

Exploring Factors that affect the attraction and retention of mathematics and physical sciences teachers at selected secondary schools, North West province

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DECLARATION

I, SONIA MMONIEMANG SHOLE, declare that all the work done in this mini dissertation entitled: Exploring Factors that Affect the Attraction and Retention of mathematics and Physical Sciences Teachers in the selected Secondary Schools in the North West Province, is my own efforts and any other sources that I have quoted are acknowledged and indicated as references.

S.M. Shole

Signature

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This study would have been impossible to complete if I was all alone. I therefore acknowledge the people surrounding me. First of all, my loving husband, Itumeleng Jacob Shole, who motivated me to study MBA and always saw a potential in me, stood by me through thick and thin, embracing me with love and taking care of the kids in my absence. Dear, you are highly appreciated.

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To God, I give the Glory, for protecting me with His powerful hand and guided me throughout the whole research process, balancing all forces acting on me thereby making the resultant force to be zero.

ABSTRACT

The production of every organization depends on the type of human resource it has. The Department of basic education in the North West Province is no exception. Hence, this study is about exploring factors that affect the retention and attraction of mathematics and physical sciences teachers in the selected secondary schools in North West Province. South Africa is under performing in as far as math and science is concerned, and the shortage of teachers for these subjects is one of the major contributing factors. As a consequence, the retention and attraction of math and science teachers in the Secondary Schools of the North West Province is vital. The primary objective of the study is to come up with strategies that can be implemented to retain and attract mathematics and physical sciences teachers. Talent management, as a human resource component, plays an important role in the retention of employees, including teachers.

Quantitative research method was used in this study because it allows one to verify validity and reliability of data collected. A quota sampling method was applied using Sakaran table (2003:253), where a group of math and science teachers from selected secondary schools were conveniently selected. The population of math and science teachers was 101 and as a result, the researcher found it necessary to sample the whole population. The sample for the study is therefore 101. The instrument thereof is the questionnaire which consists of the open ended and close ended questions for a clear understanding of the study objectives. Data is analysed in the form of tables and graphs for aspects covered in the questionnaire. Explanation to all the findings, which lead to recommendations, was also indicated.

Based on the findings, compensation and working conditions (including learners' discipline) seem to be the major factors that affect the retention and attraction of math and science teachers and therefore the Department of Basic Education need to find strategies to improve the working conditions of these men and women as well to compensate them according to the work load and the extra mile they are always willing to take in order to improve learner's performance. Retention factors are to be taken into serious consideration as they influence the teachers to stay in their classrooms. To mention just a few, skill recognition, job flexibility, passion and commitment, good

working conditions, compensation and benefits are the major retention factors explained in the study.

Results are based on the findings and recommendations were made to the Department of Basic Education in the North West Province. The conclusion is linked with the objectives of the study and the findings thereof. The achievement of objectives leads to the study completion.

Key words: Talent management, retention, attraction, recruitment, compensation, teacher turnover, teacher attrition, and teacher development.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The study is about giving a detailed explanation and discussing the factors affecting the retention and attraction of mathematics and physical sciences teachers in selected secondary schools in the North West Province. The focus area for the study will be Ngaka Modiri Molema District. The reason why this area was chosen is because the researcher is an inside participant in the research and she is currently employed by the Department of Education in North West and is teaching mathematics and physical sciences at Tau Rapulana Secondary School in the Bodibe Village. The latter is one of the schools in Ngaka Modiri Molema District, operating under the Ditsobotla Sub District Office.

The researcher views mathematics and physical sciences as scarce skills subjects and the shortage of teachers thereof is very crucial as it affects the learners' performance negatively and the grade 12 output results are used as a measuring tool for the performance of the learners. According to a report by South African Institute of Race Relations(SAIRR), mathematics was not offered in at least 84 high schools across the country from grade 10 to12 in 2012 as a result of a shortage of qualified math teachers (Anon, 2017). SAIRR also indicated that schools that did not offer mathematics will only offer mathematical literacy, as the National Senior Certificate (NSC) required that every learner should study either mathematics or mathematical literacy.

The Department of Education is therefore faced with the three main talent management components, that is, attraction, recruitment and retention of math and science teachers. As pointed out by Tai *et al.*, (2007), much of the existing research on recruitment mainly focused on bringing new science and mathematics teachers into the teaching fraternity and used retention as a means of keeping these new teachers in the schools.

1.3 PROBLEM STATEMENT

The problem this study wishes to address is:

The Department of Basic Education in the North West province seems to experience a challenge of mathematics and physical sciences teachers leaving the system which in turn, happen to be the reason behind the decrease in the rate of performance of the learners in the mentioned subjects. According to statistics released in December 2008 by the Cape Professional Teachers' Association (CPTA), it is estimated that 20 000 teachers leave the system each year (Samodien, 2008).

On the basis of the above statistics, the researcher therefore finds it very difficult to separate the performance of the learners from the exodus of teachers.

As an inside participant, the researcher observed that the Department of Education in South Africa made an alteration to the curriculum by adding Mathematical Literacy that is an alternative to pure mathematics, ensuring that every learner takes part in the learning math, even those who are less skilled in the understanding pure mathematics. Although this proved to be a fruitful idea, the implementation thereof needed an increase in math teachers. This curriculum change aggravated the issue of shortage of fully qualified and skilled math and science teachers. This issue lies in the failure of Department of Education to recruit talented math and science graduates who understand and could teach math and science.

Mathematics and mathematical literacy have a relation but there is a difference in terms of their nature and aims. Particularly, mathematics enables creative and logical reasoning about problems in mathematics itself which leads to theories of abstract relations (DOE, 2003). On the other hand, mathematical literacy uses a number of methods to help learners understand the application and uses of mathematics in real life situations. (DOE, 2003). The researcher therefore, does not see mathematical literacy as a solution for the poor performance of learners in mathematics or a strategy to put the country on the map regarding the mathematics.

Govender & Gruzd (2011), coated in UKessays, revealed shocking statistics with relation to educators in South Africa, by stating that up to 60% of the educators, were not academically equipped for teaching math and science. Education policies are drafted but there is lack of commitment, that is, the shutdown of colleges that strictly

specialized in education courses, the absence of efficiency when training teachers and teacher practices that are out of date which result in teachers with lack of training and limited knowledge of topics; therefore, the teachers have imparted knowledge with limited skilled knowledge of imagination usage and insight on content. This has built an unstable foundation for the future development of math and science graduates (UKessays, 2018)

Samodien(2008) reported that in 2008, Dr Rian de Villiers of the University of Pretoria, a teacher migration specialist, estimated that between 25 and 30% of all graduating teachers, left annually to teach abroad. "We are losing the best teachers in scarce subjects", De Velliers said.

