

**EXPLORING FACTORS MOTIVATING GIRLS TO STUDY  
PHYSICAL SCIENCE IN GRADE 10 IN THE RAKWADU  
CIRCUIT**

By

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DISSERTATION

Submitted in fulfillment of the requirement for the degree of  
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**UNIVERSITY OF LIMPOPO**

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## **DECLARATION**

I, Shapule Edith Ladygay Modjadji declares that **Exploring factors that motivate girls to study Physical Sciences in Grade 10 in Rakwadu Circuit** is my own work and that all the sources that I used and quoted in this research have been acknowledged by means of complete references. This work is submitted in fulfilment of the requirements for the degree of Master of Education in the Department of Mathematics, Science and Technology at the University of Limpopo, South Africa. It has not been submitted for any degree or examination at this or any other university.

Signed at Mankweng, Polokwane

On the 10 day of November 2015

Modjadji SEL (Mrs)

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Signature

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Date

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## **DEDICATION**

This dissertation is dedicated to my late loving mother Victoria Mamokgatla Malatji who passed away in August 2002. May her soul rest in peace.

## **LIST OF ABBREVIATIONS AND ACRONYMS**

DBE	Department of Basic Education
SMT	Science, Mathematics and Technology
SMT	School Management Teams
FEMSA	Female Education in Mathematics and Science in Africa
IM	Intrinsic Motivation
EM	Extrinsic Motivation
GET	General Education and Training (Grade R-9)
HSRC	Human Science Research Council
FET	Further Education and Training (Grade 10-12)
TIMSS	Trends in Mathematics and Science Studies
IBSE	Inquiry-Based Science Education
SGB	School Governing Body
HOD	Head of Department
TWAS	Third World Academy of Science
TWOS	Third World Organisation for Women in Science
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WiPiSA	Women in Physics in South Africa
SAASTA	South African Association for Science and Technology Advancement
NRF	National Research Foundation

## **ABSTRACT**

The aim of the study was to explore factors which motivated girls to study Physical Sciences in Grade 10. The study followed a qualitative research paradigm and a case study design. A sample of twenty four girls from three secondary schools in Rakwadu Circuit in Limpopo province was purposively sampled for the study. Data was collected using interviews with Grade 10 girls who were studying Physical Sciences and Grade 9 girls who intended to study Physical Sciences in Grade 10. In addition, document analysis was used to analyse participants' classwork, tests and other forms of assessments. The results show that these groups of girls were motivated by both external factors and internal factors. The factors included career opportunities that Physical Sciences offers, financial assistance, learner performance and interest in the subject. The study revealed that girls had positive attitudes towards science and wanted to pursue science related careers. The learning environment and family also played a role in motivating learners to study science. It is therefore recommended that parents, educators and the entire education sector support and motivate girls to assert their role in science.

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# CHAPTER ONE

## INTRODUCTION

### 1.1. Background

Learners' interest in Physical Sciences subjects beyond the period of compulsory study has been the focus of attention in several countries for a number of years (Bennett, Lubben & Hampden-Thompson, 2013). In the context of subject choice, motivational concerns might be addressed, for example, why some learners choose Physical Sciences and Mathematics, while others choose Accounting and Economics or History and Geography. It is reported that fewer girls than boys choose Physical Sciences (Wadesango, Rembe & Chabaya, 2011). It is common knowledge that if a person is engaged in an activity that is interesting, engrossing and involving and the person is oblivious to everything, then motivation might be high. According to Tella (2007), motivation is seen as the most important aspect of effective learning. Is the motivation the same in both boys and girls? Maree and Molepo (2005) argued that girls are often discouraged from taking key subjects such as Physical Sciences. This implies that there might be factors motivating girls to choose Physical Sciences in secondary schools.

Research shows that fewer girls choose Physical Sciences in South African secondary schools than boys (Ogilvy, 2012). With the overall population of South Africa being over 50% females, it is essential that this demographic feature is reflected in science education and science learning (Dlamini, Ngwenya & Dlamini, 2004). As a result, various strategies and policies have been introduced to address gender inequalities in science education. In many African countries, including South Africa, concerns about gender disparities in education have concentrated on student performance, predominantly in terms of under-achievement of girls (Archer, DeWitt, & Willies, 2014). However, the question of motivating girls in the field of Physical Sciences has received little attention in South Africa (Terblanche, 2013). The disproportion where a greater percentage of boys study Physical Sciences is not

peculiar to Africa; it is a challenge that has been documented in other parts of the globe (Ogilvy, 2012).

In France, for example, in spite of girls performing better than boys at secondary level, only 44.2% of Physical Sciences learners are girls (Nyarko, 2012). In the United States of America (USA), organisations such as 'Girls, Mathematics and Science Partnership' (GMSP) have been established to address matters regarding girls' participation and the development of their opportunities and their influence in schools in the field of science (Valentina & Singh, 2014).

Similarly, in African countries such as Nigeria, Ghana, Malawi and South Africa, larger percentages of boys than girls are likely to choose scientific and technological subjects (Clegg, 2007). The Association for the Development of Education in Africa (ADEA) and the Forum for African Women Education (FAWE) indicate that only 22% of girls in Africa attend secondary school and only 2.2% study science related subjects (Dweck, 2010).

To prosper in today's scientific and technological world, every country must produce a population highly educated in science and technology (Valentina & Singh, 2014). The purpose of science education, according to the National Research Foundation (NRF, 2009), is to develop all learners' scientific literacy by supporting learners to grasp essential science concepts and realise the nature of science. The NRF also aims to inspire an interest in science and technology. Organisations such as South African Association for Advancement of Science and Technology (SAASTA) were designed under the NRF to build the supply of tomorrow's scientists and innovators.

South Africa has the possibility to become a rich foundation of up-coming scientists, engineers and innovators (SAASTA, 2011). As such, learners need to acknowledge the relevance and importance of studying science and technology. However, it is not clear if girls all over the world, including South Africa, realise the significance of

science. Science education critics indicate that gender differences continue to exist in the selection of science subjects and careers that are linked to science (Vedder-Weiss & Fortus, 2013).

Science education in South Africa begins at primary school level and continues through to secondary school and tertiary level. Science learning in secondary schools includes Life Sciences, Physical Sciences and Natural Sciences. Even if South Africa is one of Africa's most rapidly developing countries, the percentage of girls studying Physical Sciences is still low (Terblanche, 2013).

In the South African education system, all subjects are compulsory for all learners from Grade R to Grade 9. Natural Sciences is a compulsory subject; that is, it is taken in all schools from Grade 4 to Grade 9. It is a subject that incorporates both Physical Sciences and Life Sciences. Natural Sciences is taught at intermediate phase (Grades 4-6) and senior phase (Grades 7-9). When learners reach Grade 10, they choose the subjects they wish to pursue through to Grade 12. In Grade 10-12, Physical Sciences is taught as an individual subject. Grade 10 is the stage where learners are introduced to the study of Physical Sciences as a separate science subject in the Further Education and Training (FET) phase (Grades 10-12). Physical Sciences is thus not compulsory at FET phase and it is at this level that many female learners chose to opt out of studying Physical Sciences (Muola, 2010). South African education system is different from other countries in as far as choice of Physical is concerned. In Zimbabwe for example, it is compulsory for all learners to choose Physical Sciences and Mathematics (Wadesango, Mutekwe, Ndofirepi, Maphosa & Machingambi, 2015) and this is not the case in South Africa.

In urban schools learners may have access to information about science, scientific careers and role models whereas learners in rural areas have little information (Muola, 2010). Access to information about sciences and science related careers has been reported to affect the enrolment of girls in sciences particularly in rural schools (Dlamini et al., 2004). As such, if learners grow up in an environment where

there is no access to information about science and science related careers, they might not be motivated to follow this line. Ultimately, they shy away from science; hence their low enrollment in Physical Sciences.

Records indicate that more girls are enrolled in primary schools than boys (Lindahl, 2007). However, this is reversed at secondary schools, where boys out-number girls (Hicks & Segooa, 2011). Worse still, the number of girls at secondary level enrolled in Physical Sciences is very low. A number of initiatives have been done in South Africa to promote girls' enrolment in Mathematics and Physical Sciences. One of such initiatives was the establishment of Dinaledi schools led by the former Minister Pandor in her previous capacity as the Minister for Education in 2008. Other initiatives include the Mathematics and Physical Sciences camps for girls. These efforts open opportunities for girls in various fields of science. When girls are given such educational opportunities they become achievers in the field of science, technology, and research (Mayende-Sibiya, 2010). Studies suggest that the lower percentage of females may be because they are not motivated enough or have a negative attitude towards the study of science subjects (Changeiywo et al., 2010; Christidou, 2010).

## **1.2. Statement of the problem**

The South African Bill of Rights, as written in the 1996 Constitution, states that every citizen has a right to basic and tertiary education. In particular, the government recognizes the importance of learner exposure to science and technology thus assists learners to develop a solid science foundation in order to be more competent once they enter the workforce (Krumm & Kimmie, 2013).

Despite the tremendous progress in providing education to all citizens in South Africa, girls are underrepresented in Mathematics, Science and Technology (ASSAf, 2010). Studies show that men still dominate the sciences and it has become important to attract more girls into the field of science (Aguete & Agwa, 2007; ASSAf,

2010; Wadesango, Rembe & Chabaya, 2011). The factors that attract and influence girls to choose Physical Sciences as one of their subjects have not been established in the South African context.

In the South African education system, learners are expected to choose subjects they will specialise in, at Grade 10. Their choice of a career by the end of Grade 12 is significantly impacted by the choice of these subjects in Grade 9. When learners enter Grade 10, they choose seven subjects of which three (Home Language, First Additional Language and Life Orientation) are compulsory and other subjects including Physical Sciences are elective.

A survey conducted in the Eastern Cape, Mpumalanga, Gauteng and Kwa-Zulu Natal, by Moletsane and Reddy (2011), showed that many educators had little or no knowledge of national and international policies of Mathematics and Physical Sciences education promotion, strategies that guide gender equality in the curriculum, and strategies that promote the participation of girls in Mathematics and Science. These findings suggest that while educators may sometimes believe in the values of gender equality, they lack adequate knowledge about the policies for translating this into gender-sensitive practice. As a result, they might not have strategies to motivate girls in the studies of Physical Sciences. As the key agents of change, policy implementation and addressing gender inequality in schools, educators require relevant knowledge and skills to increase the number of girls in Physical Sciences.

If educators are unaware of national and international policies on gender equality, they are not likely to motivate girls to take sciences. Despite the equal opportunities availed to all learners in South Africa, very few girls choose to study Physical Sciences in Grade 10. Therefore, the researcher wants to understand factors motivating girls who take Physical Sciences as one of their subjects in Grade 10.

While many previous studies (Makgato & Mji, 2006; Mulemwa, 2000 & Sebeka, 2012) have dwelt much on poor performance of girls in the studies of Physical Sciences, few have investigated the reasons why girls study this subject. Therefore, there is a need to understand the factors which motivate girls to study of Physical Sciences so as to encourage more of them to venture into science and technology.

### **1.3. Aim of the study**

Physical Sciences is not a compulsory subject to learners in South Africa. There might be factors that influence the choice of the respective subjects. The aim of this study, therefore, was to explore and identify factors that motivate girls to study Physical Sciences in Grade 10.

### **1.4. Objectives of the study**

The objectives of this study were to:

- Understand the attitudes of girls towards Physical Sciences;
- Investigate the role of the school, including educators, peers, curricula and the teaching and learning environment in motivating girls in studying Physical Sciences; and
- Establish the role of families in motivating girls towards studying Physical Sciences in Grade 10.

### **1.5. Research questions**

The main research question for this study was: What factors motivate girls within Rakwadu Circuit to choose Physical Sciences in Grade 10? This was answered by the following sub-questions:

- What are the attitudes of girls towards Physical Science?
- How does the learning environment influence girls' motivation to study Physical Sciences?

- What is the role of families in motivating girls to study Physical Sciences?

### **1.6. Motivation of the study**

The choice of this topic was based on the current world trend as well as research emphasizing gender inequalities, following the United Nations' millennium declaration goals of September 2009 (United Nations, 2009). The declaration embraces the promotion of gender equity, the empowerment of women and the eradication of gender inequality in basic and secondary education by 2010 and at all levels by 2015. Unfortunately, gender inequality in education has remained a continuing global problem. When Diab (2011) was compiling the policy-makers booklet, she concluded that experts in science should look at ways to encourage girls and young women, through Inquiry-Based Science Education (IBSE), to enrol for sciences at school, pursue science careers, as well as design interventions that could nurture girls in science education.

### **1.6. Significance of the study**

The findings from this study may contribute to the improvement of policies that address the problems girls face in the field of science. This might also assist stakeholders in education (Department of Basic Education, employers, learners, educators, parents, society) to be aware of the needs of girls in schools.

These stakeholders may be able to know how to contribute towards ensuring maximum participation of girls in the study of Physical Sciences. The study may also influence teaching and learning material developers in Physical Sciences and Natural Sciences to align their materials to the needs of girls.

## **1.7. Definition of concepts**

### **1.7.1 Motivation**

Motivation is the attribute that moves us to do something and is defined as the process that initiates, guides and maintains goal-oriented behaviours. Motivation is what causes us to act, whether it is getting a glass of water to reduce thirst or reading a book to gain knowledge. It involves the biological, emotional, social and cognitive forces that activate behaviour (Cherry, 2013).

### **1.7.2 Science Education**

Science education is the field concerned with sharing science content and process with individuals not traditionally considered part of the scientific community. The field of science education comprises science content, some social science and pedagogy. The standards for science education provide expectations for the development of understanding for learners through the entire course of their Grade R-12 education. The traditional subjects included in the standards are physical, life, earth, and space sciences (Zhu, 2007).

### **1.7.3 Physical Sciences**

Physical Sciences is the systematic study of the inorganic world, as distinct from the study of the organic world, which is the province of biological science. Physical Sciences is ordinarily thought of as consisting of four broad areas: astronomy, physics, chemistry, and the Earth sciences (TNOD, 2009).

### **1.7.4 Attitude**

Attitude is an expression of favour or disfavour toward a person, place, thing, or event. It is a predisposition or a tendency to respond positively or negatively towards a certain idea, object, person, or situation. Attitude influences an individual's choice of action and responses to challenges, incentives, and rewards (Manning, 2003).

### **1.7.5 Gender equality**

Gender equality refers to a social order in which women and men share the same opportunities and the same constraints in equal proportions and responsibilities in

both the economic and domestic realms (Ogilvy, 2012). It emphasises treating people equally.

## **1.8. Summary**

This chapter outlined the background of the study, statement of the problem and the aim of the study. The chapter also outlined the objectives of the research questions and the significance of the study. The next chapter will discuss literature review in context.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1. Introduction**

In this chapter, literature based on the topic under study is reviewed. A literature review is an evaluative report of studies found in the literature related to the selected area (Boote & Beile, 2005). Working with literature is an important part of the research process as it assists to generate ideas, helps form significant questions and is instrumental in the process of research design.

The production of new knowledge is fundamentally dependent on past knowledge (O'Leary, 2004). As result, primary and secondary sources were carefully chosen, studied and investigated with the purpose of drawing out only the essential information that is present, reliable and applicable to the current study. This literature review thus concentrated on motivation factors that might contribute or hinder the progress of girls in Science.

#### **2.2. Science education in South Africa**

In the South African context, science and technology are presumed to be fundamental to improving the quality of life and fast-tracking economic opportunities. However, despite elevated exposure, not only do the failure rates at secondary schools remain high, but social problems of unemployment are increasing at an alarming rate (Krumm & Kimmie, 2013). These escalating problems reveal critical gaps in the teaching, learning and application of science to day-to-day living. A critically informed teaching and learning approach offers the ideal opportunity to resolve the above crises. However, what is needed is a transformation in the mind of the learner. This transformation should enable learners to take complete ownership of the learning process through critical and reflective thinking (Bang & Baker, 2013).

Science education in South Africa starts at primary school level. Curriculum and Assessment Policy Statement (CAPS) forms the foundation of the curriculum in South Africa from Grades R to 9 where learners should achieve certain skills. These skills should be achieved at the end of a learning process and CAPS encourages an activity-based approach to education while focussing on skills development. Science at this level is aimed at fostering an appreciation of the relationships between science, society and the environment, the development and use of science process skills and application of scientific knowledge. It covers Mathematics, Natural Sciences, Social Sciences, Management and Economic Sciences and Technology (Nelson, Williams & Joseph, 2012).

Between Grades 4 and 9 learners are taught Natural Sciences which incorporate both Physical Sciences and Life Sciences. Scientific enquiry and problem-solving skills similar to those used by scientists at work are developed at this level (Heeralal, 2014). Learners are able to understand relationships between science and technology, the society and the environment (Nelson, Williams & Joseph, 2012). Life Sciences involve the systematic study of life in the changing natural and man-made environment. This enables learners to understand biological, physiological, environmental, technological and social processes that impact on the environment (Christidou, 2011).

### **Girls in Science Education in South Africa**

Girls represent 56 % of the estimated 47 million school age children who are out of school in Sub-Saharan Africa (Dolan & Grady 2010; Dlamini et al., 2004). The Gender Parity Index (GPI) is highest in Southern Africa, where many countries have attained near universal primary education and high adult literacy. Cases of extreme gender disparity are mostly found along the southern rim of the Sahara, a region characterized by low adult literacy and weak economies. It is evident from the above that Sub-Saharan Africa (SSA) faces a challenge to increase the number of girls that are educated in general, and in science education, in particular (ASSAf, 2010).

South Africa has some of the most progressive policies that are aimed at advancing women empowerment and gender equality. However, the challenge remains the capacity to implement such policies (Moletsane & Reddy, 2011). In addressing the United Nations ahead of the presentation of the country report to the 56th Session of the Commission on the Status of Women, Lulu Xingwana, the Minister of Women, Children and People with Disabilities said:

*“The majority of women and girls in South Africa live in rural areas where poverty and underdevelopment define their daily existence. The rural profile of South Africa continues to be one of female-headed households, growing poverty, human rights abuses and increased gender-based violence, unemployment and high prevalence of HIV and AIDS. In this regard, the department is currently formulating a Strategy on Rural Women’s Development in which we are partnering with the Department of Rural Women and Land Reform. The Strategy is intended to accelerate implementation of measures aimed at improving the lives of rural women”.*

There is the legacy of apartheid education and Bantu Education, under which black people were not taught Mathematics and Physical Sciences needed for tertiary education. Although this changed in late 1994, a report by the Organisation for Economic Cooperation and Development (OECD) programme for International Student Assessment indicated in 2009 that South African learners continued to score poorly in Physical Sciences (Mutemeri & Mugweni, 2005). This finding may be an indication of the difficulty of overcoming the Bantu Education legacy. The provision of equal education for all in South Africa today is regarded as one of the most important components in the education system. Despite the equal opportunities provided, the country is still grappling with the problem of low percentages of females in science, and these gender disparities are evident at secondary school level (Clegg, 2007). Sebeka (2012) points out that science subjects are regarded as inappropriate for girls. For this reason, gender stereotyping of girls starts at primary school level where school children are shown images that perpetuate gender stereotypes and convey the message that science and technology are not for girls.

After completing his study in Limpopo, Sebeka (2012) established that rural schools had the lowest percentage of girls studying Physical Sciences. He further highlighted the role of the environment in influencing choices to study Physical Sciences, pointing out that many girls stayed in environments where there was no access to information regarding career opportunities in Physical Sciences. Thus, there is very little in the environment to motivate girls to study science subjects. When girls are not motivated, they get discouraged and do not aspire to choose any career related to science (Vedder-Weiss & Fortus, 2013).

Kgabi (2010) indicated that in South Africa, girls tend to move away from the Physical Sciences when they go to high school, and if they do choose the Natural Sciences, they usually prefer Biology. A small research project conducted by Christidou (2011) traced the subject and career choices of a group of learners from matriculation through to university. The study confirmed the move away from the Physical Sciences as girls move up the academic/career ladder. It however, showed that girls choose careers in fields they believe will put them in a better position to help their communities for example, health, environment, education and the social sciences (Christidou, 2011). This shows that learners do not get sufficient information about science and technology-related careers.

