document and prescribed textbooks?

G- Observation schedule

characteristic	Subtle bias	Use of gender-biased texts	Learner participation	Teacher neutrality	Learner confidence
	Present/not present	Present/not present	Equal/more males/more females.	Neutral/favours males/favours females	Neutral/males more/ Females more
School A					
School B					
School C					
School D					

H- Document analysis schedule

	He/she	Pictures	Gender biased texts	Representation of scientists
	Utalised/ not utalised	More males/ more females	Present/ not present	Neutral/ more males/ more females
CAPS document				
Textbook 1				
Textbook 2				

I- Letter of gratitude

P.O Box 431
Polokwane
0700

To the principal of …(name of school)…,

I would like to relay my sincerest gratitude for allowing me to conduct my research in your school. I am thankful for the time you allowed me to work at your school. May the good Lord that blesses good deeds bless you.

Without schools, there would be no participants; without participants, there would be no research. Hence, I am grateful for the chance given.

Thank you very much.

J: Language Editing Certificate

ZANEZ EXPERT EDITING

Registered with the South African Translators' Institutes (SATI)
Reference number 1000363

24 Honeyball Street
Vanderbijlpark SE2
Gauteng
1911

Cell: 0631434276
Email: kufazano@gmail.com
Email: kufazano@yahoo.com

15 December 2020

TO WHOM IT MAY CONCERN

CERTIFICATE OF EDITING A MASTER THESIS

This serves to confirm that I have read and edited Chuene Elisa Sebina's Master thesis titled: *Exploring the impact of gender biased texts in the curriculum on grade 12 Physical Sciences female learners in Mogodumo circuit, Capricorn District, South Africa*. The candidate corrected the language errors identified. The document is of an acceptable linguistic standard.

Yours faithfully

Dr. K. Zano
Ph.D. in English