De Velliers further pointed out that Zimbabwean teachers make up a large population of foreign teachers in South Africa (Department of Higher Education & Training (DHET), 2013). The main reason that South Africa accepts migrant teachers is that they may come as a viable solution to the problem of shortage of math and science teachers in the country (De Velliers and Weda, 2017).

The statements above by Dr De Velliers and Weda, should really ring a bell in the ears of our Government Officials that the Education system is experiencing a serious problem.

A report by the math, science and technology ministerial task team, drafted in 2013, indicates that the lack of qualified, skilled and experienced mathematics, science and technology teachers has become a critical matter (Steyn, 2015).

From the researcher's point of view, it pains to see a minimum number of learners registering for mathematics and physical sciences as though they are not important to the growth and development of the country. Something needs to be done. We need professionals to hold hands and come up with a solution that will cure this scourge once and for all. As a matter of fact, teachers are responsible for bringing a variety of knowledge, skills and experience into their classrooms, but the classroom conditions have an influence on productivity and the promotion of student educational outcomes. They also have a massive influence on the decision of whether or not the teachers want to remain in the profession.

Studies indicate that the South African education system is not only facing the teacher shortage epidemic, but there is a consistent number of teachers that have years of experience who exit the education system every year. In 2013, studies made a revelation that there was a need for a number of teachers between 25 000 and 30 000 every year, but even so the higher education and training produced only up to an average of 7 000 teachers a year with a maximum of 10 000 in a good year. This clearly shows that the demand for teachers is way more than the available supply and the education development system do not produce a sufficient amount of teachers required in the field (Anon, 2017).

Writer, (2018) in Sunday Times, indicated that South African teachers flee to Abu Dhabi since 2014 because of the high salaries where a qualified teacher is paid between R50 000 and R78 000 per month whereas in South Africa, an average teacher earns R275 000 per annum. The other factor is safety in our South African Schools. Minister of basic Education, Angie Motshekga stated that schools are becoming more violent and dangerous for both teachers and learners. In 2018 in North West Province, a teacher was stabbed to death by a 17-year-old learner and in Eldorado Park; a 15-year-old learner threatened the teacher with a gun (Writer, 2018).

In the North West University alone, Mahikeng Campus, out of 500 students who registered for education, only 29 are for mathematics and 18 for physical sciences in 2017. Even during the student teachers' time of internship, one will find that very few students are practicing to be mathematics and physical sciences teachers. For example, at Tau Rapulana Secondary School, in 2018, 14 student teachers came for training but only 1 came to practice for mathematics and zero for physical sciences. It is over 3 years now at the very same school that there is no one came for teaching practice for the two subjects.

1.2 BACKGROUND

South Africa is experiencing a shortage of teachers in general. In KwaZulu Natal only, South African Democratic Teachers Union (SADTU) indicates that in the whole province there is a shortage of teachers, especially for scarce skills subjects like mathematics, accounting and physical sciences. (Anon, 2014)

The decreased enrolment of learners in some schools had put the schools in a position where some of the teachers had to be declared in excess, and as a result they were

deployed to other schools, math and science teachers were also affected. During a Press Conference, the union's provincial secretary, Nomarashiya Caluza, commented that the Post Provisioning Model (PPM) did not take into account that certain subjects require specialized teachers. Caluza singled one incident at a school in Amajuba in the Newcastle District; the department had ordered that one of the school's Departmental Heads (DH) had to be moved to another school because of the decrease in the schooling numbers. The problem, according to Caluza, was that the school had no one qualified to teach math and science, except for this DH, and his transfer to another school would put the school in a predicament as no one was able to teach math and science in the particular school. (Anon, 2017).

It was reported in IOL news that in January 2016, Elias Malindi, spokesperson for North West Department of Education, said that as a department, they can confirm that there is a shortage of teachers since the teachers resigned in large numbers in the North West Province and that the treasury's co-management contributed to this fact as teachers were left with no choice but to leave the system since they had doubts about the security of their pension funds. (Montsho, 2016).

A 2016 statistical study released by the education department, indicated that there are about 435 000 teachers across the country. The department revealed that, in 2016, Kwa-Zulu Natal had 2 875 unqualified or under-qualified teachers, Northern Cape 400, and North West 419, out of which Ngaka Modiri Molema District has 201. The subjects most affected include mathematics, science and technology at all levels (Savides, 2017).

The points mentioned above simply suggest, according to the researcher, that much need to be done to have the relevant human resource for a job well-done in the Department of Education. The department is then faced with a problem of managing human resource and talent, so as to have the right people for the right jobs at the right time.

From the researcher's point of view, in some schools such as Tau Rapulana Secondary School, one could find a teacher faced with a class of 60 learners in grade 10, which creates a problem to the teacher as he/she is unable to comply with one of the performance standards of IQMS (Integrated Quality Management System), which is, creation of a positive learning environment, for example, learning space. In this

case, the poor teacher cannot divide learners into groups and is unable to move around to monitor individual learners' work so as to help those who are in need immediately to avoid misunderstandings in future. Classroom management then becomes a problem.

Apart from that, mathematics and physical sciences are the two most challenging subjects that need attention and the learners should have an opportunity to work out the examples individually and in groups, this cannot be practiced at Tau Rapulana secondary School as the teacher has to use the old method of standing at the front and preach as though everybody is listening and then expects a miracle to happen. Some of the learners happen to lose interest in learning the two subjects along the way because of these overcrowded classes, as the teachers are unable to address their individual problems and as a result, these learners become frustrated and do not know the correct career path to take.

The shortage of mathematics and science teachers in the North West secondary schools is a ubiquitous problem. Most of the schools face two sides of the problem, that is, recruitment and retention (Tai *et al.*, 2007). Generally, teachers are leaving the system in large numbers and mathematics and science teachers are no exceptions. As a result, the Department of Basic Education finds itself in a state where mathematics and science teachers are employed from other neighbouring African countries and India. A total of 3 796 were from Zimbabwe, 500 from Ghana, 90 from Namibia and 501 from India in 2011, according to the government employee database. Most of the foreign teachers taught physical science, math and technology to pupils from grade 7 to 12 at schools. (Anon,2011)

National Professional Teachers Organization of South Africa president Esrah Ramasehla said "we are not growing our teachers locally, but we are depending on teachers from Zimbabwe and India in key subjects like math and science." (Anon, 2014).