At ASSAf, an organisation promoting girls in science education, workshop held in Pretoria in 2010, presenters highlighted key challenges faced by South Africa girls concerning their involvement in Physical Sciences. These included; poverty, social and cultural factors, among others. Cultural factors and traditional expectations, for instance, lead girls to be socialised into gender specific roles, and that inhibits progression into science education and careers. Furthermore, there are general perceptions that girls lack abilities in areas of science and technology. Hannula (2010), one of the presenters in the workshop, pointed out that the following aspects contributed to the low number of girls in Physical Sciences education and career choices:

- lack of science role models and mentors in families and the society at large;

- lack of motivation and encouragement from school, family and community;
- factors such as infrastructure and facilities at schools that are not female friendly;
- policy of exclusion;
- social factors including early pregnancies at a young age;
- restrictive education policies that do not encourage girls and their families to enrol in school education for example, lack of free primary education;
- lack of career guidance that informs girls of science-related careers;
- girls tend to lose interest in science as they enter adolescence;
- science is not seen as appropriate for women in terms of field studies and the career choices it offers; and
- examples and pictures used in science textbooks are not appealing or interesting to girls.

The Commission for Gender Equality (CGE) is an independent state institution, established in terms of Section 187 of the 1996 South African Constitution. This commission was charged with a broad mandate to promote respect for gender equality and the protection, development and attainment of gender equality in South Africa. Organisations such as the Academy of Science in South Africa (ASSAF) were established to look at ways of encouraging girls and young women to enter into science at school and later on into science careers, as well as the interventions that should be introduced to nurture girls in science education (Archer, DeWitt & Willis, 2014). The association of South African Women in Science and Engineering (SA WISE) is a dynamic association for all those who support the idea of strengthening the role of women in science and engineering in South Africa. One of its objectives is to highlight and address problems faced specifically by women in these fields (Archer et al., 2014).

Maphoso and Mahlo (2014) indicated that women scientists are still generally underrepresented in research work in most countries, especially on the African continent. The dearth of women in science was lamented on the 28 October 2010 at a conference titled 'Milestone in Advancing Women's Participation in Research' in South Africa at the University of KwaZulu-Natal. This conference was one of those which intended to increase the number of women in science. Despite this, little is done on empowering women scientists, technologists, researchers and academics. This conference launched the University of KwaZulu-Natal's Women in Research Academy which would give a platform to emerging scientists. The increasing awareness of the importance of science and technology in national developments by government has resulted in the establishment of special science schools.

South Africa has been promoting girls' participation in the areas of Mathematics and Physical Sciences through the establishment of Dinaledi schools led by Minister Pandor in her previous capacity as the Minister of Basic Education. There have been other initiatives such as Mathematics and science camps for girls. These efforts are meant to open the doors for girls in various fields of science. When girls are given such educational opportunities they will be achievers in their fields including such as Mathematics, Science, Technology, and probably research in such areas.

In 2005, an organisation called Women in Physics in South Africa (WiPiSA) was launched. It was funded by the Department of Science and Technology and administered by the South African Institute of Physics (SAIP). The aims and objectives of WiPiSA were to stimulate an interest in physics among girls and women and to encourage girls and women to study physics. The other aim was to encourage and support girls and women to work in physics-related careers and also assist in removing or overcoming obstacles and barriers for girls and women to study physics and work in physics-related careers. Other aims of WiPiSA are to attract girls into physics, mentor young women in physics and to obtain baseline information on women in physics in South Africa (Diab, 2010). The South African Government has stated that WiPiSA, as one of the most successful science programmes, highlighted

women's issues in South Africa. This programme carried out projects in schools to attract girls to physics by providing role models.

### **2.3. Girls in Science**

Gender equality is enshrined in the Bill of Rights of the South African Constitution. Section 15 of the South African Schools Act (No. 84 of 1996) reconfirms that the Department of Basic Education (DBE) and all other educational institutions are required to observe the fundamental rights provided in the Constitution. Bound by this provision, the department is legally required to integrate gender issues into its policies. To facilitate gender mainstreaming, the DBE policies advance gender equity and strategies to advance the representation, participation and performance of girls in the areas of mathematics, science and technology (DBE, 2008).

The development of science as a field of study is one of the aims of social constructivism; a theory that asserts that gender identities are socially constructed (Dweck, 2010). It is based on the premise that our understanding of nature, science and technology are socially mediated processes. Social mediation, according to Bistros (2011), is a way of explaining existing gender imbalances in science and technology majors and careers. Archer et al. (2014), on the other hand, explains that in countries such as the United States of America, England and Australia, women were not allowed to study Physical Sciences or any of its sub-disciplines for the better part of the 19th century because they were thought to be lacking the necessary capacity to do well. Durant (2011) also mentioned that it was only in the last century that more females started enrolling for Physical Sciences and its related areas, even though the numbers decreased when moving up the educational ladder.

In sub-Saharan Africa women are known to be the foundation of life due to their multiple and critical roles in the family as homemakers, caretakers, workers, producers and managers of food and environmental resources (Halat, 2010). Anamuah-Mansah (2000) asserted that involvement of girls in science and

technology education is important in the drive towards development, especially, in developing countries. This is because science and technology information enables nations to adequately cope with global issues and to be competitive players in the global market (Anamuah-Mansah, 2000).

The Dakar Framework which was held in Dakar during the World Economic Forum (2000), aimed that by 2015 all children, particularly girls in difficult circumstances and those belonging to ethnic minorities, should have access to and complete, free and compulsory primary education of good quality. The education of girls particularly in Science, Mathematics and Technology remains a major challenge. Despite the international attention that this challenge has received, 60% of all children without access to primary education are girls (UNESCO, 2009).

Regarding how children develop male or female life styles and preferences, Fagot (1974) reported that parents socialise their sons and daughters differently, and this socialisation has a strong bearing on future career goals and motives. Christidou (2011) maintains that whereas boys play tough, hard games, and are encouraged to explore, girls are often discouraged from participation in what are considered masculine activities. He concluded that girls are often discouraged from taking key subjects such as Mathematics and Physical Sciences, which impacts significantly on enrolment patterns at tertiary institutions.

Physical Sciences studies have over the years been considered a male-oriented area of study wherein women are in minority. For example, Migunde et al. (2012) indicated that Physical Sciences has been portrayed as a Eurocentric and male subject of study; this might have instilled an inferiority complex among women. Muola (2010) argued that many women are strangers to science because the logic of science dominated and developed by men can never be totally compatible with women's standpoints. Moir and Moir (2012) agreed that the inherent masculinity of science was the prime reason for girls' avoidance of science. Hannula (2010)

suggests that science is masculine at the surface level, at the deeper epistemological level and in the nature of knowledge that is accepted as scientific.

The disparity in science, where males dominate the science fraternity, can be predominantly attributed to the history and the origin of science (Bistros, 2011). His study further indicated that though countries developed policies to encourage more females in science, males have been dominating the science field for centuries (Bistros, 2011).

Despite policy pronouncements, girls continue to be underrepresented in sciences compared to boys. In fact, throughout the continent of Africa and other parts of the world, more boys than girls tend to pursue careers in science and technology sectors (UNESCO, 2007). In Zimbabwe and Botswana, for example, only 30% and 39% respectively, of advanced level of science learners are females (Clegg, 2007). At higher education level the enrolments of females become even lower in sciences. For instance, the 2004 enrolment of females in engineering courses across all tertiary institutions in Zimbabwe was as low as 5% and for other science degrees was 31% (Clegg, 2007).

To increase the percentage of females in science, nations should motivate girls from a young age (Siddiqui & Khatoon, 2013). The question many are asking is why are women not choosing to pursue degrees and careers in the Physical Sciences? Vedder-Weiss and Fortus (2013) attribute the low percentage of women in Physical Sciences to societal forces operating during early development and aspects of the Physical Sciences that could be unappealing to women. Although there are many efforts across the world to attract girls to scientific and technological education, many disparities remain due to political, social, environmental or cultural factors, or individual choices (Terblanche, 2013).

Siddiqui and Khatoon (2013) indicated that girls' scientific education develops their critical thinking skills, self-esteem, Mathematics, language and awareness of gender equality and human rights. It gives girls and women the opportunity to understand their potential and role in the holistic development of any nation. It is therefore important to attract girls and women to scientific and technological education.

Girls' access to science education is generally lower than that of boys in many countries in sub-Saharan Africa (Mulemwa, 2000). Consequently the percentage of girls who study Physical Sciences is less than that of boys. Mulemwa (2000) further highlights the following reasons as causes of the gender disparity in Science, Mathematics and Technology education (SMT) in Africa:

- “A negative attitude; where societies think that the study of Physical Sciences is only for boys and men;
- A lack of awareness of gender issues in science education;
- The instructional method employed;
- Inappropriate and irrelevant syllabuses; and
- A lack of role models and information on SMT based careers” (Mulemwa, 2000).

Although the participation in Mathematics and Science at primary level is compulsory in all Sub-Saharan Africa (UNESCO, 2010), the gender inequality in science studies increases from senior secondary school to university level. This is mainly due to the fact that Mathematics and Science are no longer compulsory at these levels and most girls opt for other fields of study. A study by Terblanche (2013) revealed that the factors that limit girls' participation in the study of Physical Sciences is not lack of ability but rather the lack of opportunities. Terblanche (2013) argued that girls at school may excel in Mathematics and Physical Sciences if they have role models to follow, science clubs for girls, science competitions as well as funding and recognition awards at school and national levels.

Physical Sciences is predominantly a subject dominated by whites (Tan, Barton, Kang & O'Neill, 2013). On the other hand, African societies still have the misconception that this subject is for males and that females cannot expect to perform as much as their male counterparts (Tan et al., 2013). Therefore, if the current trend continues, the number of female scientists will remain lower than that of males. Christidou (2011) concluded that to have more girls in subjects such as Physical Sciences and Mathematics, the following should be considered:

- Girls need to be increasingly exposed to successful female role models and mentors in SMT;
- Science-related activities and experiments should be structured such that girls are able to explore, explain, extend, and evaluate their progress;
- Mathematics is critical to the knowledge of science. There is a need to build girls' mathematical skills during early education;
- Bring girl-friendly instructional resources to class;
- Develop girls' oral and writing skills;
- Facilitate guided discovery during science lessons;
- Parents should also encourage girls to be confident about their ability to do science;
- Parents and educators need to teach children that intellectual skills can be acquired and that physical strength is not related to the intellectual capabilities; and
- Encourage after school and weekend science clubs.

#### **2.4. Attitude and interest of girls in Physical Sciences**

There are various definitions of attitude. Some studies define attitude in terms of an affective reaction that involves emotional feelings about an object (Zamrud, 2008, p.78). The definition of attitude adopted for this study was from Aiken (1979), who defined attitude as a composite trait that consists of the following personality factors:

motivation, enjoyment, value and fearlessness of Mathematics and Physical Sciences. The three integral parts of attitude are:

- Motivation - a motivated learner tends to pursue the subject with eagerness and persistence (Maqsud, 1992);
- Freedom from fear - this encourages better performance (Fennema & Franke, 1992); and
- Enjoyment - this encourages learners to perform well (Kulm, 1980).

Research has identified a number of factors influencing attitude towards science in general. These can be largely defined as gender, personality, structural variables and curriculum variables. Of these the most significant is gender (Bang & Baker, 2011). This is supported by Tuaundu (2012) who argues that sex is probably the most significant variable related to pupils' attitude towards science.

Girls are more likely to choose courses and careers in Mathematics and Physical Sciences if their interest in these fields is sparked and cultivated in their earlier schooling years (Wigfield et al., 1996). Social support from peers and attitude towards enrolling for a subject are strong determinants for a student's choice of science subjects (Zhu, 2007).

In a study conducted by Osborne and Dillon (2008), highly talented Grade 7 and 8 learners were asked to rank their liking for biology, chemistry, and physics. The results showed that girls favoured biology more than boys, and boys preferred physics and chemistry more than girls (Benbow & Minor, 1986). Furthermore, Eccles and Wigfield (2002) reported that female high school learners feel less confident than male learners about their abilities and the likelihood of success in Physical Sciences and engineering professions, but they feel more confident in health-related professions. Another study by Pintrich and Zusho (2007) showed that boys have more positive attitudes fuelled by higher achievement in Physics and

Mathematics, while girls are slightly more confident about attaining language proficiency (Machingambi, 2013). The same study suggested that girls can do well if they are assisted through building positive attitudes and aspirations.

The myths and realities of women progressing in the Mathematics and Physical Sciences field were studied by Kang'ethe (2014) who concluded that the attitudes adopted by girls from parents, educators, friends and society have a significant influence on the girls' choices and performance in Physical Sciences and Mathematics. These influences may come from a cultural or social background.

All schools should ideally provide equal opportunities for both boys and girls. Even though there is a tendency among low social economic status schools to practice gender chauvinism against female learners (Siddiqui & Khatoon, 2013), it is believed that when the school environment is enriching and stimulates positive attitudes, female learners will achieve higher grades (Vedder-Weiss & Fortus, 2013). As a result, schools with less provisions, fewer educators, poor school infrastructure and insufficient facilities for female learners might have a negative influence on the attitudes of female learners.

Valentina and Singh (2014) indicated that women constitute only a small percentage of the science workforce because of their beliefs and attitudes. Negative attitude and beliefs may result in girls underestimating their competency in science, feeling less adequate, and having low expectations for success in Physical Sciences. Many learners, particularly girls, see Physical Sciences and Mathematics as a difficult subject, thus, only few of them study these subjects. Unknowingly, female learners are cutting themselves off from lucrative opportunities in universities and careers, (Terblanche, 2013). To enhance girls' beliefs about their abilities, Diale (2010) recommends that educators should understand and communicate effectively with learners. Furthermore, educators should frequently inform all learners that Physical Sciences abilities, like all abilities, can be improved through consistent effort and learning. Many children today make subject choices at school based on the fear of

Physical Sciences rather than on their personal aspirations (Anglo-Gold Ashanti, 2006). The management of Anglo-Gold mine invested R6 million with the hope to change this attitude.

On the other hand, a positive attitude towards science leads to a positive commitment to science (Simpson & Oliver, 1990). Studies show that children who are introduced to technology at school while at an early age had the opportunity to develop a positive attitude towards science and technology (Bang & Baker, 2013), and will be more likely to choose these subjects as their education continues (Dionne et al., 2013). This might be the reason why major science education reform efforts in Africa have emphasised the improvement of learners' attitude and interest towards science.

While interest is certainly a factor in getting girls to study and pursue Physical Sciences, attention should be given to building confidence in their abilities early in their education (Fouad & Smith, 1996). It is believed that the relationship between confidence and interest is close (Ryan & Deci, 2006); meaning that if students believe they can make it, that belief can ultimately feed their interest and ambition.

In a study about gender equity in science, Sinnes (2005) indicated that there were differences between girls and boys in the way they engaged in Physical Sciences. This study concluded that these differences may be a result of biological differences or a society which is not gender neutral or because girls and boys have different interests and attitudes (Sinnes, 2005). In a study involving learners from ten different countries, the differences between boys' and girls' attitudes towards science increased as learners moved from primary to secondary school, especially, between the ages of ten and fourteen years (Lee & Bowen, 2006).

Female Education in Mathematics and Science in Africa (FEMSA) is one of the most extensive initiatives undertaken in sub-Saharan Africa to advance the participation of

girls in Science, Mathematics and Technology education at primary and secondary school levels. In one of its reports, FEMSA (1999) recommended that societies should sensitize girls that their abilities to succeed in science are equal to boys'. Implicit in the recommendation was that girls and boys have equal capabilities to perform well in science provided that girls are granted the same opportunities as boys.

Providing opportunities is important, but female learners' can only benefit from these if they have the confidence and attitude they need to pursue their ambitions and take advantage of the educational and professional openings that are available to them (Cherry, 2013). Too often, girls are not encouraged to develop the confidence they need in order to continue with higher level mathematics and science courses in high school. Physical Sciences educators need to encourage capable young women to seriously think of science or engineering and other scientific careers. Educators cannot escape the responsibility to present science as equally appropriate for girls and boys and to expect both boys and girls to engage thoughtfully in science activities.

According to Haussler and Hoffmann (2000), learners' interest in science involves three dimensions namely: interest in a particular context in studying science; interest in a particular content connected with that context; and interest in a particular activity a student is engaged in, in conjunction with that content. Therefore, the context in which science is studied might be a powerful predictor of learners' interest. Contexts that stimulate interest involve science as a means to promote practical competence, a socio-economic enterprise, a vehicle to enhance emotional experience, an intellectually challenging endeavor and a vehicle to qualify for professional life (Haussler & Hoffmann, 2000).

A study by Dionne et al. (2012) that focused on gender differences in learners' experiences, interests, and attitudes towards science revealed the following findings:

- Males reported more extracurricular experiences with a variety of tools such as batteries, electric toys, fuses, microscopes, and pulleys whereas females reported more experiences with bread-making, knitting, sewing, and planting seeds;
- More male than female learners indicated they were interested in atomic bombs, atoms, cars, computers, x-rays, and technology, whereas more females reported interest in animal communication, rainbows, healthy eating, weather, and AIDS;
- In addition, when asked about future jobs, male and female learners' responses differed by gender;
- Males saw variables such as controlling other people, becoming famous, earning lots of money, and having a simple and easy job as important. Females, more than males, wanted to help other people; and
- Learners' perceptions of science showed that significantly more females than males reported that science was difficult to understand, whereas more males reported that science was destructive and dangerous, as well as more suitable for boys.

The above information shows that girls might not be as interested and motivated as boys to study Physical Sciences at FET and HET levels.

## **2.5. Motivational Factors**

Motivation to learn science may benefit young learners who aspire to be future scientists by nurturing their scientific literacy. Scientific literacy is the capability to understand scientific knowledge, identify important scientific questions, draw evidence-based conclusions, and make decisions about how human activity affects the natural world (ASSAf, 2010).

Motivation has been regarded as an important issue in science education (Walker & Guzdial, 1999). Hannula (2010) further highlighted that in order to understand

learners' various behaviours in classrooms, including those unexpected, it was important to increase the understanding of what motivation was and how it was directed. Motivation might attempt to give some guidance in understanding an individuals' behaviour and the effort applied in different activities. Although many definitions are used in the literature to explain the concept of motivation, this concept is generally defined as the internal state, or condition, that serves to activate, direct and sustain behaviour (Pintrich & Zusho, 2007; Palmer, 2009). According to Brophy (2004), motivation to learn is a student's tendency to find academic activities meaningful and worthwhile and to try to derive the intended academic benefits from them.

Learners' motivation in learning science is explained as learners' active engagement in science-related tasks for achieving a better understanding of science (Lee & Brophy, 1996). Motivation to learn science might promote students' construction of their conceptual understanding of science. It is a vital educational variable for promoting both new learning and performance of previously learned skills and strategies (Barlia, 1999). As noted by Glynn and Koballa (2006), learners' learning aim is also important for construction of their knowledge, based on learning value and learning strategies (Tuan, Chin & Shieh, 2005).

From the educational perspective, Palmer (2009) stated that motivation can be applied to any process that activates and maintains learning behaviour. Palmer (2009) highlighted three major components to motivation namely; activation, persistence and intensity. These components according to Palmer (2009), involve the decision to initiate behaviour, continued effort toward a goal even though obstacles may exist and concentration and vigour that goes into pursuing a goal. For example, one student might succeed in her study without much effort, while another student might study regularly, participate in discussions and take advantage of research opportunities outside of class in order to succeed.

There are various factors that motivate learners to study, and many of them can be divided into extrinsic or intrinsic motivation (Ryan & Deci, 2006). Extrinsic motivation arises from outside of the individual and often involves rewards such as trophies, money, social recognition or praise. Intrinsic motivation arises from within the individual, such as doing a complicated cross-word puzzle purely for the personal gratification of solving a problem. The amount of motivation does not necessarily vary, but the nature and focus of the motivation being evidenced certainly does (Ryan & Deci, 2006).