SADTU general secretary Mugwena Maluleke said that because the teaching profession in South Africa is not attractive, most of the teachers decided to leave the country and work overseas. (Anon, 2011)

Williams (2014), reported that the Department of Basic Education indicated that although 10 000 teachers leave the profession each year, little more 6 000 graduated each year. In 2017, World Education Forum (WEF) also reported that South Africa came last in 2016 for mathematics and science education quality. In 2018 South Africa was ranked 128th out of 139 countries for mathematics and science teaching (WEF, 2017/2018).

Within South Africa, Western Cape, Gauteng, and Mpumalanga were the best performing provinces. On the other hand, the three worst performers were North West, Limpopo, and Eastern Cape (Ngoepe, 2016).

The above statistics corresponds with what was found by Kent, Kruger and Du Toit in (2016), that South Africa was rated by the WEF on the report by Global Information Technology, as 146th out of 148 countries with regard to the quality of educational system. The 2015 report rated South Africa as 139th out of 143 countries, and the quality of mathematics and science education was still rated as last out of 143 countries. (Kent et al, 2016). These reports are more or less the same. North West Province is not an exception. Eugene Daniels indicated that out of 100 learners registered in grade 1, 40 will reach grade 12, out of which 28 will pass and four will qualify for university entrance and only 1 will graduate (OIL, 2012).

Table 1.1: The percentage of learners who qualified for university entrance in 2015 – 2017

Source: Department of basic Education

Year	Number of candidates	% receiving a bachelor pass
2017	534 484	28.7%
2016	610 178	26.6%
2015	644 536	25.8%

The North West Education Department had often emphasized that our province relies heavily on the production of more Mathematics, Science, Technology and Commerce learners as North West is a mining and agricultural province. Special efforts need to be channelled to improve the quality of the Grade 12 mathematics and physical sciences

results (Department of Education, DoE, 2014). Shortage of maths and science teachers leads to poor performance of the learners in these subjects, especially in grade 12.

According to the figure below, there is an improvement in the mathematics and science results but what is worrying is that the percentages have not yet reached at 50%, which shows that the results are not satisfactory. The results are at an average level.

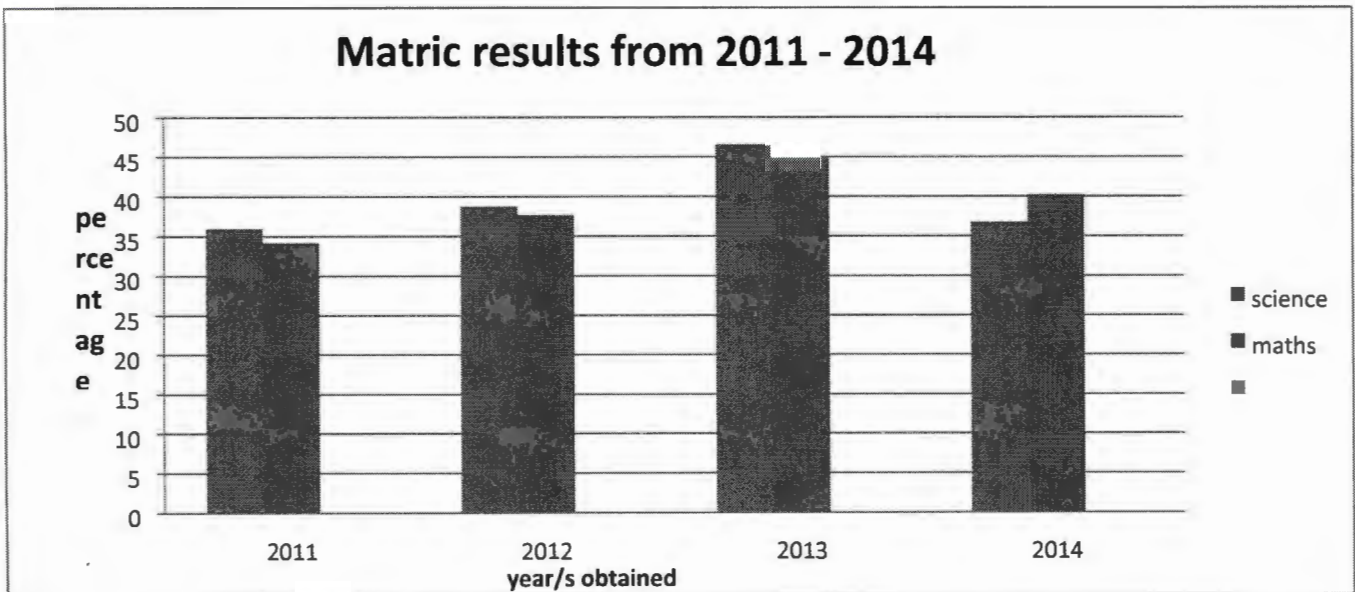


Figure 1.1: The grade 12 learners' performance in mathematics and physical sciences (2011-2014) – Adapted from DoE 2014 Grade 12 Results Analysis

Grade 12 results are used in the study, because the department of education uses the results as a measure of learners' performance in the country and for international rating in the performance of these subjects.

1.4 CORE RESEARCH QUESTION

What are the factors affecting the retention and attraction of mathematics and physical sciences secondary school teachers and what strategies can be implemented to solve the shortage of mathematics and science teachers in North West Province Secondary schools?

1.5 SPECIFIC RESEARCH QUESTIONS

The study will be guided by the following research questions:

- i. What measures have the department of Education in the North West Province put together to address the problem of the shortage of mathematics and physical sciences teachers at the selected secondary schools?
- ii. What strategies are put in place by the management of secondary schools in the North West Province to retain the mathematics and physical sciences teachers?
- iii. How is the shortage of mathematics and science teachers affecting the performance of learners in the North West secondary schools?
- iv. What are the specific identifiable qualities of a good mathematics and science teacher in secondary schooling system?
- v. What is the effect of working conditions on attraction and retention of mathematics and science teachers in the North West secondary schools?
- vi. What is the effect of compensation on the attraction and retention of mathematics and science teachers in North West secondary schools?

1.6 RESEARCH OBJECTIVES

On the basis of the research questions formulated above, the following is therefore the research objectives of this study, namely:

- i. To investigate what the Department of Education in the North West is doing to address the problem of the shortage of mathematics and science teachers.

- ii. To determine the strategies put in place by the management of North West Province Secondary Schools to retain the mathematics and science teachers.
- iii. To determine how the shortage of mathematics and science teachers affect the performance of learners at the North West secondary schools.
- iv. To determine specific identifiable qualities of a good mathematics and science teacher in secondary schooling system.
- v. To determine the effect of working conditions on the attraction and retention of mathematics and science teachers in the North West secondary schools.
- vi. To determine the effect of compensation on the attraction and retention of mathematics and science teachers in the North West secondary schools.