Research suggests that intrinsic and extrinsic motivations may not necessarily be polar opposites (Lepper & Cordova, 1992). For instance, in Bateman and Crant's (2003) study with more than 800 secondary schools, extrinsic rewards and values often demonstrated significant positive main effects on intrinsic outcomes. Similar results were obtained by Cameron (2001), whose study showed that extrinsic motivation was helpful when intrinsic motivation was low. In particular, the study proved that people often do things which are not intrinsically motivated so that they may simply lose interest in doing them without external rewards.

### **2.5.1. Intrinsic Motivation**

Intrinsic motivation entails doing something for its inherent satisfaction rather than for some separable consequence. If students are intrinsically motivated, they will be moved to learn for the fun of it rather than because of external pressures or rewards (Gagne & Deci, 2005). It can be argued that intrinsic motivation results in high-quality learning and creativity.

This motivational tendency is a critical element in cognitive and social development (Meece, Glienke, & Burg, 2006). Probably because it is through acting on one's inbuilt interests that one grows in knowledge and skills. Learners' feelings to take interest in novelty and to creatively apply their skills might not be limited to childhood, but might be a significant feature of human nature that affects performance and

persistence (Pintrich, 2011). Consequently, they may be motivated internally through cognitive and social development.

Intrinsic motivation can only occur if learners are internally motivated by their educators to do something because it either brings pleasure to them, they think it is important, or they feel that what they are learning is significant (Tuan et al., 2005). In the educational scene the educator has the primary responsibility to develop and enhance the intrinsic motivation in the learner, by so doing the educator will be applying extrinsic motivation (Ryan & Deci, 2006).

Intrinsic motivation exists within individuals and is also shown in the way individuals relate to various activities (Tella, 2007). People are intrinsically motivated to perform some activities and not others, and not everyone is intrinsically motivated for any particular task. Because intrinsic motivation exists in the link between a person and a task, some authors have defined intrinsic motivation in terms of the task being interesting while others have defined it in terms of the satisfactions a person gains from intrinsically motivated task engagement (Meece, Glienke & Burg, 2006). In part, these different definitions derive from the fact that the concept of intrinsic motivation was proposed as a critical reaction to the two behavioural theories that were dominant in empirical psychology (Ryan & Deci, 2006).

Everybody is born with the potential to enjoy learning (Lepper & Cordova, 1992). An approach that offers a reward for better performance is destined to be ineffective (Kohn, 1993). When learners do not enjoy learning, the blame might be on ineffective teaching, boring or irrelevant curricula, and maybe the use of extrinsic incentives such as rewards. Educators are thus advised to find ways to make learning interesting and to tap into learners' natural curiosity in order to motivate them for school (Lepper & Cordova, 1992). Therefore, learners and educators can find themselves in a secure academic relationship, one in which educator and learner are intrinsically connected to each other.

To use intrinsic motivation, the educators should include a means of stimulation in their teaching programs to catch learners' interest (Middleton, Dupuis & Tang, 2012). It can be argued that, how educators conduct their classrooms is a major factor in directing learners' motivation. As such, when learners are intrinsically motivated, they might experience interest and enjoyment and feel competent.

The intrinsic value of a task has often been linked to achievement. For example, in the Eccles expectancy-value model of achievement choices, intrinsic value was defined as the enjoyment the individual gets from performing the activity or the subjective interest the individual has in the subject (Eccles & Wigfield, 2002). They suggested that when a task has high intrinsic value, the individual will be motivated to continue to engage in the task.

### **2.5.2. Extrinsic Motivation**

Extrinsic motivation is a construct that pertains to activities done in order to attain some separable outcome (Pintrich & Zusho, 2007). Extrinsic motivation thus contrasts with intrinsic motivation (Gagne & Deci, 2005). However, unlike some perspectives that view extrinsically motivated behaviour as invariably non-autonomous, Eccles and Wigfield (2002) propose that extrinsic motivation can vary greatly in the degree to which it is autonomous. For example, learners who do their homework for fear of their parents' reprimand are extrinsically motivated because they do this task in order to get results and avoiding such reprimand. Similarly, students who do the work because they believe it is valuable for her chosen career are also extrinsically motivated because they do it for its instrumental value rather than out of interest (Eisenberger, Pierce & Cameron, 1999). Both examples involve instrumentalities, yet the second case involves personal endorsement and a feeling of choice, whereas the former involves just compliance with an external control. Both represent intentional behaviour, but the two types of extrinsic motivation may vary in their relative autonomy.

Given that many educational activities prescribed in schools are not designed to be intrinsically interesting, a central question concerns how to motivate learners to value and self-regulate activities without external pressure, so as to carry them out on their own. This problem is described within the Self-determination Theory (SDT) in terms of fostering the internalisation and integration of values and behavioural regulations (Ryan & Deci, 2006). Internalisation is the process of taking in a value or regulation. Integration is the process by which individuals more fully transform the regulation into their own so that it will emanate from their sense of self (Christidou, 2011). Thought of as a continuum, the concept of internalisation describes how one's motivation for behaviour can range from a motivation or unwillingness, to passive compliance and to active personal commitment (Christidou, 2011). Differences in attitudes and adjustment were also associated with the different types of extrinsic motivation (Sikwari, 2014). For example, the more learners were externally regulated the less they show interest, value, or effort, and the more they indicated a tendency to blame others, such as the teacher, for negative outcomes.

Learners can perform extrinsically motivated actions with resentment, resistance, and disinterest or, alternatively, with an attitude of willingness that reflects an inner acceptance of the value or utility of a task, (Bryan et al., 2013). Understanding these different types of extrinsic motivational factors, and what fosters each of them, is an important issue for educators who cannot always rely on intrinsic motivation to foster learning. Because many of the tasks that educators want their learners to perform are not inherently interesting or enjoyable, knowing how to promote more active forms of extrinsic motivation becomes an essential strategy for successful teaching (Brophy, 2004).

### **2.5.3 Learners' motivation to learn**

Many studies have been conducted on learners' motivation to learn and these studies showed that there are many factors related to motivation (Brophy, 2004; Garcia & Pintrich, 1995; Pintrich & Schunk, 2002). Besides intrinsic and extrinsic aspects, the other factors may include self-perceptions of ability, effort, self-regulated learning and learning strategies. Tuan et al. (2005) integrated constructivist learning

and motivation theories and found five important factors for motivation in science learning motivation. These were: learners' abilities, importance of learning science, learners' learning strategies, the individual's learning goal, and the learning environment (Tuan et al., 2005).

There has been a number of studies relating individual factors affecting learners' motivation in science such as home life, parental influence, and peer pressure (Andoh et al., 2012; Migunde et al., 2012,). These individual factors were a great challenge for educators since none of these could be easily influenced by the teacher. However, there are factors which may be under the teacher's control. These might include classroom atmosphere, school environment, teaching style, and relevance of the subject matter (Ledford, Gerhart & Fang, 2013). It remains to be discovered in this study if all or some of these factors can motivate girls to choose Physical Sciences as one of their subjects.

Some researchers have conducted case studies to explore eighth-grade and ninth-grade learners' motivation in science learning in order to confirm the motivation domains (Tuan, Chin & Shieh 2005; Tan et al., 2013). These studies concluded that learners' motivation toward science learning was related to themselves, the teacher's performance and relevance of science content relevant to their daily lives. Results obtained from learners' responses showed that their goals for learning science were both extrinsic (for example, getting award and reward from educators) and intrinsic (for example, satisfying with their own curiosity). Dede and Yaman (2007) investigated high school learners' motivation towards science with respect to gender, grade level and courses liked by learners and discovered that there was a huge difference in learners' motivation toward science learning in terms of these factors. This can explain the low enrolment of girls in Physical Sciences classes.

In a theoretical review of the role of motivation in explaining gender differences in academic attainment and achievement, Meece, Glienke and Burg (2006) concluded that girls and boys continue to differ in line with traditional gender role stereotypes,

with boys indicating higher ability and interest in science. Pintrich and Zusho (2007) reviewed research related to gender differences in learners' motivation and self-regulated learning. One of the major noticeable differences was that girls inherently have lower self-perceptions of their academic ability in science even when they actually performed better when compared to boys (Sikhwari, 2014). The reason might be that, during adolescence girls are more inclined to conform to gender stereotypic roles (Ufuophu-Biri, 2014). Consequently, they may be reluctant to choose Physical Sciences as one of their subjects.

#### **2.5.4 Career aspirations and guidance**

Salami (2008) states that choosing a career is a momentous decision as it affects the rest of a person's life; therefore the first institution to lay the foundation for a person's career choice is family where domestic tasks are prescribed from a young age. Career choice starts early in life and might be culturally embedded. It is, consequently, important to consider the significance of stereotyped sex roles in relation to career choices (Andoh, Antwi-Bosiakoh & Afranie, 2012).

Women have entered many male-dominated careers over the past 20 years, but there is still a limited number of women in Science, Mathematics and Technology (Sikhwari, 2014). The relatively low percentage of women and girls in Science careers and in higher institutions is dropping even further because there are fewer females studying Physical Sciences in secondary school. Learners choosing Physical Sciences, according to Archer et al. (2014), explain their decisions in terms of university, career aspirations and background.

Learners, who avoid Physical Sciences and Mathematics at secondary schools level, are unlikely to be accepted into Science, Mathematics and Technology at university. Therefore, it is critical for learners in secondary schools to choose Physical Sciences so that they can be accepted in the science degrees at university level (Tan, Barton, Kang & O'Neill, 2013). The future of learners might be shaped in secondary schools where they determine the careers they want to pursue in life.

The South African Government is trying to incorporate girls in many fields of work. The Department of Basic Education, with the support of UNICEF, started the Techno-girls mentorship programme in 2005. The initiative, which was part of the Girls and Boys Education Movement, helped girls make informed career choices, with an emphasis on science, technology and engineering (Nelson et al., 2012). Techno-girls identified high achieving 15-18 year old school girls from disadvantaged communities, especially those coming from rural areas. The girls are placed in corporate mentorship and skills development programmes where they also benefit from academic scholarships. Career mentorship is important because it may help learners to link what they learn at school with the skills needed to succeed in the world of science.

The South African government, under the department of Women, Children and People with Disabilities (WCPD), launched the Techno-Girl project which aimed to change the face of the South African market where there is lack of significant representation of women in the scientific professions. The project inspires girls to pursue fields in Science, Mathematics, Engineering and Technology where women have historically been under-represented. The aim of this project was to support girls to study Mathematics and Science and pursue careers in science and technology and to help girls make informed career choices. It is reported that during the school holidays, girls are placed in various companies through Techno-Girl project to gain first hand insight into career choices available. The programme maintains an exclusive focus on careers in the fields of Mathematics, Science and Technology. However, in the Limpopo province such initiatives are not accessible to learners, especially in rural schools (Changeiywo, Wambugu & Wachanga, 2010). If the young girls in rural schools had access to such information, the project such as Techno-Girl might increase girls' self-esteem, attitude and, most importantly, opportunities available to them.

Career mentorship and guidance is important as it helps the learners link what they learn at school with the skills needed to succeed in the scientific world. When choosing a career in scientific-related fields, girls tend to gravitate towards

professions that help humanity; thus the fields of health and medicine are widely chosen by women (Changeiywo, Wambugu & Wachanga, 2010).

Makgato and Mji (2006) argued that parents are very important stakeholders who affect and play critical roles in improving learners' performance at school. Many studies recognise the influence of family, peers and background as significant factors in the decision making of students with regard to subject choices (Cumming, 1997 & Stokking, 2000). In his study into the problem of falling enrolments in physics and chemistry paths, Stokking (2000) suggested that the combination of interactions of family and school on learners' decision making were significant in their choices. Cumming (1997) also suggested that strong socialising influences had significant impact on the vocational choices of girls.

Parents' support, as well as that of educators, has been shown to be crucial to a girls' interest in science. If parents can make girls aware of the variety of science and related careers available and their relevance to society, they might be attracted to science careers. Parents and educators are possibly in a position to advise young people what they need to do to put them on a path in science at secondary school and probably science related careers. The ASSAf (2010) foundation highlighted that parents should also encourage girls to be confident about their ability to do science.

Oriahi et al. (2010) indicated that schools have a great role to play in influencing learners' choice of science subjects, particularly in Africa. Schools should support subjects and careers decision making. This might go a long way in encouraging learners' choice of science subjects. In addition, learners need information about the structure and content of the science subjects they want to study (Archer et al., 2014).

Research showed that learners need information about the structure and content of the programs they are considering providing an understanding of what in particular a discipline involves (Andre et al., 1999; Ogilvy, 2012). Tan et al. (2013) argued that

learners often receive conflicting advice from parents, educators, friends and career advisers about science. As a result when they enter senior secondary classes there can be mismatch between expectations and actual experiences.

Girls' rejection of science can be partially driven by parents, educators and peers when they subtly steer girls away from informal technical pastimes (for instance fixing bicycles) and science activities (such as science fairs) that too often are still thought of as the province of boys (Archer et al., 2014). Exposing girls to female role models may help negate the stereotype and encourage more girls to pursue mathematics and science-related careers (Halat, 2010). To counteract the negative stereotypes regarding women's science abilities, Fonseca (2006) suggests that educators should provide exposure to female role models and mentors who are experts in mathematics and science fields.

Fortunately, research has shown that strategies such as presentation of female role models, distribution of career information, examination of gender-equitable materials, and participation in hands-on science investigations are effective in contradicting the perception that sciences are unsuitable for girls (Archer et al, 2014; Dolan & Grady, 2010; Valentina & Singh, 2014). Research has also pointed to the presence of female role models in science as the most important factor in sustaining girls' interests in engineering and science (AWSEM, 2000). As a result, role models in the form of successful scientists are needed to attract and mentor learners to and through science education and careers.

While interest is certainly a factor in getting older girls to study and pursue a career in these disciplines, more attention should be given to building confidence in their abilities early in their education. Kang'ethe (2014) indicated that the self-confidence instilled by parents and educators is more important for young girls learning math and science than their initial interest. Fouad and Smith (1996) indicated that the relationship between confidence and interest is close and if learners feel that they can do it, it feeds their interest.

Girls' limited involvement with science subjects at school means there are few female entrants to science and technology disciplines at higher education levels. Sebeka (2012) indicated that it is vital that South Africa, along with other countries, do more to increase women access to scientific knowledge. The South African Minister of Science and Technology, Naledi Pandor (19 April 2010, Durban), highlighted that science is critical for innovation and economic growth. Thus, as a country, we should tackle the development challenges that face girls from vulnerable communities.

#### **2.5.4 Educators role in motivating girls**

Educators are essential players in promoting quality education, whether in schools or in more flexible community-based programmes. They are advocates and catalysts of change. No education reform is likely to succeed without the active participation and ownership of educators (ASSAf, 2010). Educators must accept their professional responsibilities and be accountable to both learners and communities. Educators are clearly in control in the classroom situations, as a result, extrinsic motivation might have a greater opportunity to be effective and it is up to learners to adopt the intrinsic motivation in a negative or positive way (Newman, 1998).

After examining the different interactions that educators have with boys compared to girls science classes, Tan et al. (2013) concluded that the treatment that boys get is different to that of girls. This might be due to the fact that educators have different expectations and beliefs about pre-existing knowledge in girls and in boys. These beliefs turn to justify the educators' rate of asking questions and giving more practical tasks in science to boys than to girls.

Biases are persistent, and educators often interact more with boys than with girls in Physical Sciences and Mathematics (Christidou, 2011). According to Mamlok-Naaman (2013), educators often help boys to do experiments by explaining how to do, while when girls ask for assistance educators simply do the experiments, leaving them to watch rather than do. Good Physical Sciences educators recognize that

when instruction is inquiry-based and hands-on, and learners engage in problem solving as cooperative teams, both boys and girls are motivated to pursue science activities (Christidou, 2011). Therefore, science educators can make a special effort to connect science concepts to learners' current and future lives by explaining the importance of scientific literacy, describing many career opportunities in science, and inviting scientists from the community to participate regularly in school science activities (Archer et al., 2014).

Research indicated that some of teaching strategies and methods are worth careful considerations as educators strive to improve their science teaching practices (Dabula & Makura, 2013). Facilitating the use of correct appropriate teaching methods is critical to successful teaching and learning (Ledford, Gerhart & Fang, 2013). Knowledge of how teaching methods affect learners may help educators to select methods that improve teaching quality, effectiveness, and accountability to learners (Siddiqui & Khatoon, 2013). Possibly, student motivation and student engagement are relevant to science education in the light of recurring questions about how to get more learners interested and involved in learning science (Onwuegbuzie & Leech, 2007).

Terblanche (2013) has pointed out that it is important for educators to support and nurture girls' interest in science and related careers. Research has also shown that educators play a critical role in young girls' decisions to pursue careers in science (Tan et al., 2013). This showed that educators' praise, expectations, attention and criticism often differ according to sex of the learners (Mulemwa, 2000; Nyarko, 2012). Their view was also supported by Limo and Morogo (2013), who indicated that educators are biased in their perception of the scientific ability of their learners, believing girls to lack scientific skills. This message might cause young girls to develop negative attitudes and the lowering of motivation towards science.

Educators have a primary responsibility in education to help learners to cultivate personal qualities of motivation that can give them courage to develop hope (Durant,

2011). Being motivated to learn requires steady encouragement and support from stakeholders, including parents and educators (Changeiywo, Wambugu, & Wachanga, 2010). Such motivation is unlikely to develop in a chaotic atmosphere, so it is important to build a good relationship between Department of Basic Education, parents and educators in order to improve the performance of a girl learner in the FET phase. Educators can also focus more on the social relevance of science and technology and play a role in improving the image of science and technology, and jobs in those sectors, by using male and female role models (Ufuophu-Biri, 2014).

Durant (2011) suggests that educators should invite women or older learners who can serve as role models in science to be guest speakers or tutors. This, according to Christidou (2011), teaches learners that struggle and eventual success are normal. A role model who communicates this may serve as a greater inspiration to persist through difficulty than someone for whom achievement appears effortless (Archer, DeWitt, & Willies, 2014).

Limo and Morogo (2013) indicate that educators should have expertise to teach the subject they are teaching and should encourage all learners, irrespective of gender, to participate fully and engage in all activities in class. In England, for instance, surveys indicate that there is a considerable imbalance within the science teaching community in the subject specialisation of science educators which is weighted heavily towards a specialist in biology (Dillon, Osborne, Fairbrother & Kurina, 2000). Teacher subject knowledge is determinant of effective teaching and this has a great impact on motivating learners to pursue a subject.

Christidou (2011) suggested that educators and the environment in which they work, define and establish structures within which learners derive strategies enabling them to adjust to learn. For female learners, these structures might inhibit and delimit the learners' effective learning of Physical Sciences. In Nigeria, for example, Alele-Williams (1987) asserted that girls are discouraged from participating in Physical Sciences by predominantly male science educators. Machingambi (2013) discovered

that while educators interacted more with girls than boys on social dimensions of classroom life, boys received frequent interaction than girls.

The transmission of the educators' expectations to the learners', the particular topics that are covered in the lessons, and the strategies and tactics within strategies adopted by the teacher may motivate learners to study science (Archer et al., 2014). Furthermore, Osborne and Dillon (2008) indicate that there are common aspects of teaching that are perceived to be effective by both educators and learners with regard to motivation and attitudes. These were:

- Clear goals for learners' learning;
- Clarity of communication of lesson goals and agenda to learners';
- Use of preview and review of lesson content;
- Helping learners to contextualize content in terms of their own experience and knowledge, as well as in terms of other teaching goals and learning experiences;
- Some willingness to allow learners to have input into goal and agenda setting;
- A supportive social context designed by the teacher to help learners feel accepted, cared for and valued;
- An ability and willingness to allow for different cognitive styles and ways of engaging with the learning process among pupils, through multiple exemplification, and the use of different types of illustrations and modes of presentation, and offering learners a choice from a menu of possible ways of engaging; and
- A willingness to take into account learners' circumstances and to modify, pace, and structure learning tasks accordingly.