1.7 THE IMPORTANCE AND BENEFITS OF THE STUDY

The study is basically focused on the factors affecting the retention of mathematics and physical sciences teachers in North West Province Secondary Schools. The Grade 12 output results will be used as a measuring tool for the performance of the learners versus the number of mathematics and science teachers. This study will help the Department of Basic Education in North West to identify the challenges faced by mathematics and science teachers and the factors leading to them leaving the system or moving from one school to another.

The importance of retaining the mathematics and science teachers in the secondary schools will also be realized as this will be highlighted in the recommendations of this study.

The study will also provide the Department of Basic Education North West with strategies to retain the mathematics and science teachers in the teaching fraternity, and to recruit and attract more mathematics and science teachers into the system.

Most importantly, the study addresses the grade 12 failing rate in mathematics and physical sciences so as to be in same level as other countries, because South Africa is rated among the under-performing countries in a far as mathematics and science are concerned. This will be indicated in recommendations and if the Department apply those recommendations and solutions, the problem will be alleviated and this will result in the improved quality in grade 12 results.

As part of introduction of the study, delimitations and assumptions related to the title of the dissertation, and definitions of key words used in the literature review as well as abbreviations used in the whole document will be explained in the following paragraphs:

1.8 DELIMITATIONS AND ASSUMPTIONS

Delimitations refer to choices made by a researcher with regards to the study and are completely controlled by the researcher. Delimitations also include the population of a study, variables, statistical analysis and focus of researcher. In short, delimitations mean boundaries of the study (Simon, 2011)

Assumptions are factors potentially influenced to your study for which you have no hard data, might not ever know, and cannot or do not intend to control (Simon, 2011).

1.8.1 Delimitations (scope)

The purpose of this study is to explore, identify and describe the factors that affect the retention of mathematics and science teachers in the Ngaka Modiri Molema District. In understanding the factors, the school management can better plan and implement a talented retention strategy for this group of talented employees. The focus will be in the Ngaka Modiri Molema District because it is the area to which the researcher is attached and being an inside participant in the study. The researcher finds it very convenient to conduct the research in this area as this will enable her to save time and minimize travelling costs (Simon, 2011).

1.9 ASSUMPTIONS

There seem to be a high shortage of mathematics and physical science teachers in North West and my focus area, Ngaka Modiri Molema District is of no exception. There are likely to be several factors affecting the retention of mathematics and science teachers in this area of focus. This study is therefore poised to investigate these possible factors. Because, mathematics and science teachers are leaving the teaching fraternity in large numbers and the exodus of these scarce skills, leads to the poor performance in these two subject areas.

1.10 DEFINITION OF KEY TERMS

- **Talent management:** A process in which people with aptitude abilities are retained in order to meet the current and future organizational needs, thereby having the right people, for the right jobs at the right time and includes attracting, managing and developing high quality workforce (Sireesha & Ganapavarapu, 2014).
- **Teacher development:** A process where teachers naturally develop personal growth by way of acquiring confidence, increasing knowledge, gaining new perspectives, discovering new methods and taking on new roles (Eraut, 2016).
- **Performance management:** A process whereby the success of an organization depends on the working together of managers and employees to set expectations, review results and reward performance (Grobler *et al.*, 2006).
- **Teacher attrition:** A decrease in the number of teachers caused by poor working conditions such as work overload, poor interpersonal relations, poor salaries and lack of support from the school management team (Mkhondo, 2017).
- **Teacher turnover:** The number or percentage of teachers who voluntarily or involuntarily leave the teaching fraternity in comparison with the number or percentage of teachers who stay in the teaching fraternity over a certain period of time – literature review (the role mathematics and science teachers' turnover in staffing problems and the reasons behind the turnover (Ingersoll and Perda, 2010).
- **Recruitment:** The process of acquiring applicants who are available and qualified to fill positions in the organizations (Grobler *et al.*, 2006).

- **Retention** is the process whereby an organization ensures the competitive advantage of its workforce by putting in place the strategic opportunities (Lockwood, 2006).
- **Compensation:** The term is used interchangeably with wage and salary administration but in actual fact, the term refers not only to extrinsic rewards such as salary, but also to intrinsic rewards such as achieving personal goals, autonomy and more challenging job opportunities (Grobler *et al*, 2006).

Table 1.2: Acronyms used in this study

Abbreviation	Meaning
ABET	Adult Basic Education and Training
ANA	Annual National Assessment
CAPS	Curriculum Assessment Policy Statement
DoE	Department of Education
FET	Further Education and Training
GET	General Education and Training
ICT	Information and Communication Technology
IQMS	Integrated Quality Management System
NCS	National Curriculum Statement
NSC	National Senior Certificate
OBE	Outcomes Based Education
PPM	Post Provisioning Model
PSF	Professional Support Forum
SACE	South African Council of Educators
SAIRR	South African Institute of Race Relations

SES	Subject Education Specialist
SGB	School Governing Body
SMET	Science Mathematics Engineering and Technology
WEF	World Education Forum

1.11 OUTLINE OF THE STUDY

The study consists of five chapters

Chapter 1: is the introduction and background to the study as explained

Chapter 2: is the literature review which provides detailed explanation of the factors affecting the retention of mathematics and physical sciences teachers in the North West Province Secondary Schools. The theoretical foundations derived from related research articles are examined.

Chapter 3: is the design and methodology which describes the way in which the research will be conducted, the tools for gathering information and the population of the study including data collection. In this chapter, the quantitative and qualitative aspects of methodology methods are explored.

Chapter 4: Will present the research results and discuss the findings. Data collected will be analysed.

Chapter 5: Will be concluding the study with summary of the whole study as well as recommendations. Suggestions and managerial implications and future strategies to overcome the problem will be discussed in this chapter (Ingersoll, 2011).

1.12 CHAPTER SUMMARY

This chapter introduces the study based on the factors affecting retention, attraction and quality of mathematics and science teaching and the performance of the learners in North West Province Secondary Schools. The chapter gives the background information about the Department of Education in the North West Province and the general Education System in South Africa.

The problem statement and the core research question are outlined in this chapter. The significance of the study provides a clear understanding of why the researcher chose the particular study and the benefits thereof.