Progress of girls in school is often hampered by teacher attitudes and gender-biased textbooks that reinforce gender stereotypes (Terblanche, 2013). Regardless, educators have a big role to play in encouraging girl learners to pursue the scientific field. Halat (2010) has posited that the educators and the environment in which they

work, sometimes supportive, sometimes not, define and establish structures within which learners derive strategies enabling them to adjust and learn. For female learners, the structures established by the educators might inhibit and delimit the learners' effective learning of Physical Sciences. Alele-Williams (1987) has asserted that girls are discouraged from participation in Science, Technology and Mathematics education in many African states, including South Africa, by predominantly male educators.

### **2.5.6 Effect of learning environment**

The learning environment plays a vital role in encouraging or discouraging learners to study. Girls need to experience a caring learning environment in their Physical Sciences classes. Stemmer (2004) indicated that girls' interest in Physical Sciences is prompted by a well-balanced environment which incorporates their experiences as well as support from educators and adults. This was supported by Wadesango, Chabaya, and Rembe (2011) who indicated that the attitude of educators, parents and classmates as well as the level of confidence of girls in their science skills determine the often observed gender gap in science education. By creating safe and gender-sensitive learning environments, it should be possible to remove a major hurdle to girls' participation in Physical Sciences.

Lyons (2005) showed that the different learning goals of girls and boys leave girls at a disadvantage in competitive environments. Boys and girls preferred a Physical Sciences curriculum that enabled them to work at their own pace as their reasoning was different. Girls might have valued experiences that allowed them to develop their own ideas since their aim was to gain understanding. Boys, on the other hand, may have emphasised speed and accuracy and saw these as indicators of success. Boys were able to function well in a competitive environment of text-book based Physical Sciences learning (Christidou, 2011).

Literature indicated that a safe, secure classroom and school environment is conducive to learning. Oyamo and Amoth (2008) suggest that girls' learning styles

tend to differ from those of boys and gender equity in education is dependent on ensuring that the classroom and school environments are safe for girls. Part of making the school and classroom environment safe, secure and conducive to learning should entail investing, understanding and utilising suitable teaching-learning methods for girls.

In their study about assessment of the implementation of gender equity policies in schools in South Africa, Wadesango, Rembe and Chabaya (2011) found that girls continue to be disadvantaged by the fact that classroom practices continue to favour boys and marginalise girls. This study showed that some school environments do not promote favourable conditions for learning for girls as they are affected by sexual violence (Wadesango et al., 2011). Changes in science-related attitudes are associated with developmental change in gender identity (Middleton, Dupuis, & Tang, 2012). During high school years girls begin to firmly establish their feminine identity and thus become susceptible to social and environmental pressures that undermine their self-confidence and performance in male-dominated subjects like Physical Sciences. Archer et al. (2014) argued that the learning environment that learners face in high school may interact with adolescent development changes in ways that may result in low interest in Physical Sciences.

Numerous studies have tried to identify the aspects of the schooling environment that contribute to the gender difference in Physical Sciences performance (Mulemwa, 2000; Muola, 2010 & Pintrich, 2011). Existing research has concentrated on three general features of the schooling experiences namely organisational characteristics of learners and classrooms, social interaction within the school (between learners and school authorities, or among learners themselves) and methods of assessment and curriculum content (Middleton, Dupuis, & Tang, 2012).

Classroom interaction has emerged as a factor in explaining the gender gap in Physical Sciences (Chikuvadze & Matswetu, 2013). Studies have found that boys' use of verbal and non-verbal language tends to command more of the teacher's time

in both attention and classroom control. Furthermore, boys are more mobile in the classroom than girls, and this tends to influence some educators' beliefs that boys are more competent than girls. Curricular materials used in the schools have also been singled out as an influencing factor in the study of Physical Sciences. For example, in some textbooks women are portrayed as insignificant or invisible as compared to men who dominate texts, and are referred to as pioneers and great scientists (Dabula & Makura, 2013).

Even though there is a tendency among low social economic status schools to practice gender chauvinism against female learners (Botma et al., 2011), it is believed that when the school environment is enriching and stimulates positive attitudes, female learners will achieve higher grades (Zamrud, 2008). Schools with less provisions, fewer educators, poor school buildings and inadequate facilities for female learners will have a negative influence on the attitudes and academic achievements of female learners (Vedder-Weiss & Fortus, 2013).

The World Education forum which was held in Dakar, Senegal in 2000, concluded that countries should increase the admission, completion and transition rates of girls to equal those of boys (World Economic Forum, 2000). The forum concluded that countries ought to remove legislative hindrances to the participation of girls and women in education, create safe learning environments for girls and women inside and outside school, institutionalize affirmative action to enhance their access to education, especially in science and conduct gender awareness campaigns and training for parents, educators and education managers. Thus, the learning environment, the content, processes and context of education must be free of gender bias, and encourage and support equality and respect. This includes educators' behaviours and attitudes, student interactions, textbooks and curriculum. Aguele and Agwa (2007) suggested that in order to improve upon the participation of women in Physical Sciences, communities should empower them economically and integrate them into the mainstream of national development. There should also be restructuring of undergraduate curricular to include more investigative learning,

technology, laboratory experience and collaborative work and girl learners should be provided an opportunity to engage in hands on real life projects.

In their study about differences between boys and girls in extracurricular learning settings, Batz, Wittler and Wilde (2010) indicated that girls show a higher degree of intrinsic motivation in extracurricular outdoor learning. Motivation and expectations of learners, their prior knowledge, their interests and beliefs, determine whether they are intrinsically or extrinsically motivated. What is more important, though, is that interest in a particular learning area plays a significant role in motivation (Bang & Baker, 2013).

Research findings have shown that the pattern of learners' interaction inside and outside the classroom has significant effects on their interest and achievement in science (Hannula, 2010). In terms of the classroom, the individual child is motivated not only by personal basic influences but also by the stimulation provided by peers. Outside the classroom, one factor that seems to affect learners' interaction is the effect of social class stratification. Gender related aspects in out of school learning are mostly neglected, even though at school the differences between boys' and girls' cognitive achievement are evident, (Batz, et al., 2010). As a result, social class and the environment have a big influence on who studies science and these can be exacerbated by lack of motivation, inside and outside the classroom.

Researchers, internationally, have undertaken studies in various contexts examined factors that influence gendered achievement in Physical Sciences. Many studies have focused on factors related to differences in the performance of boys and girls in Physical Sciences and Mathematics (Abiam & Odok, 2006; Mahlomaholo & Sematle, 2005; Opolot-Okurut, 2005; Zhu, 2007). There are differences in ways boys and girls learn and the content of science education reflected in gender curricula and textbooks which are not related to women and girls' concerns and interest (Mutemeri & Mugweni, 2005; Wadesango et al., 2011). Therefore, if they don't have interest in

Physical Sciences, their achievement might be low. As a result, they might not participate in science because the content is not relevant to their lives.

One body of research comes from feminist researchers who have tried to make meaning of the experiences of girls and boys in the Physical Sciences classrooms, and to interpret male-female power relations (Trumper, 2006). These findings revealed that often girls are marginalised and given a subordinate status in the Physical Sciences class. The findings suggested that perceptions of educators were that girls' performances in Physical Sciences were dependent on rote learning, hard work and perseverance rather than natural talent, flexibility and risk taking which were the learning styles of boys. Educators were also of the view that girls learnt Mathematics whilst boys know Physical Sciences. Such studies argued that hegemonic masculinity is played out in Physical Sciences classes in that the behaviour of some boys negatively impacts on the ability of girls to learn, and those girls who perform well in Physical Sciences, experience the Physical Sciences class as outsiders (Pintrich, 2011).

According to Fennema and Franke (1992), gender differences in Physical Sciences teaching, learning and achievement have been explained on the basis of gender differences in cognition and brain lateralisation. In a similar argument, Pintrich and Zusho (2007) argued that male and female learners do experience the world in different ways because they are differently positioned in society and because their different learning styles and how they perceive and process reality. These researchers emphasise that most Physical Sciences classroom discourse is organised to accommodate male learning patterns, hence their participation in this subject. These differences may have implications for the kind of instructional procedures adopted for appropriate teaching and learning Physical Sciences instruction that is suitable to both genders (Lawson, Banks, & Logvin, 2007).

Fennema and Franke (1992) reported that educators treat male and female learners differently and the treatment favours male learners. Other studies have shown that

many educators, especially males, view Physical Sciences as a male domain and convey this attitude both directly and indirectly to learners (Chikuvadze & Matswetu, 2013). It will be difficult in this study to support or refute these findings because boys are not part of the study and there will not be lesson observations.

## **2.6 Summary**

This chapter has provided a summary of studies in Physical Sciences in relationship with the topic under investigation. From the literature it became evident that there are challenges in respect to girls' involvement in science. The government, educators and parents have a role to play in promoting the involvement of girls in the study of Physical Sciences. The literature review provided various reasons that contribute to girls' perceptions, beliefs and interest in Physical Sciences. The origin, nature of science and cultural background also influence girls' choice of Physical Sciences. The next chapter will explain methodology in detail, including design, sampling, data collection and analysis.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1. Introduction**

In the previous chapter, the ideas of different scholars and researchers were presented in line with the research questions. This chapter describes the process by which data on what motivates girls to choose Physical Sciences as one of their subjects in Grade 10 was collected so as to achieve the objective of the study. The research methodology, design, sampling and data analysis are described.

#### **Research paradigm**

This study used the qualitative paradigm. The qualitative paradigm (De Vos, Strydom, Fouche, & Delport, 2005) refers to research that elicits participants' accounts of meaning, experience or perceptions. A qualitative research paradigm was employed since the purpose of this study was to explore factors which motivate girls to choose Physical Sciences in Grade 10. This paradigm was chosen so as to understand the learners' feelings and experiences in Physical Sciences classes from their own point of view. Data collected in qualitative studies is descriptive and, as such, is in the participants' spoken words. Furthermore, this paradigm acquires data in the form of words rather than numbers (McMillan & Schumacher, 2012). The rationale for using this paradigm was to explore and describe factors which motivate girls to choose Physical Sciences in Grade 10. Therefore, the qualitative paradigm was seen as the most appropriate way to capture their experiences.

The qualitative paradigm was used for the following reasons:

- Data was obtained in a natural setting and not in researcher-controlled environments under researcher-controlled conditions as is the case in a quantitative study (McMillan & Schumacher, 2012);

- Most of the descriptions and interpretations in this study were portrayed in words rather than numbers (De Vos et al., 2005).
- The qualitative paradigm is a form of social inquiry that focuses on the way people interpret and experience events and the world in which they live. According to McMillan and Schumacher (2012), a number of different approaches exist within the wider framework of qualitative research, but most of these have the same aims, namely, to understand the social reality of individuals, groups and cultures. This is opposed to a quantitative approach which involves numerous respondents with the aim of explaining or confirming the cause of relationships and hence generalising results to the whole population (Straker, 2001). Thus, the qualitative approach was chosen for this study to explore the behaviour, perspectives and experiences of the participants regarding factors which motivate them to choose Physical Sciences. This is in line with a contention by Holliday (2007) who points out that the basis of qualitative research lies in the interpretive approach to social reality; and
- A qualitative paradigm allows the researcher opportunity to concentrate on a specific instance or situation (Cohen, Manion, & Morrison, 2013) in this case, factors motivating girl learners to study Physical Sciences.

### **3.2. Research design**

A research design is the plan according to which relevant data is collected (Bassegy, 2009). This research followed a case study design. Creswell (2013) explains a case study as a story about how something exists within a real world context that is created by carefully examining an instance. The advantage of a case study, according to Cohen, Manion and Morrison (2013), is that data is drawn from peoples' experiences and practices and seen to be strong in reality. According to Macmillan and Schumacher (2012), in case study designs, the data focus on one phenomenon or event regardless of the number of participants in the study.

An explorative case study design was used in this study in order to clarify the research questions that guided the entire research. A case study focuses on an intensive examination of a particular group (Creswell, 2013). The group in this research was made up of girls who studied Physical Sciences and those who intended to study Physical Sciences. The design was viewed as the best design because it provided an opportunity to understand the participants' experience from their perspective. Understanding was acquired by analysing the many contexts of the participants and by narrating participants' meanings, which included their feelings, beliefs, ideas, thoughts and actions regarding their choice of Physical Sciences (McMillan & Schumacher, 2012).

Thomas (2013) indicated further that the advantage of a case study is that, data is drawn from peoples' experiences and practices and seen to be strong in reality. Because the data contained in case studies is close to people's experiences, they can be more persuasive and more accessible. In a case study design (Cohen, Manion, & Morrison, 2013), the data focuses on one phenomenon which is selected in order to understand it in depth, regardless of the number of participants for the study. As such, case studies give explanations underlying links in real life.

Thomas (2013) outlines the following types of case study research:

- *Intrinsic case study*, also called the *descriptive case study*: where the interest is to gain a better understanding of a particular case;
- *Explorative case study*: explores situations where there is no single outcome; and
- *Explanatory case study*: explains causal relationships.

The exploratory design was the most appropriate design for this study because this study aimed at exploring factors which motivate girls to study Physical Sciences in Grade 10.

However, case studies do have some disadvantages. One of the main criticisms is that the data collected cannot necessarily be generalised to the wider population (Bell, 2010). This leads to data being collected over longitudinal case studies not always being relevant or particularly useful.

### **3.3. Research population and study sample**

One of the crucial stages of the research process is deciding on a research population and study sample for a study. The choice of the population and sample is likely to influence generalisability or external validity, which can also be described as comparability, translatability of the study results (Cohen, Manion, & Morrison, 2013). A population is any group that is the subject of research interest (Melville & Goddard, 1996). For the purpose of this study, 14 secondary schools in the Rakwadu Circuit formed part of the population in this study.

In terms of geographical location, the Rakwadu circuit is situated in the east of the Greater Letaba local municipality in the Mopani District. The circuit stretches from Sekgopo cluster to Kgapane cluster. The schools are situated in Sekgopo village near Modjadjiskloof in the Greater Letaba Municipality. The circuit was chosen because it was observed that there is a low percentage of girls who study Physical Sciences. The three schools in which the research was conducted are located within a radius of 25 kilometres of Greater Letaba Municipality. The target population of this research study was Grade 9 and 10 learners in Rakwadu circuit.

#### **3.3.1. Sampling**

Sampling is a process of selecting a group of individuals to participate in a research (Cohen et al., 2013). Sampling guides researchers to choose in an appropriate way, the restricted set of individuals from which actual information can be drawn. The aim of sampling is to save time and to obtain consistent and unbiased information of the population status in terms of whatever is being researched.

There are two types of samples, probability and non-probability samples (Burton, Brundrett & Jones, 2008). A probability sample was deemed not appropriate for this study because the results could be generalised from the sample to the population. The non-probability sample was used because it does not allow the study's findings to be generalised from the sample to the population (Creswell, 2013). When discussing the results of the non-probability sample the findings were limited to the girls sampled. This procedure did not allow for calculation of sampling statistics that provide information about the precision of the results. Due to the fact that this study did not intend to generalise beyond the sample, the non-probability sampling methodology provided the desired information.

According to Creswell (2013), there are three common types of non-probability sampling, that is, convenience sampling, quota sampling, and purposive sampling. Purposive sampling was used to identify those girls who were studying Physical Sciences and those who intended to study Physical Sciences in Grade 10. Purposive sampling is based on the assumption that the investigator wants to discover, understand and gain insight and therefore must select sample from which the most can be learned. The sample consisted of 24 girls of whom 10 were studying Physical Sciences in Grade 10 and 14 were in Grade 9 and had intentions of studying Physical Sciences in Grade 10.

Grade 9 and Grade 10 girls in secondary schools in the Rakwadu circuit, Sekgopo cluster were purposefully sampled to participate in this study. This cluster has three senior secondary schools and one junior secondary school. Three secondary schools constituted the study sample because Physical Sciences is offered from Grade 10 to Grade 12. These schools were of particular interest because they are rural, dominated by boys in the studies of Physical Sciences and have more male educators teaching this subject. Participants were not selected randomly but purposively selected because they could provide reliable information needed for this study, that is, factors motivating girls to choose Physical Sciences in Grade 10 (Onwuegbuzie & Leech, 2007).

### **3.3.2. Study sample**

In qualitative research, the focus is the quality of information obtained from the participants rather than on the size of the sample (Thomas, 2013). There is no need (De Vos et al., 2005) to determine the number of participants at the beginning of the research because the goal is not to generalise the findings.

All Grade 9 participants (girls) who were intending to study Physical Sciences in Grade 10 participated in this study. In Grade 10, I sampled all the girls who were studying Physical Sciences at the time of the study. The samples were then combined to form the total sample from the whole population. The participants were able to give information pertaining to factors motivating them to choose Physical Sciences in Grade 10. As a result, the sample consisted of twenty four girls.

In Grade 10, there were a total of ten girls studying Physical Sciences in the three schools. All the ten girls studying Physical Sciences participated in this study. Grade 9 classes in the three schools had a total of 216 learners of which 145 were girls. Out of 145 girls, fourteen were intending to choose Physical Sciences in Grade 10 and all of them participated in the study. The remaining 131 girls did not have any interest in choosing Physical Sciences in Grade 10 and as such they did not form part of the sample. Participants were identified by random numbers and the schools they attended (A, B & C), for example, learner number 1 from school A was identified as L1A, learner number 1 from school B was identified L1B and learner number 1 from school C was identified as L1C.

### **3.4. Data collection**

According to Creswell (2013), data refers to materials researchers collect from the world they are studying. There are different methods and techniques of data collection. Two methods were used for collecting data in this study. These were interviews and document analysis. These methods were used to collect data from the sample that was described above. These methods were also employed to

triangulate the data collected and to increase trustworthiness. The interviews intended to prompt ideas behind participants' choice of Physical Sciences whereas document analysis sought to help uncover meaning, develop understanding, and discover insights relevant to the research problem. These methods for collecting data were chosen so as to gain insight and a better understanding of the topic under study.

#### **3.4.1. Document analysis**

Document analysis is a systematic procedure for reviewing or evaluating documents from both printed and electronic material (Thomas, 2013). The documents analysed included learners' class work books, assignments, practical tasks, tests and textbooks. These documents were used because they contained authentic texts that have been recorded without a researcher's intervention. Like other logical methods in qualitative research, document analysis requires that data be examined and interpreted in order to prompt meaning, gain understanding, and develop empirical knowledge (McMillan & Schumacher, 2012).

Document analysis and interviews were chosen so as to provide a confluence of evidence that breeds credibility. By examining information collected through different methods there was corroboration of findings across data sets and thus reduced the impact of potential biases. A checklist (Annexure H) was developed to examine these documents. This checklist was developed to see whether the school environment, including educators and peers, motivated the participants in this study. The contents of the documents were later compared with data gathered during the interviews.

#### **3.4.2. Interviews**

Babbie and Mouton (2009) define an interview as an interaction between an interviewer and a respondent in which the interview has a general plan of the inquiry where questions are asked in particular words and particular order. A qualitative interview is essentially a conversation in which the interviewer establishes a general

direction for the conversation (Cohen et al., 2013). Ideally the respondent does most of the talking. Even though the interview has some drawbacks, Brink, (2006) highlighted the following advantages:

- the subjects need not be able to read or write;
- responses can be obtained from a wide range of subjects (almost all segments of the population);
- non-verbal behavior and mannerisms can be observed;
- questions may be clarified if they are misunderstood; and
- in-depth responses can be obtained.

Semi-structured interviews were conducted using a list of questions on specific topics as an interview guide (Annexure F and G). The advantage of a semi-structured interview is that questions may not follow on exactly in the way outlined on the schedule (Denzin & Lincoln, 2011). Questions that were not included in the interview guide were asked because the researcher observed things from the documents which needed more clarity during interviews. This showed the importance of triangulation. The interview allowed participants to express their views without limitations (Holliday, 2007). Semi-structured interviews are more flexible because they allow for a depth of feeling to be ascertained by providing opportunities to probe in order to expand the interviewee's responses.