In this chapter, the key words are defined, the acronyms are explained and the chapters are outlined. It is in this chapter that a reader will want to go through the whole study as it gives direction of what the study is all about.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the core literature in support of the study will be presented and discussed to comprehend the meaning of job satisfaction in general as well as retention, its advantages and significance to the mathematics and physical sciences teacher's profession.

The main aspect that is crucial in this study is the shortage of mathematics and physical sciences teachers in South Africa especially in the Ngaka Modiri Molema District in the North West Province. This shortage is a cause for concern hence this study wishes to examine and explore the factors that may lead to the retention of mathematics and physical sciences teachers in the selected secondary schools in Ngaka Modiri Molema district. It may also be important right at the outset to indicate that the job satisfaction levels of the teachers may to some extent be linked to factors that are responsible for the retention of the teaching cohort under study. Furthermore, as part of human resource management, talent management is the epitome of retention. It is thus vital to explain what job satisfaction is in the context of teachers and also to explore the meaning of talent management. These will enhance a better understanding of the retention of mathematics and science teachers in the secondary schooling environment under study.

In addition to job satisfaction, theories related to talent management and retention will be explored at length. However, in doing so, the focus will be more on exploring the factors that influence retention of mathematics and science teachers in North West Secondary Schools. The chapter will end up in a conceptual framework for this study.

2.2 NATURE OF JOB SATISFACTION AND WHAT IT MEANS TO A MATHS AND SCIENCE TEACHER REGARDING RETENTION

Job satisfaction is one of the mechanisms that directly affect job performance and organizational commitment (Stanton, 2010).

Job satisfaction is defined as the process whereby employees' expectations, which lead to a positive feeling about the job, are met, as a result of the evaluation of job characteristics. The feeling thereof is dependent on employee's perception of satisfaction (Gangai and Agrawal, 2014).

In the teaching context, job satisfaction is influenced by the leadership qualities of the school principal. The principal plays an important role in leading the teachers to achieve their main goal of installing knowledge and information into the minds of learners because leadership means guiding the members towards a purpose and in an educational institution it is a basic phenomenon, as the whole department depends on the teachers who cultivate minds and implement educational policies based on curriculum (Hussain *et al.*, 2017).

Job satisfaction is, in simpler terms, a way of explaining how content or satisfied employees are with their jobs because employees' emotions about their workplace, the approach towards the job and the extent to which the job is satisfying their needs, are measured through job satisfaction (Javed, Balouch and Hassan, 2014)

Job satisfaction in teaching, however, is negatively related to stress because many teachers are experiencing stress within the profession which then have a negative impact on their job satisfaction and consequently may find themselves resorting to absenteeism, turnover or eventually leaving the profession (Veldman *et al.*, 2016).

The researcher sees job satisfaction as a tool that management of any organization can use to retain its employees. One cannot deny the fact that happy employees will always be dedicated, committed, devoted, and determined to go an extra mile for the benefit of the organization. Such employees become part of decision makers and they form an anchor to the particular organization. Teachers on the other hand, need to feel appreciated by the principals and SMT as that will motivate them and encourage them to face challenges in their classes, eventually improving learners' performance.

Furthermore, job satisfaction, according to the researcher, is directly proportional to job performance, competency and retention. If employees are satisfied, they will put more efforts on their work, be competent and will see it a need to stay in the organization for a longer period.

2.3 TALENT MANAGEMENT

Talent management is a human resource component that was initially designed to ensure that the supply of talent is available in order to have the right people for the right jobs at the right time, based on the need of an organization (Grobler et. al, 2010). On the other hand, the meaning of talent is generally assumed and not explicitly defined. Lewis and Heckman (2006) argue that frequently and synonymously, people's individual knowledge, skills, attitudes or competences, are used to describe talent. The researcher therefore considers an employee as a talent to the organization, so are teachers in the fraternity.

Talent management is defined by various researchers and authors, as we all have our understanding of the concept. Hereunder, follows definitions by some of the researchers and scholars:

Talent management refers to the planning to meet the required human capital for a particular organization and the anticipation thereof. Talent management is the science of using human strategic planning applied by organizations and companies to reach their goals thereby improving business value (Du Plessies, 2013).

We can therefore define talents as individuals who have distinct skills and capabilities that enable them to perform exceedingly well above set standards or expected standards and can provide effective support to the employer and higher management in the pursuit of reaching its intended objectives (Longo, 2014).

Talent management and employee retention put together, can assist any organization to retain quality employees (Longo, 2014).

According to the researcher, a talented teacher is the one capable of providing instructions that engage gifted learners. One of the measures used for teacher performance is the creation of a positive learning environment for the learners and most of the teachers find it very difficult to practice that, sometimes because of the frustrations experienced by teachers due to pressure put on them by the Department of Education.

As the researcher is an active participant in the North West Province Department of Education, it was realized that it is quite difficult to retain mathematics and physical sciences teachers in rural areas than in urban areas as most of the teachers are not

willing to serve in the rural areas due to lack of resources, and the misconception that mathematics and physical sciences are the most difficult subjects and therefore one will always find negative learners in the class.

Recruitment and retention are clearly linked but represent different aspects of school staffing. The recruitment of mathematics and science teachers is not an easy task because education research appears to be focused on attracting individuals with mathematics and science backgrounds into teaching as a profession (Tai *et al.*, 2007). The effort to improve math and science education in South Africa would be better if the focus is on the development of professional capital in the teaching profession but not exclusively on the identification, recruitment, and preparation of teachers; hence this research is mainly focused on retention of these talented individuals in the system of education.

2.3.1 Retention as part of Talent Management

In as far as retention is concerned, every HR department of any organization has a major role to play in the reduction of number of employees leaving or planning to leave the organization by improving their working conditions and key processes. The aim at the ultimate end is keeping happier and loyal employees that want to remain in the organization. The first and one of the hardest tasks faced by HR departments, is how key factors such as employee engagement, salary expectations, perception of working environment and perception of managerial ability, are measured (HRzone, 2015).

According to the Business Dictionary, retention has two definitions: (1) is a condition of retaining (keeping) something. (2) Retention is an effort by an organization to create and maintain an environment or atmosphere that will ensure that employees want to continue their employment with the company. A lot of policies concerning employee retention are aimed at addressing a variety of needs of employees to enhance their job satisfaction and reduce the substantial costs.

Teacher retention has a relation to the composition of the school's student population, in particular, to the poverty level and racial make-up of students (Plecki *et.al*, 2005).

The researcher's definition of retention is that: it is a process whereby an organization keeps its well-skilled, qualified and experienced employees for good production, by providing good working conditions, engaging them in decision making and paying them

good salaries. Teacher retention is thus a process whereby Education Department ministry, principals and school governing bodies work together to provide support, more conducive working environment with good salaries in order to keep qualified teachers for the enhancement of good results.