While collecting data from the analysis of documents, some questions arose that could only be clarified by participants during interviews. These questions were then incorporated into the original interview schedule. This resulted in the re-organisation of the interview schedule so that participants could clarify issues which could not be clarified by only analysing the documents.

The participants were interviewed individually, privately and without any distraction, so as to encourage free participation without any kind of intimidation. The Grade 10 participants were interviewed using a set of questions and Grade 9 participants also had their own set of questions. The interviewees were given sufficient time to respond to the interview questions. Each interview session lasted an average of forty five minutes as recommended by Shahid et al. (2009) so as to give participants sufficient time to minimize anxiety. All interviews were tape recorded in order to enhance the accuracy and trustworthiness of the data collected and later transcribed verbatim.

### **3.5. Data analysis**

Qualitative data analysis is a systematic process of coding, categorising and interpreting data to provide for explanations of a single phenomenon or event of interest (McMillan & Schumacher, 2012). Data analysis begins with a large body of information that is gradually reduced to small set of abstract underlying themes through inductive reasoning (Leedy & Ormrod 2005). The analysis of data started when the first piece of data was collected. The analysis at this stage involved the synthesis of what the participants were informing the researcher. This approach allowed for the build-up of questions to ask participants as follow-up questions during interviews.

Data from the interviews was transcribed verbatim and extensive notes were also taken during the interviews. According to Thomas (2013), when transcribing data, text from interviews or observation is typed into word processing document. The information gathered from these interviews was subjective, although an attempt was made to present an account from various perspectives and levels within the schools. Interview transcripts and written notes were analysed systematically through iterative reading. This made it possible to gain an increasingly deep understanding of each interviewee's viewpoint and perspective, of links and contradictions within and across interviews, of complex contextual factors emerging from the interviews and of the many relationships between the relevant concepts.

Data from the interviews and documents was analysed thematically. The process of thematic analysis involved identifying themes and categories which emerged from the data. Themes are patterns across data sets that are important to the description of a phenomenon associated with the research questions (Thomas, 2013). These themes become categories for analysis. This was done in order to provide a narrative account of findings (Creswell, 2013). The themes were generated inductively from the raw data through reading and re-reading the transcripts. Data from document analysis was obtained based on the checklist in order to determine whether motivation factors were depicted in learners' scripts and exercise books.

By locating meaningful segments, the data was coded using inductive coding. Wesley (2010) indicates that in inductive coding, codes are developed by directly examining the data. Coding and categorising were generally initiated as soon as data collection began. Coding, as highlighted by Brink (2006) was used to organise data collected from interviews and documents. Data analysis (Creswell, 2013), was in-built and continuous throughout the study. This was executed as follows:

- a) Transcribing all the recorded interviews verbatim;
- b) Reading and re-reading the transcribed interviews and documents to make meaning of the data;
- c) Coding the units of meaning identified;
- d) Grouping related codes into categories; and
- e) Grouping the categories into themes.

### **3.6. Trustworthiness**

Trustworthiness (Boudah, 2011) is how a researcher convinces the audience that the findings described are credible and provide conclusions that are appropriate and fully developed. Ensuring trustworthiness in qualitative research is important because qualitative research has been criticised for lack of credibility (Bassegy, 2009). Therefore, it was important for me to devise strategies to minimise threats so that the

results can be credible. However, it is important to acknowledge that trustworthiness in research cannot be brought about by methods (Brinberg & McGrath, 1985). This means that trustworthiness is not a product but rather it is a goal that researchers strive to achieve.

The process of data verification was carried out according to Guba’s model of trustworthiness as described by Krefting (1991). The strategies carried out in this study to ensure trustworthiness are listed in Table 1 and conform to the strategies in Guba’s model of trustworthiness.

**Table 1: Threats to Trustworthiness and Strategies Employed to Minimise the Threats**

Threat to trustworthiness	Strategy
1.Participants providing information for the sake of making the researcher happy	<ul style="list-style-type: none"> <li>• checking</li> </ul>
2.Participants concealing vital information	<ul style="list-style-type: none"> <li>• Prolonged engagement</li> </ul>
3.Researcher bias	<ul style="list-style-type: none"> <li>• Neutral and-open ended interview questions were used</li> <li>• During data collection no statements showing preferences of the aspects investigated were mentioned</li> <li>• Participants were allowed to talk freely about their experiences with no interjections from the researcher</li> <li>• During data analysis, no cases were given priorities over others</li> <li>• Analysis was based on verbatim transcripts and what was observed in documents</li> </ul>
4.Reactivity	<ul style="list-style-type: none"> <li>• Personal observations</li> </ul>

	<ul style="list-style-type: none"> <li>• Informal conversations</li> <li>• Mindfulness of the environment of participants</li> </ul>
5.Limitations	<ul style="list-style-type: none"> <li>• Data was collected through interviews and document analysis for triangulation purposes.</li> </ul>

### 3.7. Ethical considerations

Conducting research requires not only expertise and diligence, but also honesty and integrity (Boudah, 2011). Within the context of this study, participation was purely on a voluntary basis and necessary permission was granted from the participating schools (Annexure B) and the Department of Basic Education in Limpopo (Annexure A) and permission to conduct the study was granted by the University's Research Ethics Committee.

Participants' in this study were all minors. As a result consent letters (Annexure C) were issued to their parents/guardians so that they could grant permission for their children to participate in this study. Parents' letters were written in Sepedi, in cases where the parents were not conversant with English. Participants' consent (Annexure D) was obtained before the interview process started. Informed consent is the prospective participants' agreement to participate voluntarily in a study, which was reached after integration of essential information about the study (Rubin & Babbie, 2008). The participants were informed of their rights to voluntarily consent or decline to participate, and to withdraw participation at any time without penalty. Participants were then informed about the purpose of the study, the procedures that would be used to collect the data, and assured that there were no potential risks involved. Interviews were conducted after the participants signed a consent form.

To render the study ethical, considerations for rights to anonymity and confidentiality were observed (McMillan & Schumacher, 2012). Anonymity and confidentiality were maintained throughout the study. Creswell (2013) defines anonymity as when

subjects cannot be linked with his or her individual responses. In this study anonymity was ensured by not disclosing the learners' personal details and the school they attend on the research reports.

Scientific honesty is regarded as a very important ethical responsibility when conducting research. Dishonest conduct includes manipulation of design and methods, and retention or manipulation of data (Thomas, 2013). The open-ended questions which were analysed were also checked by the supervisor for confirmation of credibility.

### **3.8. Limitations**

The main focus of this study was to explore factors that motivate girls to study Physical Sciences. This study was limited to Grade 9 and 10 girls who were studying Natural and Physical Sciences respectively. This study only focused on secondary schools in the Rakwadu Circuit in Limpopo province. Primary schools were not part of the study because in primary schools, all subjects are compulsory and Physical Sciences is only taught from Grade 10.

Due to time constraints, only two qualitatively oriented types of data collection instruments were used, interviews and document analysis. Due to financial constraints, the research was restricted to only three secondary schools in the Sekgopo cluster of Rakwadu Circuit. If more schools were involved in the research, different findings might have emerged in the same circuit. The study was only conducted at Rakwadu Circuit in the Mopani district of Limpopo Province. Possibly different findings might have existed at provincial level if the study was extended to the other districts of Limpopo Province. The results of the study cannot therefore be generalised to a larger, provincially-based population.

### **3.9. Summary**

This chapter discussed the research design and methodology employed in this study. It explained how the research was conducted in order to find out what motivated girls to study Physical Sciences. The chapter also provided ample justifications for the techniques used to gather data in this circuit. The method allowed and facilitated systematic data collection, recording and analysis. Ethical issues, delimitations and limitations were also discussed.

## CHAPTER FOUR

### RESULTS

#### 4.1. Introduction

The previous chapter presented the methodology of the study and explained the research design, population and sampling procedure which were followed. In this chapter results of the study will be presented.

#### 4.2. Demographic profile of respondents

The three schools had a total of fourteen girls in Grade 9 who intended to study Physical Sciences in Grade 10 and ten girls in Grade 10 who were studying Physical Sciences at the time of the study. The average age of participants was 16 years and 15 years for Grade 10 and Grade 9 girls, respectively. All these participants came from families with an average of five children.

From the sample, five (21%) of the participants did not have parents, while ten (42%) had a mother only, two (8%) had a father only and seven (29%) had both parents. Twenty three of the participants' parents/guardians did not have basic education and most of them were unemployed. Those who were employed were working either as domestic workers or unskilled farm workers. Only one of them had a father who was a teacher and the mother a nurse.

The data was independently sorted and responses from the learners were compared with what was observed in the documents. In sorting the responses, statements projecting similar ideas were grouped together. For example, a statement like, "*... we usually receive help from our Physical Sciences educators...*" was grouped together with a statement like "*... my teacher helps me by making me understand concepts which he sees I'm struggling with ...*" The sorting process was followed by initially cross-checking common ideas. Out of this process three distinct themes emerged.

These themes will be discussed under data interpretation and were interpreted to represent rationale for subject choice, support versus lack of support at all levels and measurement of achievement.

### **4.3. Results from interviews**

Interviews were conducted in order to understand reasons that motivate girls to choose to study Physical Sciences. Twenty four learners were interviewed. The findings of the study from the interviews are presented according to the research questions, under the following headings:

- What are the attitudes of girls towards science?
- How does the learning environment surrounding learners, influence their motivation in Physical Sciences learning?
- What is the role of families in motivating learners to study sciences?

#### **4.3.1. The attitude of girls towards Physical Sciences**

These participants revealed that they had a positive attitude towards Physical Sciences. A common view amongst the participants was that Physical Sciences is fun and they enjoyed studying it. Participants' statements:

L1A: *"Physical Sciences is an interesting subject and I enjoy learning it. I understand when my teacher teaches me about science concepts. I know there are opportunities and that I will get a good paying job and get money. I can get a bursary or scholarship to further my studies at university"*.

L2B: *"I always wanted to study Physical Sciences. People said it is a difficult subject but I see it as the simplest. Unlike Mathematics, Physical Sciences is simple and I understand it more than Mathematics. I pass the tests and assignment very well. Physical Sciences is an enjoyable subject to me"*.

One learner indicated that she initially chose History as one of her subjects but later changed from the History stream to the science stream.

L2C: *“I think I was motivated by reading an article about analytical chemistry. At first I wanted to study History and study law at the university.....but that newspaper opened my eyes, I think I was motivated by it. Physical Sciences became interesting to me and we learn about things which are practical, things we can relate to everyday”.*

Grade 9 learners indicated that learning Natural Sciences prepares them for Physical Sciences. They specified that since Natural Sciences is enjoyable and interesting to them, they hoped Physical Sciences would be interesting and enjoyable.

L4C-IS: *“Natural Sciences is an interesting subject and I perform very well in it. I think NS prepares us for Physics and I know I will enjoy and achieve well in Physical Sciences as much as I do in Natural Sciences so I love Physical Sciences”.*

This view was echoed by another participant who said, L3B-IS: *“I like it. Natural Sciences is fun and enjoyable and even Physical Sciences will be fun. There are many career opportunities for those who study Physical Sciences and I know that if I do well I can get a bursary and go and study at the university and I will then get a good paying job”.*

### **Future career**

It was found that participants chose Physical Sciences based on the career they want to pursue. Future career was the most common reason for their choice of Physical Sciences for the majority of girls. When participants were asked why they chose Physical Sciences, all of them commented that it is a prerequisite for the careers they wanted to pursue. The following table (Table 4) presents the summary of careers these participants preferred.

**Table 2: Careers that learners want to pursue**

<b>Anticipated future career</b>	<b>Number</b>	<b>Percentage (%)</b>
Engineer	8	33.33%
Doctor	7	29.16%
Pilot	3	12.5%

Pharmacist	2	8.33%
Optometrist	1	4,16%
Biotechnologist	1	4,16%
Nurse	1	4,16%
Analytical Chemist	1	4,16%
Total	24	100%

Some of the participants' responses on what motivated them to choose Physical Sciences are presented here below:

L4A: *"I chose Physical Sciences because I want to be a medical doctor. For me to do medicine I must have Physical Sciences as one of the subject because this is a prerequisite for entrance into medicine".*

L3C: *"I chose Physical Sciences because I want to do civil engineering at the university, I attended career guidance and it was interesting to see what civil engineers do. It's really interesting".*

L2B: *"I chose Physical Sciences because I want to be a doctor and again because I know I am good at it".*

### **Career guidance**

Participants indicated the importance of career guidance. Attending career guidance workshops motivated learners to study Physical Sciences.

L3B: *"We attended career guidance at Polokwane showground and I saw what civil engineers do. I liked what they do and I want to be like them one day".*

L2C: *"I learnt about this when I visited my aunt in Tembisa. She took me and my cousin to career exhibition at the Rand Easter Show last year and this is when I knew what biotechnology is and what they do".*

## **Importance of science**

The interviews showed that girls appreciated the importance of science. According to these girls, they chose Physical Sciences because they viewed it as an important subject and that it makes great difference in the world.

*L1A said: "Science is important because we learn to understand how things were invented and how things work. Our lives these days depend on science and technology. I think science makes us to understand our world".*

*L1C added: "I think is important because you can choose any career you want. At universities if you have done Physics and Mathematics they don't hesitate to admit you, I think we learn more things in science".*

*L3B-IS: "I think everything in the world depends on Physical Sciences, Mathematics and Technology that's the reason we have many inventions".*

*L4C-IS said: "I think our lives wouldn't be the same if people were not studying Physical Sciences because, people who invent things use science in their inventions I think Physical Sciences is very important because one needs to study it before becoming a scientist. It is a prerequisite for most science careers".*

Participants indicated that they chose Physical Sciences because they felt that it was an important subject and they performed well. They also pointed out that there are more and better opportunities for those who studied science. This indicates how important Physical Sciences it is to them. They also indicated that the importance of Physical Sciences can be seen around us because of innovations all over the world. Such innovations show how importance of science is to the society.

### **4.3.2. Learning environment**

#### **Support from educators**

Participants indicated that the support they continually received from educators motivated them to continue studying Physical Sciences.

*L3B stated that: "When we were choosing subjects, my educators said I must choose Physical Sciences and Mathematics because they believe that I am capable*

*of performing well. They indicated that based on my performance in Grade 9, I should consider studying Physical Sciences, and I did”.*

*L1A said: “Our teacher supports us. When we don’t do well in a topic he stays with us after school so that we can understand, he makes efforts that we understand the concepts that he teaches us so that we can pass the test and assignments”.*

*L4A added by saying: “Our teacher is a nice person. He always wants the best from us. When we don’t understand something he stays with us so that we can understand. But sometimes is difficult when we have to remain after school and clean the classes while boys go home. There are four girls and the class is big, so we finish late and go home late”.*

### **Class environment**

The environment where learners studied was a concern to learners. Learners in Grade 9 highlighted that their classes have large enrolments. Those in Grade 10 indicated that they did not have libraries, laboratories or internet access and it becomes difficult for them to search information about science.

*L1A-IS said: “Our class has many learners, about 76. It is impossible for educators to recognise learners who have difficulties in learning. Educators concentrate more on learners who perform well in Natural Sciences and Mathematics, and forget about those who have difficulties”.*

*L3C-IS said: “There are about 68 learners in my class and we all do Natural Sciences, there are also other two classes with a number more or less the same number as ours, when we do an exercise or test the teacher will mark the work for a whole month, this discourages me a lot”.*

*L3B stated that: “I love Physical Sciences even if we don’t have a laboratory to do practical tasks. We use a class where there are no equipment to do experiments. There are a few equipment for science which are kept at the principals’ office and boys collect them when we are about to use them, I wish we could have a big laboratory with physics and chemistry equipment so that we don’t have one group doing the task while we watch”.*

*L2C said: "I think if we had a laboratory at school, more learners will join Physical Sciences. Physical Sciences has a lot of practical and sometimes it's difficult to understand concepts if you don't do experiment. If we are given tasks to search for information on the internet or library, we usually don't do the task because we cannot go to town for internet or library".*

### **Group work**

Participants indicated that working in groups was important to them. They mentioned that they supported and helped one another when they work in groups.

*L3A said: "Most of my friends who are not doing Physical Sciences say it's a difficult subject. Those who are in my science class, we help each other every time we have tasks to do at home. Sometimes we make our homework together here at school".*

*L1B: "I was in the History class before I could do Physical Sciences. When I switched to Physical Sciences class my friends from History class said I would fail. But the three girls who were in the Physical Sciences class were happy that I joined them".*

*L2A-IS said: "When we do practical tasks, we work in groups. Working in groups helps us to understand things quickly because there are those who are smarter than others and they can make you understand I can say that my educators support me a lot because they want me to choose Physical Sciences and Mathematics in Grade 10."*

*L4A also shared the same idea when she said: "There are four girls who are doing Physics and we always work together. We help each other and always work as a group. If we see that one of us is left behind we support her and help her. We always make our homework together at school".*

*L3A said: "Boys are always bossy and they always want to be group leaders but its fine to work with them because they understand some concepts faster. I think working in groups makes me not to forget things easily".*

On the contrary, L2C said: *“It is better to work with girls than boys because boys always want to take the lead. Girls agree on whom they want to be their group leader”*.

Participants in this study indicated that they received continuous support from educators. They also showed that peers assisted them even if some disliked working with boys. The importance of working in groups was also noticeable.

### 4.3.3. The role of family

When learners were asked if they get support from family when they choose subjects or when they do activities at home, about twenty two (92%) indicated that they did not get support from family members. Of the 24 participants interviewed, only two (8%) received some assistance from family members. The table below indicates the number of participants who received support from family members.

**Table 3: Support received by learners from family members**

Grade	Family support	Percentage	No family support	Percentage
Grade 9	None	0%	14	100%
Grade 10	2	20%	8	80%
Total	2	8%	22	92%

It is apparent from Table 3 that very few families gave support to their children and most families did not play a vital role in the education of their children. The percentages of those who had family support differ significantly with those who did not receive any support from their family members.

L2A said: *“.....because I know they won’t know the answer. My parents did not go to school and my sisters also don’t know Physical Sciences. They won’t know what I do”*.

L1A said: *“My family does not know what I’m doing. My mother did not go to school and my elder brother did not go further than Grade 7. He is working in Johannesburg now and he can’t know what I’m doing”*.

On the other hand L1C had a brother and sister who assisted her when they are at home during holidays. She said: *“When my brother and sister are at home during holidays, they are always helpful when I have assignments. They assist me a lot and I get high marks for such assignments. They are my role models and they have motivated me. I see them as successful people in the field of science and I want to follow into their footsteps. I think role models are important and as youth we can emulate them and aspire to be like them”*.

The most striking result to emerge from the data was that even though her parents gave her support, she defied their suggestion for her to choose a career. L1B whose parents are working, where the father is a teacher and the mother a nurse said: *“My father is a teacher, when I don’t understand some of the things or questions he helps me. But he does not know most of the thing because he is not a Physical Sciences teacher”*. My parents motivated me to choose the science stream. But I also wanted to choose science. My father wants me to do actuarial science but I want to be a medical doctor”.

These findings revealed lack of support from family members. Participants highlighted the importance of role models even though they did not have them. These learners showed that because they lacked financial resources, studying Physical Sciences would aid them in receiving bursaries and scholarships for tertiary education. L2B said: *“Maybe I will get a bursary to go and study to be a nurse at the university”*. This was implied by learners in other schools. For example, L3C indicated that, *“If you pass Physics and Mathematics well, you are likely to get a bursary to go to varsity”*.

However, it was found that participants do not approve assistance from either family members or educators when they are to choose subjects. When learners were asked whether parents or educators should assist them when they are to choose subjects, L3C said: *“No, I think learners must choose subjects they want but teachers must support learners on whatever they choose. Nobody should choose for us the*

*subjects because if they choose for us then they want to choose our future*". L1A-IS said: *"I think they should just support what the learners want to choose"*. The participants indicated that educators and parents should just support their choices of subjects and not choose subjects for them.

#### **4.4. Results from documentation**

Students' portfolios were analysed to find the actual work done and the communication between learners and educators. Learners' portfolios consisted of class work books, assignments and test scripts in both Grade 9 and 10. The checklist was developed for this analysis and was used to analyze the work of the girls (Annexure F).

##### **4.4.1. Marking**

In Grade 9, only five out of fourteen class work books were marked and signed by the educators. The other books were not marked by the educators but learners assessed each other's work and the educators did not sign or give any feedback. In Grade 10 all the learners' books were marked and signed by the educators. Assignments, tests and practical tasks were marked and signed for all the learners who participated in this study. There was feedback in learners' books, tests and practical tasks. The following table illustrates the comments by educators in learners' portfolios:

**Table 4: Verbatim feedback that learners received from educators**

✓ Poor results, bad effort
✓ Good effort better results
✓ Don't copy from others
✓ Well done keep it up
✓ This is irrelevant
✓ There is improvement in your work
✓ This is nonsense
✓ You show much improvement in your work
✓ If you continue like this you will never pass
✓ You can do better than this
✓ This can be improved

**4.4.2. Frequency of tests and assignments (Formal Tasks)**

The following table illustrates frequency of formal tasks in the three schools in Grade 9 and 10.

**Table 5: Frequency of formal tasks in schools A, B and C**

School	Tests	Assignments	Practical tasks	Investigations	Total tasks
A	2	1	2	0	5
B	1	1	1	1	4
C	3	1	1	1	6

The results, as shown in Table 5 above, indicate assessment which was given to learners through tests, assignments, practical tasks and investigations. It is important to mention that educators' portfolios were not scrutinised to check whether learners' marks are consistent with educators' mark-sheet.

#### **4.4.3. Cognitive level of the tests and assignments**

The cognitive level of questions was almost similar in the three schools. The questioning technique used by educators focused mainly on low order questions. In both grades, for instance, educators asked mostly questions like choose the correct answer, true or false and match column A with column B or fill in the missing words.

#### **4.4.4. Ambition**

The participants generally coped well with the work given in Physical Sciences. However, some Grade 9 learners had difficulty with the questions given. These questions requested learners to either fill in the missing words or to name structures in drawings. In Grade 10 learners performed in a manner that showed that they could achieve their personal goals because their performance in Physical Sciences was good with an average of 70%. Performance of Grade 9 girls in school A was not good because their average mark was 48%. In schools B and C, girls performed better because their average mark was 65% and 68% respectively.

#### **4.4.5. Gender biasing**

In all the three schools there was no sign of gender bias in activities given to learners. Gender sensitivity was observed during class work, practical tasks, assignments and tests. The following is an example of gender sensitivity on the part of educators:

*“Explain what you think will happen if one of the boys and girls in the above picture touches the wires”? (The picture showed girls and boys holding hands and playing next to an electric wire)*

Words used in such activities inspired inclusion of girls. In instances where names of people were used, both girls' and boys' names were observed. However, it was observed that the curricula mostly included the experiences of boys.

#### 4.5. Data Interpretation

After data was consolidated, the following themes and sub-themes emerged:

**Table 6: Consolidated Themes and Sub-themes**

Theme	Sub-themes
1. Rationale behind subject choice	<ul style="list-style-type: none"> <li>• Anticipated better future career</li> <li>• Existence of potential</li> <li>• Interest in the subject</li> <li>• Choice guided by career guidance</li> <li>• Availability of financial assistance at tertiary institutions</li> <li>• Importance of the subject</li> </ul>
2. Measurement for learners' achievement	<ul style="list-style-type: none"> <li>• Feedback received from educators</li> <li>• Interest and attitude in subject increased based on competency</li> <li>• Frequency of tasks and cognitive level</li> </ul>
3. Support versus lack of support at all levels	<ul style="list-style-type: none"> <li>• Continued support from educators</li> <li>• Lack of family support emanating from lack of knowledge</li> <li>• Support versus lack of support</li> </ul>

	<p>from friends and classmates</p> <ul style="list-style-type: none"><li>• Importance of working in groups</li><li>• Lack of role models</li></ul>
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#### **4.6. Summary**

This chapter presented the results obtained in this study. The chapter showed the reasons why learners chose to study Physical Sciences in Grade 10. Overall, these results indicate that participants had positive attitude towards Physical Sciences and that is the reason why they chose the subject. The results in this chapter also indicate that anticipated future careers influenced as another determinant of participants' choice of Physical Sciences. In the next chapter, the results and implications of the study will be discussed.

# CHAPTER FIVE

## DISCUSSION, CONCLUSION AND RECOMMENDATIONS

### 5.1. Introduction

The previous chapter presented results of the current study and the results were presented based on the research questions. This chapter discusses the data gathered during the study. In this chapter, the results and implications of the study will be discussed.

### 5.2. The purpose of the study

The main purpose of this study was to explore and identify factors that motivated girls to study Physical Sciences in Grade 10. This was obtained through interviewing girls in Grade 9 and 10 and analysing their portfolios. The findings are here discussed according to the themes that emerged.

### 5.3. Rationale for subject choice

The results of this study revealed justification of girls' choice of Physical Sciences as a subject. Participants indicated the following factors that motivated them to study Physical Sciences in Grade 10.

#### 5.3.1. Attitude towards Physical Sciences

With respect to the first research question, it was found that participants had positive attitudes towards Physical Sciences. On the contrary, Mogashoa (2015) discovered that learners have a negative attitude towards Physical Sciences. Murphy and Whitelegg (2006) argue that learners must be motivated to cultivate the right attitude towards Physical Sciences so that they could realise its significance later in life.

The participants indicated that they were competent and performed well in Physical Sciences and Natural Sciences and this motivated them to study the subject. According to Pintrich and Schunk (2002), motivation influences learning and performance and what learners do and learn influence their motivation. Participants' liking of Physical Sciences may imply that learners have a positive attitude towards this subject. As suggested by Kibirige and Tsamago (2013), learners' attitudes are critical to learning science and in developing motivation, and genuine interest in studying Physical Sciences. A negative attitude towards a subject may lead to lack of interest and a positive attitude may lead to greater effort which positively impacts on performance (Machingambi, 2013). This might also influence lifelong interest and learning and therefore, it can be suggested that a learner with a positive attitude is likely to perform well. This implies that positive attitudes towards science may also lead to better performance (O'Connell, 2000). However, it can also be suggested that those who did not choose Physical Sciences had a negative attitudes towards this subject.

The results of this study showed that academic achievement motivated participants to choose Physical Sciences. Learners differ in their need to achieve in situations that call for excellence (Muola, 2010). As a result, many things can motivate learners to study Physical Sciences; academic achievement being one of them. An achievement-oriented person (Ufuophu-Biri, 2014) can be driven by the desire to succeed and be motivated by a desire for accomplishment in order to satisfy the need. Therefore motivation was a driving force for these participants to choose Physical Sciences. According to Awan et al. (2011), academic achievement can be defined by examination marks and educators' given marks in academic subjects. During documents analysis, test papers and assignment papers revealed that participants were performing well, hence they chose or wanted to choose Physical Sciences in Grade 10. Their performance had a great influence for them to choose Physical Sciences. This was also confirmed during interviews where learners indicated that they were doing well and this motivated them to choose or want to choose Physical Sciences. This aspect confirmed the observation of Archer et al. (2012) who concluded that girls who hold science aspirations tend to excel in science subjects; this finding confirms their observation.

These participants were confident of their performance and believed that their academic achievement in Grade 9 was one of the reasons they chose to study Physical Sciences. They perceived Physical Sciences as easy, therefore, had a positive attitude towards the subject and were prepared to work hard in order to achieve their goals. This study concurs with that of Covington (2000) regarding the importance of attitudes and motivation in science.

The girls indicated that Physical Sciences was an interesting subject and, as a result, their performance and achievement reflected their attitude. According to Andre et al. (1999), when girls enjoy science their perceptions of their competence in the subject are lower than boys. However, this was not the case in the current study because the participants' perceptions were that they were competent in Physical Sciences. Learners in this study showed that they chose to study science because they were comfortable with science subjects. However, the findings of the current study do not support the previous research by Buabeng, Ampiah and Quarcoo-Nelson (2012), where it emerged that learners viewed science as a difficult subject to understand and therefore girls normally shy away from studying it. It can be concluded, based on this study, that girls' motivation by their performance and abilities to continue studying Physical Sciences.

This suggests that with the right kind of motivation, girls might be comfortable with the study of science as much as their male counterparts from lower grades. Thus, for girls who do not show interest in the study of science, it is not due to natural difficulty in the studying of science but perhaps due to the manner in which science is presented and the way girls were socialised to see science education in the past.

This study also revealed that interest in Physical Sciences and abilities seem to be basic keys for active participation of girls in Physical Sciences. Participants indicated that they chose or wanted to choose Physical Sciences based on the abilities and interest in the subject. This would imply that learners who were motivated to do well

in their academic work seemed to develop inner confidence or a more positive belief about their academic abilities (van den Berg & Coetzee, 2014).

In light of these results, topics that interest girls in secondary school science should be encouraged by educators from Grade 8 in order to stimulate more interests in scientific careers (Dionne et al., 2012). This suggests that learners' interests influence their potential and performance, since enrolling for a subject at a stage when it becomes optional is an obvious way of expressing one's interest (Trumper, 2006). Trumper further indicated that interest in science appears to be aroused at an earlier age suggesting that primary science experience might be important for future learners' long-term interest in the subject.

Learners' interest is a stable trait developed with respect to a particular subject, and type of interest leads to persistence at a task over long periods of time, ability to focus, and increased learning and enjoyment (van den Berge & Coetzee, 2014). It was evident in this study that participants recognised their potential and interest based on their experiences and what is taught in class. Thus, instructional approaches concerned with observing learner motivation suggest using tasks that can be differentiated according to learner ability and interest (Oriahi et al., 2010).

The value of science learning (Vedder-Weiss & Fortus, 2014) is to allow learners acquire problem-solving competency, experience the inquiry activity, stimulate their own thinking, and find the relevance of science to their daily lives. If they can perceive these important values, they will be motivated to learn science (Tuan et al., 2005). It was evident in the current study that these participants acknowledged the importance of science. The participants indicated that science is very important because it leads to new discoveries and interesting careers. If a student attributes an important value to science, for which a genuine interest is shown, and one that is closely related to learners' own goals and everyday life, the motivation will be there (Dionne et al., 2012).

The value of learning science let students to acquire problem-solving competency, experience the inquiry activity, stimulate their own thinking, and find the relevance of science to their everyday life. It can therefore be suggested that, since they can perceive these important values, they were motivated to learn Physical Sciences. The fact that they chose or want to choose Physical Sciences, made them believe that science in secondary school prepares them to function effectively in today's scientific- technological society. The findings of this study are consistent with those of Christidou (2011) who indicated that learners need to understand and acknowledge the contribution of science to society and its relevance to their personal and social lives.

Regarding the relevance of science, learners viewed scientific knowledge as an important element to their education. However, they primarily stressed the influential value of science (for example, for pursuing a career) rather than its intrinsic interest (Osborne & Dillon, 2008). Therefore the context in which Physical Sciences is taught and learned might be a powerful predictor of learners' interest (Christidou, 2011). The teaching approach was a strong factor that may have affected the learners' motivation towards learning, therefore affecting their achievement. Motivation can be enhanced through teaching methods that actively involve learners (Keraro, Wachanga & Orora, 2006).

Participants indicated that they chose or wanted to choose Physical Sciences based on the careers they wanted to pursue in future. This is contrary to Dabula and Makura's (2013) finding where they indicated that career choices for many secondary school learners in South Africa are accidental and imposed by external forces. Therefore, career preparation in secondary schools is important for successful career development across the life span (Skorikov, 2007) where learners align their subjects with their anticipated careers. As a result, girls considered choosing subjects which are aligned to their future career.

The other important reason why girls chose to study science was the opportunities that Physical Sciences offers. This was tied to what the participants aspired to do in future. The review of literature suggests that Physical Sciences is critical to the development of any society, especially developing countries. Thus, those who study science at secondary schools have a wide variety of career opportunities and can easily get jobs in the scientific world. There are more people in the other subjects than the sciences and as result, it can be suggested that there is less competition in the science world as far as job opportunities are concerned.

Although this was a small sample some girls gave the reason of Physical Sciences being a prerequisite for university admission. It seemed clear that in the three schools, university prerequisites were one of the most important factors in the subject choices of Physical Sciences. It seems possible that Physical Sciences, being a prerequisite for many careers at tertiary institutions, was a significant reason for choosing it among these participants. Many of the responses reflected that the participants had a clear goal of entering tertiary education and that Physical Sciences was a prerequisite for many careers such as engineering, medical doctor and pilot.

Based on the average age of respondents of 15 years, it can be inferred that career decisions are made at a young age. A study carried out on Swedish youth showed that career aspirations were largely formed by age 13, and that it would be progressively more difficult to engage learners in science (Lindahl, 2007). Such data points to the importance of not making light of career aspirations articulated by learners before they enter secondary school. It is therefore crucial to understand the formative experiences of learners and their career aspirations between the ages of 10-14 and to clarify how to support their aspirations and interest in science, particularly those of girls (Archer et al., 2010).

This study revealed that during secondary schooling, developing a career identity and career aspiration is a central developmental task. According to Silvia (2001),

aspirations are individual's expressed career-related goals or intentions and also include motivational components which are not present in mere interests. Career aspirations of these participants determined the kinds of subjects they chose in Grade 10. This view is consistent with that of Patton and Creed (2007) who maintained that the career aspirations of secondary school learners have been viewed as important determinants of both short term educational choices and long term career choices.

Most learners in this study aspired for careers that deal with abstract ideas and unravelling intellectual problems such as engineering and medicine. However, this finding is in contrast with the study by Tan, Barton, Kang and O'Neill (2013) who indicated that girls tend to aspire to a narrower range of occupations than boys because they believe many jobs are unsuitable for them whereas boys have a greater occupational focus and see more occupational opportunities than girls.

Intrinsic value, according to Lai (2011), is a subjective interest or enjoyment of performing a task. Participants indicated that they enjoyed the teaching of Physical Sciences (intrinsic value) and that it would lead them to choose better careers (extrinsic value). Some of the participants wanted to choose careers due to social needs and personal gain. For example, one participant indicated that she wanted to be an optometrist because her grandmother has eyesight problems and she wanted to help her. It can be suggested that they recognised the social needs of certain professions in their own communities. They also wanted to choose careers where they would have money, beautiful cars and houses which are personal gains. This type of motivation is extrinsic in nature. According to Pintrich and Zusho (2007), extrinsic motivation comes as a result of external reinforcements. They indicated that manipulation of extrinsic motivation is effected by the provision of rewards, which can be tangible like money, performance and privileges (Pintrich & Zusho, 2007).

### **5.3.2. Learning environment**

In the schools chosen for this study, science educators played a crucial role in the formation and restructuring of learners' conceptions and attitudes towards science. Educators were often involved in helping learners to identify their strengths, what a subject entailed and how a subject related to a chosen career path. It was evident during interviews that learners pointed out that educators played a predominant role in motivating them to choose Physical Sciences. Some learners indicated that educators supported them and this enabled them to make informed decisions on subject choices. However, girls in Physical Sciences classes complained that educators always gave them chores like cleaning the classes while boys went home.

This suggested possible discrimination by the educators and this might make girls to shy away from Physical Sciences. It appeared that some educators may have ideas about the respective roles of learners in life. They might be unconsciously reaffirming the responsibilities which discriminate males from females in as far as chores are concerned. It may be suggested that the educators' attitudes and tendencies towards girls, encourage gender inequality amongst learners in schools. This finding support that of Limo and Morogo (2013) who found that the educators failed to promote gender equality amongst the learners in assigning responsibilities and rather believed that certain duties were masculine while others were feminine. It should therefore, be borne in mind that basic rights and duties should be assigned to all individuals without any bias with regards to gender.

It was evident in learners' portfolios that science educators were sensitive when they were giving learners tasks because there was no sign of gender bias. However, the science curricula showed gender bias because even if educators used the names of both boys and girls in activities, experiences of girls in the curricula were not always recognised. Moreover, girls mentioned lack of resources like laboratories as challenging. Many schools in South Africa do not have science laboratories and where they do exist, they are not used effectively (Muwanga-Zake, 2008).

## **Assessment**

During interviews learners mentioned that their performance is good in Physical Sciences and Natural Sciences. This was compared with the findings from documents and, it was clear that the type of questioning made them to perform well. It was evident in the documents that the type of assessment was not suitable for the learners. In Grade 9 for instance, educators asked mostly low level questions like choose the correct answer, true or false, match column A with column B or name/label.

This type of questioning did not recognise all cognitive levels as stipulated by the Department of Basic Education CAPS policy. For example, according CAPS manual (DBE, 2011) on National policy pertaining to the programme and promotion requirements (NPPPR), Natural Sciences educators are requested to indicate the proportion of low, middle and high order questions when assessing learners. Low order questions must comprise 50% in the task, middle order questions (explain, describe, compare, and predict) must comprise 35% while high order questions (evaluate, suggest and interpret) must be 15% (DBE, 2011). But surprisingly, educators disregarded the middle and the high order questions. This might suggest educators' lack of assessment skills.

From their study on actual and ideal assessment practices in South Africa, Kibirige and Teffo (2014) concluded that educators displayed 0% compliance in assessing skills, performance-based tasks and in alignment of Learning Outcomes and Assessment Standards. A possible explanation for these results may be lack of use of the domains of learning (knowledge, skills, and attitudes) by educators (Sincero, 2013). It can be suggested that educators assessed knowledge and overlooked the other two domains, that is, skills and attitudes. This may clarify the poor performance of learners in 2011 and 2012 in the Trends in Mathematics and Science Study (TIMSS) where Grade 9 South African learners achieved averages scale score of 3.7 in 2011 and 5.5 in 2012 in science (Mullis, Martin, Foy, & Stance, 2012).

Even though textbooks had assessment at the end of each topic, educators gave learners different assessment from the one in the textbooks. The content for both Physical Sciences and Natural Sciences need abstract reasoning and this was not displayed in the tasks which were given to learners. This explains why South African learners perform poorly when they compete with learners from other countries. It can also be suggested that educators lacked expertise to teach these subjects. Lack of Physical Sciences specialist teaching has been suggested as one of the problems in encouraging young people to choose the subject (Bennet et al, 2013).

### **Educator feedback**

About 83% of the participants recognized educator feedback as a source of learning motivation. In general, assessment serves as an opportunity for the educator to give feedback to learners and to measure the level of learning and progress of the learners. Feedback must be used to develop skills if it is meaningful and appropriate. These participants indicated that feedback from educators improved their learning morale and motivation to their learning. However, in some instances, it was discovered that the verbatim feedback that educators write in learners' books and scripts is negative and might discourage participants from continuing to study science.

Young (2000) studied on how learners respond to feedback and highlighted that learners are psychologically vulnerable if feedback is negative. Similar opinion was shared by Pitt (2005) who indicated that careless feedback might affect learners' development and emotional stability. It was not surprising to see small number of girls in Physical Sciences classes. The kind of feedback educators gives might break learners' confidence especially those who perceive themselves as incapable in subjects like Physical Sciences and Mathematics. Even if learners in this study did not say much about the feedback educators gave, verbatim feedback from learners' books and test papers said it all. The finding concurs with that by Bansilal, James and Naidoo (2010) where learners expressed strong concern that educators caused learners to lose their confidence based on the negative comments. According to

Black, Harrison, Lee, Marshal and William (2003), verbatim feedback affects learners' self-image and as a result, is unlikely to improve their involvement in different tasks. Young (2000) viewed verbal comments that are derogatory and humiliating to the learner in the learning experience. Learners, whose performance is low, might not choose Physical Sciences based on the negative feedback that educators give.

Books which were not marked might also have demoralised participants. Even though some class work exercises were not always marked, motivation was as a result of marked tests and assignments. Learners indicated that the feedback made them improve. Grade 9 participants indicated that when they are given class work or homework, the teacher does not mark their books mainly because of the large number of learners in the Natural Sciences classes. It should be noted that it is a prerequisite for educators to have marking guidelines for all tasks that learners must have completed in School-Based Assessment in a particular subject (DBE, 2011). So it can be suggested that the tests and assignment which were marked, were as a result of the requirement of the department and maybe class work were not that important, hence most of them were not marked.