2.3.2 Advantages of retention

In order to retain employees, managers need to have good leadership skills (Seber, 2017). From the researcher's angle, in essence, experienced employees are said to be assets of an organization as they know all the strategies to do the work, changing employees from time to time will only imply an incompetent leader. Therefore, Human Resource (HR) managers ought to be good leaders, because not all managers can be leaders but all leaders can be managers. Principals, in particular, need to be well informed regarding human resource concepts, including talent and performance management. Seber(2017) also indicates that retention of employees prevents hiring costs and reduces training costs. Employees are therefore considered by the researcher, as an organization's intellectual assets, without which there will be a frictional force opposing the motion.

From the researcher's point of view, one of the basic roles of Human Resource managers is to manage talent. Retention, as a human resource component that proves talent management, is very essential in all companies because it means talent is well-managed. A company which keeps its employees for a longer period will obviously have good production. Similarly, to schools, if there is good governance and management, most teachers will not think of leaving the system the way they do, or teacher-turnover could be easily prevented (Seber, 2017). There are therefore four advantages of retention, namely, acquiring talent, financial gain, development of skilled labour force and positive impact on production and services.

The advantages of retention are summarized by the researcher in the following figure:

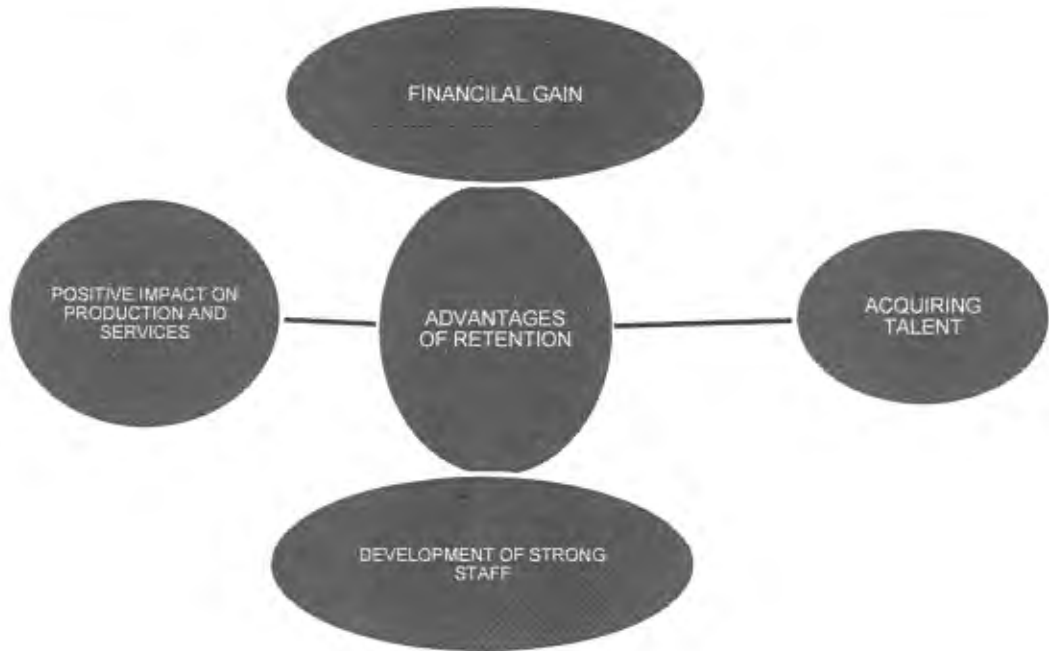


Figure 2.1: Advantages of retention

The increase of recruitment methods is a vital issue that must be taken into consideration. Teacher recruitment is an important challenge, but Ingersoll has made the strong claim that an even greater concern is teacher retention (Ingersoll, 2014).

2.3.3 Disadvantages of retention

Sometimes retention turns to have a negative impact on both the employees and employers. Some organizations experience challenges when they try to put retention into practice. Disadvantages of employee retention are: negligence of unrewarded tasks; unsuccessful negotiations on goals; competition amongst employees; lack of employees' involvement in decision making; financial implications and lack of employee motivation (Chamberlin *et al.*, 2002).

The disadvantages stated above point out that a good practice such as retention has negative impacts in the running of the organizations. It is always good to understand both sides of a coin to avoid misconceptions at a later stage. In reality, if one stays at the same workplace for a long time, they happen to make a workplace their homes and become stubborn they know every corner of the organization and tend to forget their positions they are also too demanding, do not want to be told what to do.

In teaching, as curriculum changes from time to time, the old teaching methods are still applicable. In order for them to be retained, teachers need to be developed and introduced to the new changes because the department of education depends on them for the implementation of the changes. Math and science teachers in particular, learn as they teach, so retaining them is very important as they learn new approaches on problem solving on daily basis, so to let them leave the system is an offence to the poor learners.

2.4 FACTORS CAUSING TEACHERS TO STAY IN THE SCHOOLING SYSTEM

It is important to understand the reasons causing teachers to leave the profession. Before one can understand the reasons for teachers to leave the system, the researcher finds it better to start with the reasons behind them staying in the classroom.

Not all teachers want to leave the teaching fraternity. Some teachers see it a need to stay in the profession as they took this career with passion and as a calling. Listed below, are some of the reasons that may cause the teachers to stay:

- Skill recognition
- Job Flexibility
- Passion and commitment
- Academic relationship with the learners
- Teacher expertise
- Good working conditions
- training and development
- Career Development
- Compensation and Benefits
- Communication (Mart, 2013; Claessen and Engel, 2013; Salah, 2016; Podolsky and Kini, 2016).

2.4.1 Skill recognition

Skill recognition is the process whereby employees' skills are assessed and recognized by identifying the transferable skills (Claessens & Engel, 2013).

In any organization, providing skill recognition of job accomplishments as an effective retention strategy for employees at any age, is very important (Salah, 2016)).

Studies show that satisfying individuals yearn for acceptance by giving proper acknowledgement for the performance and exceptional tasks they do, increases the chance of employee retention (Salah, 2016). A Study by Gangai and Agrawal(2014)shows trends of an increased number of job applicants that are looking for growth in their workplace. This means that they are looking for companies that provide recognition, teamwork, freedom of input and value thereof instead of ones that provide incentives and compensation packages.

2.4.2 Job Flexibility

Flexibility in a work place allows communication between employees and employers with which they will have arrangement about suitable working conditions that are mutually beneficial (Cunningham, 2002).