### **Large classes**

It was evident in Grade 9 that learners were less motivated because they indicated that sometimes educators did not mark their books because of the large number of learners in Grade 9 classes. The large class may have had implications for teaching and learning related to learner and teacher interaction, teaching and feedback. A large classroom setting where learners are packed is not conducive for the development of interpersonal dialogue. According to Rowe (2011), dialogue ensures significant teaching and learning. Structural resources, like seating arrangements and the physical environment of the classroom, might impede the space for interpersonal relationship between a teacher and a learner, as well as among learners.

Some participants indicated that learners marked each other's tasks (peer assessment) because teachers took long time to finish marking. It was not clear whether the educators were guiding the learners' while they assessed each other or not. It is important for educators to guide learners because the peer assessment process takes them through the creating of the assessment rubrics so as to arrive at the correct way of assessment (Kang'ethe, 2014). Although it was evident that some learners' books were not marked by educators, their formal tasks (test, assignment and practical tasks) were marked.

It can be suggested that management in schools must emphasise and reinforce feedback to learners in order to increase their learning. However, there might be challenges that may impede such reinforcement, including the fact that large classes pose challenges to the educators and affect feedback to learners. It is an undeniable fact that in very large classes, the majority of the learners can go through the whole term without experiencing a single interactive incident with their educators. This finding corroborates the idea of Machika, Troskie-de Bruin and Albertyn (2014) who stated that a large classroom setting is not conducive to the development of interpersonal dialogue as a significant mode of dialogue that ensures teaching and learning skills. Large classes are not the ideal environment to develop these skills. Therefore, the planning of teaching and learning in a large class setting should create opportunities to develop the required skills. It should be noted that the researcher did not visit classes to observe the class settings and the sitting arrangement in such classes but relied strongly on the information from participants.

### **Peer Support**

Participants expressed a lack of support from learners who are not doing science or willing to do science. They indicated that those who are not studying Physical Sciences see them as threats because they have that misconception that those who study Physical Sciences and Mathematics are more intelligent. The recurring adage posits that even educators believe that not all learners can do science, since it is in the preserve of the intellectuals (Maqutu 2013). However, even though the rest of

their fellow classmates did not support them, they depended on their Physical Sciences peers for assistance. It was discovered that their peers still had the misconception that Physical Sciences is a difficult subject. Even though they told their peers that they will choose Physical Sciences in Grade 10, their peers discouraged them by saying to them that Physical Sciences is a difficult subject.

During adolescence many young learners are particularly concerned with their peer relationship (Awan et al., 2011) making peers a highly influential factor on learners' motivation for learning. In this study, peers academic support was found not to predict learners' motivation for learning. However, participants in this study were demotivated by their peers in their choice of Physical Sciences. Their attitudes towards science were not connected with their peers or friends' attitude as Ismal and Anwang (2009) have suggested. In this study the influence of peers was not strong because participants did not change their attitude in agreement with that of their peers.

High school learners are often looking for a place to belong. As a result, they rely heavily on their peer groups to learn what types of behaviours are rewarded with reactions they feel to be positive, often at the expense of reason and good judgement (Mamluk-Naaman, 2013). Findings in the current study indicated that participants enjoyed working together in groups. Working in groups afforded them time to interact effectively with their peers within the groups. This might be regarded as collaborative learning, where learners work together in small groups so that each member of the group can participate in a clearly collective task (Lefrancois, 1999). These tasks engaged learners in discussions with others, enabled them to participate in authentic learning activities and also encouraged them to help one another. Collaborative learning requires that the learning environment accommodates the learners' active interaction with one another to optimise their achievement in Physics (Akinsola & Ifamuyiwa 2008).

It should be noted that while girls may always be relegated to taking notes with one group of peers, in another group with more supportive peers, they may have

opportunities to take on the role of group leader (Tan et al., 2013). The girls in this study were confident within their groups because they also indicated that they made turns to lead the groups as opposed to boys who always want to take the lead within a group.

### **Career Guidance**

Career guidance was seen as another motivational factor on learners choosing Physical Sciences. About 21% of participants attended career guidance sessions. They indicated that after attending career guidance, they had more interest in Physical Sciences. This supports the findings by Valentina and Singh (2014) who indicated that learners who attend career guidance in junior secondary were likely to choose subjects which are of interest to them. They further highlighted that learners need professional guidance that will cater for the ever increasing guidance needs as adolescents (Valentina & Singh, 2014). The study also suggested that guidance by parents and educators could influence learners' choice of science subject.

In the South African education system, career guidance is incorporated in the subject called Life Orientation. In most cases Life Orientation is taught by educators with little or no expertise of scientific careers. Careers that require science subjects are better shared by science educators who are likely to know more about them. Concepts of careers and career choices are taught from Grade 7 all the way to Grade 12. Career guidance programmes should aim at developing important skills for life, work and to assist with immediate decisions (Dabula & Makura, 2013). In some countries, career education is neither mandatory nor included in the curriculum however; it is included in curriculum frameworks.

After conducting a study on gender differences, career aspirations and career development in Kenya, Migunde et al. (2012) recommended that career counsellors and all other persons who guide learners in their career choice should help learners determine the most suitable careers based on their ability and interests. To increase

the number of girls in science, schools should be well equipped with adequate career resources and qualified personnel to provide learners with the necessary services in terms of career guidance that will help them in making informed career decisions. The School Management Teams (SMTs) can organise career days where individuals who have experiences in various careers are invited to provide learners with information on various careers and share their real life experiences so that learners are aware of what to expect from their careers of choice (Migunde et al., 2012). The fact that some learners have to travel far for career guidance means that career guidance might not be accessible to all learners. Those who had access were motivated by individual with expertise in their subject of choice and this indicates that learners need career guidance and schools should organise such.

Research shows that many learners who received career guidance in high school aim to enter higher education (Valentina & Singh, 2014). Career guidance therefore has a positive effect on one's desire to enter higher education. The assumption therefore is that, if more learners receive proper career guidance while in high school, they might be in a position to make informed career choices and that has implications for tertiary education access. This means that proper career guidance and development programmes at high school level are a necessity for secondary and tertiary education access (Dabula & Makura, 2013).

### **Financial Aid**

Most participants were from rural communities and lacked financial resources. Learners indicated that one of the reasons they chose or wanted to choose to study Physical Sciences was that they can get financial assistance from the government or private sector for further study at tertiary level. The participants indicated that bursaries and scholarships are available for people studying Physical Sciences, provided they performed well. This was supported by Dlamini, Ngwenya and Dlamini (2004) who indicated that in high schools girls may be encouraged to take the science path, if they receive financial aid. This means that as much as learners would love to pursue certain careers of interest, their financial resources available

cannot allow them to pursue in their fields of interest. Natalie (2006) also found from respondents that availability of bursaries is an advantage because lack of financial resources is the major barrier in their career choice.

### **5.3.3. Role of family in motivating girls**

Most of the learners (92%) were not assisted by their families when they made their study choices. Even though family plays an important role in any child's involvement in education, it was not the case with these participants. Durant (2011) writes that parental involvement in children's schooling is an important component of their early school success, echoing findings of Lee and Bowen (2006). However, it was evident from this study that learners lacked support from family members when making subject choices. Nevertheless, Makgato and Mji (2006) argued that parents are very important stakeholders who affect and play critical roles in the lives of their children and improving their performance at school.

Learners who are not supported by parents when they do homework become demotivated and eventually lose interest (Bryan et al., 2013). After doing a study on socio-cultural factors influencing the progress of girls in science, Tuaundu (2012) discovered that there were few parents who motivated their girl children to become involved in the fields of science. It was evident though from this study that only 8% of participants received some support from parents and other family members.

The findings in this study suggest that mentoring and influence from parents can be helpful factors. It is, however, evident that more than structural and cultural changes are needed. Changes in this regard should be initiated by family members. This is supported by ASSAf (2010), who indicated that family background and the lack of participation of parents may be a barrier to motivation. Topping (1986) concurred that parents are role models to their children who transmit, through examples, values, norms, and attitude and that they need to be involved in their children's education. Even though this is the case, in this study only a small percentage of parents acted as role models to their children. As a result, it can be concluded that

parents' involvement in their children's academic activities might be influenced by their interest, socio-economic status, and level of education.

It was somewhat surprising to find that out of twenty four girls, only two had support from family members one of which were the parents and the other one the siblings who were in tertiary institutions. Siblings pursuing science education were a source of motivation for the decision to pursue science education for this learner. Tertiary institution students who are participating in science might contribute in motivating secondary school girls to study science (Chikuvadze & Matswetu, 2013). This study revealed the importance of role models in attracting more girls into the field of sciences as they help shape their career identity (Bowman, 2007). Sikwari (2014) argues that the desire to achieve varies from one individual to the other. The researcher believes that learners who might have high achievers as their role models in their early life experience would develop a high need for achievement. As a result, the issue of motivating learners can be seen as a significant feature of actual learning.

The present study confirmed findings by Terblanche (2013) who indicated that there is absence of female positive role models in academic fields, especially in Science, Mathematics and Technology careers, in many communities in rural areas (Terblanche, 2013). Similarly, Mogashoa (2015) also discovered that lack of role models in the field of Physical Sciences was a de-motivating factor for learners to continue studying Physical Sciences. Role models in villages mainly do simple jobs like cooking and serving food, selling in the market or by the road side, and so on and have a great influence on the young girls in the community who believe that these women, with no formal education, earn money and are well off.

Tan et al. (2013) indicated the role of family as important inspiration to girls, citing familial role models and their relatives who work in science-related fields. This is different to the current study because most girls (92%) were not influenced by family and their families did not act as an important inspiration to them. It can therefore be

assumed that if family members were able to assist these girls when they had homework or tasks to complete at home, this could have been a greater motivation to them. Family members could serve as role models to whom the girls could ask questions about specific science related topics and careers.

#### **5.4. Conclusion**

The aim of the current study was to explore factors which motivated girls to choose Physical Sciences. The findings revealed that girls that participated in this study were motivated intrinsically and extrinsically. They highlighted that they had a positive attitude towards science. Even though the participants had positive attitude towards science, the low number of girls in Physical Sciences is a greatest concern. Female enrolment in Physical Sciences will not improve unless information about career awareness in the subject is made available to learners. Girls' interest in Physical Sciences can be enhanced if proper foundation is ensured by carefully examining the way Physical Sciences is taught in secondary schools.

Future career, performance, learning environment and the importance of science, financial assistance were the main determinants of girls' choice of Physical Sciences. According to Dionne et al. (2012), these factors of motivation appeal to young people and could be of interest to improve science motivation in the classroom. It became clear that learners were also dependent on the bursaries and scholarships for financial assistance when they go to tertiary institutions.

The majority of the girls intended to study science at tertiary institutions in order to attain their career aspirations. As far as career aspirations are concerned, these participants aspire for careers that are traditionally dominated by males and these could include engineering and other science related subjects. This showed their potential to bridge the gender stereotyping of job roles between males and females. On the point of family support and role models most girls had little/no support to motivate them to study Physical Sciences. However, it should be noted that the educator feedback might break learners' confidence because it was seen as

discouraging in nature. By providing girls with the necessary support, motivation and opportunities regarding the field of science, they might be empowered to persist and overcome the challenges posted by negative cultural and traditional values and beliefs.

The study was conducted in a rural area and the sample was small with only ten girls studying Physical Sciences and fourteen intending to study Physical Sciences. Therefore, these findings cannot be generalized to other areas in the province. The study should be repeated with a large sample of boys and girls in both rural and urban areas. This might make it possible to establish if factors motivating girls are the same as those motivating boys in rural areas and in urban areas.

### **5.5. Recommendations**

The study recommends that girls should be taught about the importance of science from primary schooling all the way to secondary schooling. It further recommends that educators should be equipped with skills which will be more effective in assisting learners to succeed in their studies.

To motivate girls to choose to study Physical Sciences, it is recommended that schools invite females (women and girls) who are successful in the field of sciences so that girls can notice that there are women in the field of science and that they can also succeed. The Department of Basic Education, through various tertiary institutions, should organise career exhibitions. These career exhibitions will provide learners with information on various careers and share real-life experiences so that learners are aware of what to expect from their careers of choice.

This study also recommends that learners be provided with enough emotional and academic support so that they can continue working hard to achieve their goals. Parents' educational programmes may be organised to make them aware about the

importance of their involvement in their children's' education, particularly in Physical Sciences.

Educational policies should include gender equality within the curriculum so that boys and girls can know that they are equally important. These policies should also include career guidance which is not gender specific. Girls should be encouraged to participate more freely in classroom activities by initiating questions, taking leading roles in practical tasks and by being more assertive when making statements so that they can be recognised.

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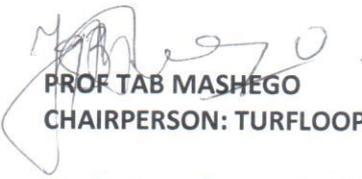
**TURFLOOP RESEARCH ETHICS  
COMMITTEECLEARANCE CERTIFICATE**

**MEETING:** 28 January 2015

**PROJECT NUMBER:** TREC/02/2015: PG

**PROJECT:**

**Title:** Exploring factors motivating girls to study Physical Science in Grade 10 in the Rakwadu Circuit  
**Researcher:** Ms SEL Modjadji  
**Supervisor:** Prof I Kibirige – University of Limpopo  
**Co-Supervisor:** N/A  
**Department:** Mathematics, Science and Technology Education  
**School:** Education  
**Degree:** Masters in Science Education

  
**PROF TAB MASHEGO**  
**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) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
- ii) The budget for the research will be considered separately from the protocol.  
**PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

## ANNEXURE B

Box 3056

Sovenga

0727

15 April 2014

The Circuit Manager

Rakwadu Circuit Office

Dear Sir/Madam

RE: PERMISSION TO CONDUCT RESEARCH IN THREE SECONDARY SCHOOLS WITHIN YOUR CIRCUIT

I hereby request for permission to conduct educational research in three secondary schools under your circuit in the Sekgopo Cluster. I am presently busy with my Dissertation, a compulsory requirement towards the completion of a MEd in the School of Education at the University of Limpopo. The topic of my Dissertation is:

**Exploring factors which motivate girls to choose Physical Sciences in Grade 10 in Rakwadu Circuit**

I am prepared to observe the following stipulations:

1. Participation in the research will be voluntary.
2. All information obtained will be treated confidentially and used for academic purposes only.

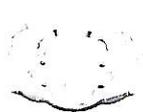
Yours sincerely,

---

Mrs Modjadji SEL

(Student No. 200309208)

**ANNEXURE C**



**LIMPOPO**  
PROVINCIAL GOVERNMENT  
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF  
**EDUCATION**

15 April 2014

Dear Modjadji S.E.L

PERMISSION TO CONDUCT RESEARCH IN THREE SECONDARY SCHOOLS IN RAKWADU CIRCUIT:  
YOURSELF

1. We acknowledge receipt of your letter dated the 15.04.2014 in which you request permission to conduct an educational research to complete your master's degree programme with the University of Limpopo.
2. We have pleasure in informing you that permission has been granted for you to pursue your studies as required by your tertiary institution.
3. We further would like to wish well in your studies.

Yours truly

SETHABA M.D.B (Circuit Manager)

**ANNEXURE D**

Box 3056

Sovenga

0727

15 May 2014

The Principal

.....

Dear Sir/Madam

**RE: PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOL**

I hereby request for permission to conduct educational research in your school. I am presently busy with my Dissertation, a compulsory requirement towards the completion of a MEd in the School of Education at the University of Limpopo.

The topic of my Dissertation is:

**Exploring factors which motivate girls to choose Physical Sciences in Grade 10 in Rakwadu Circuit.**

I am prepared to observe the following stipulations:

1. Participation in the research will be voluntary.
2. All information obtained will be treated confidentially and used for academic purposes only.

Yours sincerely,

\_\_\_\_\_

Mrs Modjadji SEL

Student No: 200309208

## ANNEXURE E

Box 3056

Sovenga

0727

15 June 2014

Dear Parent

I am enrolled to MED degree at University of Limpopo and I am working on a dissertation entitled “**Exploring factors which motivate girls to choose Physical Sciences in grade 10 in Rakwadu Circuit.**”

In this context I have to undertake a research and I would be grateful if you can grant your child permission to participate in the interviews at school during recess/break time. All information gathered will be treated with strict confidentiality and anonymity. The name of your child will not appear on the research report.

Thanking you in advance for your cooperation.

Yours sincerely

---

Mrs Modjadji SEL

Student No: 200309208

**CONSENT FORM (PARENT)**

I.....(Parents Names) am the parent of  
..... (Learner’s Names) who is in Grade.....

**I give my child/ do not give my child** permission to take part in the research which will take place in the school. The final decision to take part will be taken by her if she wants to take part in that particular research.

Parent’s Signature

Date

.....

.....

**CONSENT FORM FOR PARTICIPANTS**

I ..... (Learner’s Names) who is in Grade.....  
understand that my participation in this project is voluntary. I may withdraw and discontinue participation at any time without penalty. I understand that the researcher will not identify me by name in any reports using information obtained from this interview, and that my confidentiality as a participant in this study will remain secure.

Learners Signature

Date

.....

.....

Box 3056

Sovenga

0727

15 June 2014

Go Motswadi

Ke e ngwadisitse bjalo ka moithuti le University ya Limpopo moo ke ithutelang grata ya Masters go tsa thuto. Ka fao, keswanetse go dira dinyakisiso gore ke kgone go tswelela. Hlogo ya dinyakisiso ere: **“Mabaka ao a ka hlohleletsago basetsana go kgetha thuto ya tsa mahlale mphatong wa lesome gola sedikothutong sa Rakwadu”**

Ka ge ke tlo dira dinyakisiso, nka thaba kudu ge le ka fa ngwana wa lena tumelelo ya go kgatha tema mo dinyakisisong tseo ke di dirago. Dinyakisiso tseo di tla dirwa mosekolong se ngwana wa lena a tsenago gona. Maina le dipelo tsa bakgatha-tema e tla ba sephiri. Ka fao, ke kgopela gore le tlatse foromo ye e latelago gomme ge le feditse le saene.

Nka leboga kudu ge le ka modumelela go kgatha tema dinyakisisong tseo.

Wa lena ka boikokobetso

---

Mrs Modjadji SEL

Student No: 200309208

**FOROMO YA TUMELELO (MOTSWADI)**

Nna.....(Maina a motswadi) ke motswadi wa.....(Maina a ngwana) yo a dirago mphato wa.....(Grade). **Ke fa ngwana waka tumelelo/ Ga ke fe ngwana waka tumelelo** ya gore a kgathe tema mo dinyakisisong tseo di tla bego di dirwa sekolong sa bona. Sephetho sa mafelelo se tla tsewa ke ngwana ge e ba o tla kgatha tema.

Motswadi wa ngwana

Tsatsikgwedi

.....

.....

**FOROMO YA TUMELELO YA MORUTWANA**

Nna ..... (Leina la morutwana) ke mphantong wa.....Ke tsea karolo dinyakisisong tse ka kgetho ya ka. Ke dumela gore nka gogela morago nako ye ngwe le ye ngwe ntle le kotlo. Ke kweshisha gore monyakisisi a ka se phatlalatse leina laka go laetsa tse ke di boletsego dinyakisisong.

Morutwana

Tsatsikgwedi

.....

.....

## **ANNEXURE F**

### INTERVIEW SCHEDULE FOR GRADE 10 GIRLS

#### AGE:

1. What subjects are you studying?
2. Were there any requirements in order for a learner to choose Physical Sciences in Grade 10?
3. Why did you choose Physical Sciences as learning area?
4. Do you regret your choice of Physical Sciences as a learning area? Why, Why not?
5. When you read newspapers, are you interested in articles about science?
6. What motivated you to choose this subject?
7. Did anyone or anything in particular influence you in choosing Physical Sciences?
8. Do you think teachers or parents should assist learners in choosing subjects in Grade 10?
9. Do you enjoy the teaching of PS? Why?
10. Do you think learning PS is important? Explain?
11. Do you think you have the potential to perform well in PS Explain? Rate your performance between 0 and 10 where 0 is low and 10 good?
12. Did any of the family members at home support you when doing PS activities?
13. Did any of the family members tell you what to choose in Grade 10? If so did they recommend PS?
14. Did you get any support or discouragement from friends and other students?