Job flexibility plays a vital role in retaining employees of any age (Sinha, 2012). Researchers describe the importance of employment flexibility as the ability to schedule variations that are able to accommodate employees' tasks that are work related and that involve their personal interests (Cunningham, 2002). Marital and family responsibilities, work tasks and their workload are included in this regard. Studies show that through "flexibility" individuals are able to maintain a healthier balance between work and personal obligations, which affects employees of all ages (Myers and Sadaghiani, 2010).

The above literature suggests that with job flexibility, employers are able to offer their employees alternatives to the daily work schedule, thereby enabling them to find a better balance between work and life. Employees that have flexi times are allowed the opportunity to determine and control the hours in which they work. Again, job flexibility is advantageous as it increases morale of employees, motivates and encourages the employees to be more committed to their work and the rate of absenteeism and tardiness can be reduced.

2.4.3 Passion and commitment

Teacher performance is affected by passion. Teachers are driven by passion to a better student accomplishment. Passionate teachers are dedicated and committed to their jobs and a good education achievement is an outcome of this commitment and

dedication. In the process of learning, teachers play very important roles, one of those is to motivate students who idealize them and in a way try to imitate them (Alam and Farid, 2011).

The researcher, as an in-sight participant in this study, viewed passion according to the following aspects: (1) Math and science teachers, in particular, happen to fall in love with subjects and see everything outside the classroom from a scientific perspective. They happen to apply scientific reasoning unnecessarily because of their love for science. Some teachers want to be teachers even at their homes, community gatherings and in churches. Most of the Sunday school teachers are professional teachers. This shows the passion of teaching. (2) During lunch time, one will find mathematics and science teachers sitting amongst the learners, trying to offer extra lessons and motivation to these young scientists and mathematicians. Now, that is called dedication. Such teachers are there to stay. (3) Passionate mathematics and science teachers are able to turn every argument into a scientific enquiry. (4) Teachers with passion to teaching, find it very difficult to absent themselves from work, because missing their periods in a day is like a day without sunshine. (5) Some mathematics and science teachers even offer extra lessons in their communities, some for free, others for a little payment that is not worth their efforts. This also is a way of showing passion in teaching the two subjects.

Mathematics and science as disciplines can be epistemologically and methodologically distinguished, and these differences are represented in the subject matter, pedagogies and purposes associated with their respective school versions. The level of commitment of mathematics and science teachers and the knowledge of the subject matter is a necessity (Peerzada and Jabeen, 2014).

This brings into context, the IQMS Performance Standard 2, knowledge of the subject matter. For mathematics and science teachers, this is a very strong point that encourages them to be glued to the classroom. One will find a mathematics and/ or science teacher having an argument with their learners so as to have them as active participants in the classroom, but that does not come easy, it is accompanied by knowledge of the subject matter. If the teacher knows the subject matter, there will be no conflicts; the particular teacher will obviously command respect and that will instil learner discipline, dedication and devotion.

Monroe (2005) says: “passion is a stamina that says I am going to go after this, no matter what happens, even if I have to wait ten years, I am going to get it.”

However, passion and commitment is coupled with teacher quality and quality teaching, which depends on four aspects, namely: Data from Educational Research, Recommendations from Professional Organizations, National Standards for teachers and Science, Mathematics and Technology for students

Learners' passion and commitment also adds to the factors that encourage teachers to stay in the profession. When working with committed learners, the teacher enjoys the class and it is very rare to find him/her absent from the lesson. As an insight participant, the researcher experienced the positive impact of learner passion and commitment to the performance of mathematics and physical science. Class of 2016, at Tau Rapulana Secondary School obtained 100% performance in grade 12 physical sciences, simply because they were very committed.

2.4.4 Academic relationship with learners

Most of the teachers, when asked about the reasons keeping them in the classroom, they will not hesitate to mention their learners. For such teachers, their learners are the main reason of them staying in the profession and the main one for waking up in the morning with that positive energy, which they hope to transfer to the learners. The fact that kids are constant is enough to develop a desire within a teacher to make a positive impact into their lives which should as well be constant. (Brown, 2016)

Mart(2013) Teachers who are able to create an effective teacher-student relationship that is well in line with the professional standards and tend to perform the roles that are required from their jobs with great efficiency, are said to be committed.

When teaching with passion, teachers are able to empower their learners as they will be equipped with knowledge of the subject matter that gives them ability to think and this boosts their confidence and self-esteem, and as a result, they become motivated in performing class tasks and feel more competent (Houser & Frymier, 2009).

Mart(2013) listed basic characteristics of a passionate teacher, and among others, are:(1) the teacher takes an interest in knowledge and ideas and likes working with young people; (2) takes good care of her learners; (3) is tolerant of the meaningless and absurd things that result from learners behaviour, but critically motivates the learners to have good manners. These characterises a good teacher – learner relationship. Such teacher will hesitate to leave the classroom.

Teacher- learner relationship is, according to the researcher, one of the factors that decide the degree of teacher commitment and dedication. Maths and science teachers in particular, are in most cases, have the learners' interests at heart. In order for learning to be an enjoyable venture, one needs to fall in love with the subjects they teach and this will serve as an attraction to the learners, which is exactly what committed maths and science teachers do.

Classroom teachers wield a great deal of power over the learners simply due to the fact that they control their destiny for up to seven hours each day, five days a week or sometimes, six days a week. Students are often more willing to comply with the teacher's wishes once they feel that she values and cares for them. Their willingness to comply assists the teacher to overcome discipline problems in the class.

2.4.5 Working Conditions: Learning and working environment

In order to improve retention of teachers, more focus should be on improving the working conditions of teachers. Creation of better working conditions might work effectively towards retaining talent in schools as it also costs less (Ladd, 2006).

It is vital for talented employees to have learning and development opportunities. (Alvarado and Bretones, 2018). It is therefore important for an organization to establish and maintain a supportive learning and working environment. Abrams et al., (2008), cited by Sinha (2012), stated that previous research derived the concept of learning and working environment. This refers to the space wherein employees learn and work. Teachers always use a slogan that "We learn as we teach."

Lack of support in their environment, can decrease the teachers' involvement their and efforts. Three factors that need to be in equilibrium, for the teachers to have good working conditions are: the role change of teachers, the support from the social context

and the ambiguity in the educational objectives. If these are in equilibrium, the teachers will reach stability in the profession (Alvarado & Bretones, 2018).