## **ANNEXURE G**

### INTERVIEW SCHEDULE FOR GRADE 9 GIRLS

#### AGE:

1. Which subjects do you intend to study in Grade 10?
2. Why do you want to study these subjects?
3. What motivates you to study these subjects?
4. Do you like or dislike PS? What makes you like or dislike it (PS)?
5. Can you recommend any one to do PS? If yes or no why?
6. Do you think learning PS is important? Explain?
7. Did you get any support or discouragement from friends and other students?
8. When you read newspapers, are you interested in articles about science?
9. Do you think your teachers or parents should choose subjects for learners in Grade 10?

## ANNEXURE H

### Checklist

#### Grade 9 (NS) and 10 (PS) Classwork books, Test scripts and Assignment scripts

✓ Will be used on yes or no columns

	Marked		Controlled		Comments by educators		Type of Comments +/-
	Yes	No	Yes	No	Yes	NO	
Class Activities given							
Home Activities given							
Test Given							
Assignment Given							
Practical Tasks							
Investigations							
Projects							

## **Frequency of assessment**

Level of objectives covered in the assignments and tests and classwork/homework

- Do educators give learners adequate tasks? Yes/No
- Do educators address the cognitive level? Yes/No
- Are objectives from basic to high order covered? Yes/No
- Is the language used by educator proper? Yes/No
- Do tasks achieve the objectives of the subjects? Yes/No

## **Gender neutrality**

- Do tasks present science as male dominated? Yes/No
- Do educators show gender neutrality on work given to learners? Yes/No
- Words used - do they inspire inclusion of girls? Yes/No
- Do textbooks show experiences of girls? Yes/No
- Do textbooks show gender neutrality? Yes/No

## TRANSCRIPTS SAMPLE

### TRANSCRIPTS FOR GRADE 10 GIRLS

AGE:16

Interviewer: Which subjects are you studying?

L1A: Maths, Physical Sciences, Life Sciences, Geography, LO, Sepedi (HL) and English (FAL)

Interviewer: Were there any requirements in order for a learner to choose Physical Sciences in Grade 10?

L1A: There are no requirements everybody choose the subject they want

Interviewer: Why did you choose Physical Sciences as a subject?

L1A: I chose science because I want to do civil engineering at the university

Interviewer: Why civil engineering?

L1A: Because it is interesting and those who study engineering have lots of money

Interviewer: Do you regret choosing Physical Sciences?

L1A: No, not at all. I don't regret because what I want to do when I grow up need Physical Sciences and I pass it with high marks.

Interviewer: What motivated you to choose this subject?

L1A: We attended career guidance at Polokwane show ground and I saw what civil engineering students do. I liked what they do and I want to be like them one day. At first I was doing History but after I go to the career guidance a moved to science stream.

Interviewer: do you have any role model who has motivated you to choose Physical Sciences?

L1A: No I don't have but I think it's important to have a female role model. It's better if I have a female role model who is in the science field because maybe she had some challenges and she managed to get through them and succeed in the field of Science.

Interviewer: Did your teachers motivate you to choose Physical Sciences?

L1A: No they did not.

Interviewer: Do you think teachers should assist learners in choosing subjects in grade 10? Why do you think is important?

L1A: No, I think learners know what they want, so they must choose the subjects that they want

Interviewer: Why?

L1A: Because they are the one who are studying

Interviewer: Do you enjoy the teaching of PS? Why?

L1A: Yes, I do.

Interviewer: Why?

L1A: (laughs)... because Physical Sciences is interesting and we learn more about inventions of things in the world so we apply our minds.

Interviewer: When you read newspapers, are you interested in articles about science?

L1A: yes very much

Interviewer: Why?

L1A: Because that's where we learn most of the things about our world.

Interviewer: Do you think learning PS it's important? Explain?

L1A: Yes, it is interesting because we learn to make sense of our world and how things came to be what they are.

Interviewer: Do you think you have the potential to perform well in PS Explain? Rate your performance between 0 and 10 where 0 it's low and 10 good?

L1A: Yes I think I have potential to perform well in Physical Sciences..... I have never failed a test in PS and I always get level 6 or 7.

L1A: My performance..... I can rate myself 9

Interviewer: why 9? Why not 10 because you get level 7?

L1A: Because I have never got 90%

Interviewer: Did any of the family members at home support you when doing PS activities?

L1A: No, I do things myself.

Interviewer: Do you ever ask them to assist?

L1A: No, I don't.

Interviewer: Why?

L1A: They don't not know what I do..... Because my mom did not go to school and my brother only passed grade 7. He is working in Johannesburg now and he can't know what I'm doing.

Interviewer: Did any of the family members tell you what to choose in grade 10? If so did they recommend PS?

L1A: No..... like I said... I chose subjects for myself without any help from anybody. My mom does not even know the subjects I'm doing

Interviewer: Did you tell her?

L1A: No, I did not?

Interviewer: Why?

L1A: I don't think she will understand because she has never asked me the subjects I'm doing. I think she is not interested because she never asked.....but I think I will tell her.

Interviewer: Did you get any support or discouragement from friends and other students?

L1A: I was in the History class before I can do PS. When I switched to Physical Sciences class my friends from History class said I will fail. But the three girls who were in the PS class were happy that I joined them.

Interviewer: do the girls in PS class support you?

L1A: Yes mam, they do. We usually make our homework together here at school and we all do well more than the boys because we work together

Interviewer: Do ever work in groups at school in your science class?

L1A: .....mmm.....sometimes.

Interviewer: Do you think is important to work in groups? why?

L1A: Yes I think it's very important to work in groups because whatever you discuss about as a group, you cannot forget that easily.

Interviewer: Does your educator support you?

L1A: Yes, he does. When we don't do well in a topic he stays with us after school so that we can understand

Interviewer: Does he give you feedback of your learning?

L1A: Yes, he do give us feedback and the feedback that he gives motivate us to work hard

Interviewer: Anything that you want to say about PS?

L1A: I think Physical Sciences is interesting and I enjoy it.

Interviewer: As we conclude, is there anything that you want to tell me

L1A: No, I don't have anything to say.

Interviewer: Thank you very much for the contribution you made.

AGE:15

Interviewer: Which subjects are you studying?

L3C: Life Sciences, Geography, Physical Sciences, Mathematics, LO and Languages (Sepedi, English)

Interviewer: Were there any requirements to study these subjects?

L3C: Yes, there were some requirements.

Interviewer: What were the requirements?

L3C: The requirements is to get at least 40%+ in both Mathematics and Natural Sciences.

Interviewer: Why did you choose Physical Sciences as learning area?

L3C: I chose Physics because I think it is fun and I enjoy doing it.

Interviewer: Do you regret choosing Physical Sciences?

L3C: yes, sometimes.....

Interviewer: why?

L3C: mmm.....because I don't do well in Mathematics and these subjects go together.

Interviewer: if Physical Sciences was not in the same stream as Mathematics, would you regret choosing it?

L3C: No, I won't regret because I'm doing very good in physics my only problem is with Mathematics.

Interviewer: What motivated you to choose this subject?

L3C: Opportunities which are there in the field of science motivated me to choose Physical Sciences.

Interviewer: Which opportunities are you referring to?

L3C: If you pass Physics and Mathematics well, you are likely to get a bursary to go to university.

Interviewer: do you want to go to university when you complete Grade 12?

L3C: Yes.....i do.....mmm.....I want to study Biotechnology.

Interviewer: What is biotechnology all about, why biotechnology.

L3C: Biotechnology..... mmm.... .they manipulate living cells for application in chemicals or pharmaceuticals or agriculture.

Interviewer: Did you learn about this at school?

L3C: No.....mmm....i learnt about this when I visited my aunt in Tembisa.....ehhh.....she took me and my cousin to career exhibition at the Rand Easter show last year and this is when I knew what biotechnology is and what they are doing.

Interviewer: Do you have any role model who has motivated you to choose Physical Sciences?

L3C: No I don't have but I think it's important to have role model. Boys are doing better than us as girls in the field of science because they see many men who are successful in science but as a young girl I hardly see a female role model. If there were many of them maybe they could visit our schools and motivate us as girls.

Interviewer: Did your teachers motivate you to choose Physical Sciences?

L3C: Yes they did not.

Interviewer: Do you think teachers should assist learners in choosing subjects in grade 10? Why do you think is important?

L3C: No, I think learners must choose subject they want but teachers must support learners on whatever they choose. Nobody should choose for us the subject because if they choose for us then they want to choose our future.

Interviewer: Why do you say so?

L3C: Because learners know what they want and parents and teachers don't know what learners want.

Interviewer: Do you enjoy the teaching of PS? Why?

L3C: I enjoy very much.....ehhh.....yes I do

Interviewer: Why do you enjoy it?

L3C: I understand the things that Mam Sithole is teaching. Physical Sciences is interesting so I enjoy it.

Interviewer: When you read newspapers, are you interested in articles about science?

L3C: Yes I am. I learn most of the physics things from the newspaper

Interviewer: Things like?

L3C: The newspaper teaches us how things were work and what other people are doing in other parts of the world.

Interviewer: Do you think learning PS is important? Explain?

L3C: Yes, it is important because things depend on science and technology. It is also important because we can be able to make sense of our world.

Interviewer: Do you think you have the potential to perform well in PS Explain? Rate your performance between 0 and 10 where 0 it's low and 10 good?

L3C: Yes. I perform well in Physical Sciences..... I have never failed a test in PS and I always get level 6 or 7.

Interviewer: How do you rate yourself?

L3C: My performance is good so rate myself 9

Interviewer: Why do you rate your performance at 9?

L3C: Because I know that I'm doing well in Physics and I trust myself?

Interviewer: Did any of the family members at home support you when doing PS activities?

L3C: No, nobody help in physics activities....ehhh.....my brother sometimes help me with Sepedi.

Interviewer: Did any of the family members tell you what to choose in grade 10? If so did they recommend PS?

L3C: My brother wanted me to choose Accounting and Economics but he did not recommend Physics.....mmm.....I just chose Physics because I just love it.

Interviewer: Did you get any support or discouragement from friends and other students?

L3C: Friends always don't support you if they know you are better than them.....ehhh...those who are supportive are the one in my science class.

Interviewer: Does your educator support you?

L3C: Yes, she does.....mmm.....she always support us.

Interviewer: how does she support you?

L3C: She wants to see us doing well.....mmm.....she is always positive and encourages us to work hard.

Interviewer: Does he give you feedback of your learning?

L3C: Yes,

Interviewer: What kind of feedback?

L3C: Mmm.....ehhh.....she write things like you are the best, you can do better, a good effort. She writes these in our books and this motivate us.

Interviewer: Okay, I understand. Is there anything that you want to say about PS?

L3C: I like Physical Sciences because it is an interesting subject and I enjoy it.

Interviewer: As we conclude, is there anything that you want to tell me

L3C: No, I don't have anything say.

Interviewer: Thank you very much for the contribution you made.

L3C: Thank you.

AGE:16

Interviewer: Which subjects are you studying?

L4A: Life Sciences, Physical Sciences, Mathematics, Geography, Sepedi (HL) and English (FAL) and LO.

Interviewer: Were there any requirements in order for a learner to choose Physical Sciences in Grade 10?

L4A: There are no requirements in all the streams, everybody choose the subject they want.

Interviewer: Why did you choose Physical Sciences as a subject?

L4A: I chose sciences because I love it and because I want to be a civil engineer when I grow up.

Interviewer: Why civil engineer and not other careers?

L4A: Because people who are civil engineer are making lot of money and I also think it is interesting.

Interviewer: How do you know that they are making a lot of money?

L4A: I read on the newspapers and I also saw the car they are driving at a career guidance workshop.

Interviewer: Do you regret choosing Physical Sciences?

L4A: No, I don't think I will ever regret choosing Physical Sciences because I love it and what I want to do when I grow up depend on the subjects like Physical Sciences and Mathematics.

Interviewer: What motivated you to choose this subject?

L4A: I was motivated by my teacher at the school I was attending before I come here.

Interviewer: What did he/she say to you to motivate you?

L4A: She said I'm good in Mathematics and Science so I must choose these subjects. At first I wanted to be choose History because I wanted to be a lawyer but after she told me that law is not good for me, I opted to choose the sciences. I also think that attending career guidance exhibition also made me love Physical Sciences

Interviewer: How did career exhibition motivate you?

L4A: I saw that even woman can do civil engineering because there was a woman who is a civil engineer. I saw the cars they are driving and I told myself that I want to be like them when I grow up.

Interviewer: do you have any role model who has motivated you to choose Physical Sciences?

L4A: I think my science teacher from the school I come from is my role model because she knows almost many things in science and when I look at her I see a brave woman. She was the only female science teacher and I think it's important to have a female role model. She is my inspiration because she also motivated me to study Physical Sciences.

Interviewer: Did your teachers motivate you to choose Physical Sciences?

L4A: Yes my science teacher from my previous school motivated me.

Interviewer: Do you think teachers should assist learners in choosing subjects in grade 10? Why do you think is important?

L4A: No, I don't think they must assist us. I think learners know what they want, so they must choose the subjects that they want.

Interviewer: Why?

L4A: Because parents and teachers can choose wrong subjects for you..... subjects that I don't want.

Interviewer: Do you enjoy the teaching of PS? Why?

L4A: Yes, I do. I enjoy very much.

Interviewer: Why?

L4A: (laughs)... because I enjoy the way Mr Kgopa is teaching. I understand concepts very well. Physical Sciences is interesting and I pass all the tasks.

Interviewer: When you read newspapers, are you interested in articles about science?

L4A: Yes I am. I learn most of the physics stuff from the newspaper

Interviewer: Stuff like?

L4A: How things were invented, who invented them and how things work.

Interviewer: Do you think learning PS is important? Explain?

L4A: Yes, it is important and interesting because life these days depend on science and technology. It is also important because we can be able to make sense of our world.

Interviewer: Do you think you have the potential to perform well in PS Explain? Rate your performance between 0 and 10 where 0 it's low and 10 good?

L4A: Yes. I think I perform well in Physical Sciences..... I have never failed a test in PS and I always get level 7.

Interviewer: How do you rate yourself?

L4A: My performance..... I can rate myself 10

Interviewer: Why 10?

L4A: Because I am the best student in class and I always get high marks.

Interviewer: Did any of the family members at home support you when doing PS activities?

L4A: No, when I have homework I do things it myself without any family member helping me.

Interviewer: Do you ever ask them to assist?

L4A: No

Interviewer: Why?

L4A: My mom did not go any further with her schooling so she cant know the answers and my brothers and sisters are still young.

Interviewer: Did any of the family members tell you what to choose in grade 10? If so did they recommend PS?

L4A: Yes my mother said she want me to be a lawyer because lawyers make a lot of money. She said I must study History. She did not recommend Physical Sciences and Mathematics because she thought they are difficult subjects. But I decided to choose them instead.

Interviewer: Did you get any support or discouragement from friends and other students?

L4A: My friends think Physical Sciences is difficult. I don't think they support me. But my fellow students in my Physics class support me. In fact we support each other.

Interviewer: how do you support each other?

L4A: There are four girls who are doing Physics and we always work together. We help each other and always work as a group. If we see that one of us is left behind we support her and help her. We always make our homework together at school.

Interviewer: You mention girls, what about boys in your Physical Sciences class?

L4A: Boys?..... ahhhh, they don't work with us because they like arguing. They always want to take a lead and we don't want that.

Interviewer: Do ever work in groups at school in your science class?

L4A: Sometimes yes.....

Interviewer: Do you think is important to work in groups?

L4A: Yes. I think is very important to work in groups because we can be able to help each other.

Interviewer: Does your educator support you?

L4A: Yes, he does. He is a nice person.

Interviewer: How?

L4A: He always wants the best from us. When we don't understand something he stays with us so that we can understand.

Interviewer: Does he give you feedback of your learning?

L4A: Yes, always. That's why I like him. We always know where we did wrong because of the feedback he gives. The feedback motivates us to work harder.

Interviewer: Anything that you want to say about PS?

L4A: Physical Sciences is enjoyable and I love it. People who say is difficult are lying. I think is the easiest and is interesting.

Interviewer: As we conclude, is there anything that you want to tell me

L4A: No, I don't have anything to say.

Interviewer: Thank you very much for the contribution you made.....

L4A: Thank you mam

## TRANSCRIPTS FOR GRADE 9 GIRLS

AGE: 15

Interviewer: Which subjects do you intend to study in Grade 10?

L1B-IS: I want to study Physics , Mathematics and Life Sciences.

Interviewer: Why do you want to study these subjects?

L1B-IS: I know I will get scholarship and do any degree that I want?

Interviewer: Which degree do you think of studying?

L1B-IS: I haven't thought of it yet but I know it will have something to do with Mathematics and Physics, maybe a doctor or anything to do with medicine.

Interviewer: What motivates you to think of studying Physical Sciences?

L1B-IS: There are many opportunities for those who study Mathematics and Physics, like bursaries or scholarships. I think the opportunities which are available motivate me to think of choosing these subjects.

Interviewer: Do you like or dislike Physical Sciences? What makes you like or dislike it (Physical Sciences)?

L1B-IS: I think I will love it very much because I like Natural Sciences a lot.

Interviewer: Can you recommend any one to do Physical Sciences? Why?

L1B-IS: yes I can because they will have options when they reach university.

Interviewer: Do you think learning Physical Sciences is important? Explain?

L1B-IS: yes I think Physical Sciences is very important because those who are studying science are able to predict things that we don't know.

Interviewer: Did you get any support or discouragement from friends and other educators?

L1B-IS: I get support from my educators because they say I must learn hard so that I can be able to get high marks.

Interviewer: When you read newspapers, are you interested in topics about science?

L1B-IS: yes

Interviewer: Do you think your educators or parents should choose subjects for learners in Grade 10?

L1B-IS: I think educators must assist learners when they choose subjects because they teach them and know their weaknesses and strength.

AGE: 15

Interviewer: Which subjects do you intend to study in Grade 10?

L1A-IS: Life Sciences, Geography, Physical Sciences, Mathematics, LO and Languages.

Interviewer: Why do you want to study Physical Sciences?

L1A-IS: I want to study Physical Sciences because I think it's fun and I will enjoy learning it.

Interviewer: What motivates you to think of studying Physical Sciences?

L1A-IS: I think that seeing pilots on TV flying airplanes motivated me to want to study Physical Sciences in Grade 10. I have read that there are few black female pilots so I want to be counted in that number.

Interviewer: Do you like or dislike Physical Sciences? What makes you like or dislike it (Physical Sciences)?

L1A-IS: I like Physical Sciences very much because we learn more about how things were discovered and scientists invent things.

Interviewer: Can you recommend any one to do Physical Sciences? Why?

L1A: Yes I can, but my sister said that Physical Sciences is difficult.

Interviewer: Do you think learning Physical Sciences is important? Explain?

L1A-IS: yes I think learning Physical Sciences is very important because we are living in a world where things are changing every day so we must learn Physical Sciences.

Interviewer: Did you get any support or discouragement from family, friends and educators?

L1A-IS: I can say that my friends don't support but educators sometimes assist us even though it's difficult sometimes.

Interviewer: How is it difficult?

L1A-IS: it is difficult for our educators to support us. Our class has many learners, about 76. It is impossible for educators to recognise learners who have difficulty learning. Those who perform well in NS and Mathematics, educators concentrate more on them and forget about those who have difficulties.

Interviewer: When you read newspapers, are you interested in topics about science?

L1A-IS: Yes I am because we learn a lot about science from newspapers or magazines

Interviewer: Do you think your educators or parents should choose subjects for learners in Grade 10?

L1A-IS: No I don't think they must assist us. I think they should just support what the learners want to choose.