Based on the above point, the researcher points out that it is well-known that a teacher's work is not only to go to the classes and teach, a lot of administration work is also required. A teacher, especially, a mathematics or science teacher, is faced with the biggest challenge, that is to teach the most difficult subject, in which learners have developed a negative attitude because of their performance, so creation of a positive learning environment is a hell of a job for every mathematics and science teacher. These teachers, therefore, need support from their colleagues, parents, principal and administrators.

The literature used for the research suggests that higher school management with good leadership qualities implement a number of strategies to ensure that teachers are satisfied in the workplace. These strategies include assigning suitable teachers to respective grades and subjects; putting time aside for proper planning; building a strong bond of trust among teachers and encouragement of teacher teamwork and collaboration; giving teachers a more active role in the employment and induction of new teachers; involving teachers in the school financial planning, learner discipline, and decisions pertaining to the curriculum; supporting teachers in disciplinary matters; feedback and praise (Ingesoll, 2011).

The researcher sees a good working environment as the one bearing good fruits. The production of every organization depends on the happy employees that will obviously attract clients or customers. Teaching is no exception, as the minds of learners need to be cultivated and the only way to do this is to make it simple for the mind to absorb the knowledge and information. It is therefore vital for teachers to be in a good mood every day, in order for them to be able to transfer knowledge to learners without any struggle.

Conducive working environment is a basic need for all employees, not only teachers. If that aspect is taken into consideration, there is going to be high production. Similarly, in teaching, a good working environment influences the learner performance as the teacher will be motivated to attend classes regularly and will obviously create a positive learning environment for learners. Mathematics and science class needs that positivity, because learners need to discuss some of the concepts in groups and there

supposed to be good communication between the learners and the teacher, to make learning an enjoyable venture (Geiger and Pivivarova, 2018).

2.4.6 Teacher Expertise

Mathematics teaching requires a teacher to be able to analyse a task by sizing the task up, adapting the task for a specific group of learners and seeing the mathematical possibilities in the task. A deep understanding of knowledge and practises underpinning the specialization as well as the passion for teaching, is what defines a quality teacher (Parker, 2009).

From what Parker has pointed out about quality in teaching, this relates exactly to math and science teaching because without passion of the two subjects, one can find it difficult to transfer knowledge to learners. In reality, not all math and science learners are good, but they might have passion in learning the subjects and as a result, they need a dedicated and committed teacher who is willing to take them to where they want to see themselves in future.

Based on the point given above, the researcher wants to align herself with the fact that experience is a good teacher. One cannot deny the truth about experience, that it plays an important role in teaching. The fear is that some of the younger teachers do not have passion for teaching as they just want to use teaching as a ladder to achieve their dreams. They sometimes get frustrated by the workload, compensation and learner behaviour, and as a result, they may not stay longer than expected in the classroom. Based on the above facts, it is clear that retention and attraction of the experienced teachers is very important. Some of these youngsters took teaching out of frustration as they were unable to find jobs for the degree they have studied, and then they studied for Post Graduate Certificate in Education (PGCE) also offered by the Department of education. This is just a one year course that does not have enough content for the subjects and a little methodology. These young teachers do not have learners' interests at heart; they are doing it to earn a living, whereas teaching needs passion.

However, some researchers such as Draper, argue that it is not necessary for a teacher to be an expert in the subject matter, but should rather be an expert in

teaching. He further says learners need not to be hundred percent dependent on the teacher, but should also do their part to gather knowledge and information. As coded: “learning is only the transmission of information from expert to learner” (Draper, 1998).

The researcher agrees with the fact that teachers’ expertise is important for the development of learner’s mind. As a matter of fact, teaching mathematics and physical sciences is really a challenge to most teachers who are not experts in the subjects. The two subjects require that teachers should have a clear understanding of the concepts before they go to classes because they can be embarrassed and lose confidence, without which, learners can lose interest in learning the subjects.

Enthusiasm is also a contributing factor towards motivation because if a teacher who is happy to go to the classroom and get excited about teaching the learners, learners will definitely learn from the example. This builds a positive energy thereby leading learners to have positive attitude and there will be a successful learning atmosphere.

2.4.7 Training and Development

Employees may be regarded as the blood streams of any organization as the running of the organization depends on the performance of its employees. This is why training and development of employees is essential in order to manage retention (Salah, 2016). In training, both formal and informal processes are applied to impart knowledge and to assist the human resource available in acquiring relevant skills to ensure quality job performance, while development prepares human resource for new positions and responsibilities.

The population of a country mainly depends on the quality of teachers for excellence. Teacher development and training thus plays a role in ensuring quality human resource in the education system because teachers must be much better acquainted with personal development features of their pupils, with learning processes and with the indicators of learning quality and knowledge application.

Teacher development can be seen as a process in which the aspects of development; personal, professional and social development are occurring, and one in which development in one aspect is a prerequisite to the development of another (Evans, 2002).

In 2008 the minister of education Mrs Naledi Pando made a request to the teacher unions and DoE to create a concept paper on teacher development in South Africa, which will include, inter alia, a common vision for teacher development (Davids, 2009). As a result, the DoE committed itself to the ongoing process in order to ensure there are quality educators in South Africa as the country requires.

During the teacher development summit, the slogan that was used was: "Perfecting the art of teaching", and it assisted in restoring the image of the teaching profession.

Davids(2009), The Quality Learning and Teaching Campaign (QLTC), the aim of which is to involve stakeholders in the process of putting education at the heart of social transformation, was developed during the launching of the health and education campaign by the African National Congress (ANC). The primary duty of the QLTC is to improve quality education through the collective collaboration of all the stakeholders of the schools

Kruss(2009), cited by Davids, also commented about the improvement of higher education for teachers and stated that since 2004, the improvement of teacher education has been given a sustained attention as a consequence of the revision of the curriculum and the restructuring of higher education.

2.4.8 Career development

Career Development is a unique process whereby an individual is able to manage learning, work, and transition for effective participation in work and society and as result, moving forward to achieve lifelong objectives (Mulhall, 2014).

In order for an individual to explore and sort out questions related to employability, directions, skills development, personal development, progression and making a difference, career development programmes need to be put in place for the functionality of an organization (Mendoza, 2007).

Career development in teaching is very essential because of the ever changing curriculum and new methods that are introduced to overcome the high failure rate in schools. Newly appointed teachers need to be taken through a journey to ensure quality teaching and learning (Anon, 2017).

Career development in teaching, is subject to professional development which allows staff to have development of their instructional skills in ways that are embedded in the actual practices of their program (Frerichs *et al.*, 2018).

It is therefore important to note that career development allows individual to grow intellectually and may come up with strategies to solve problems within an organization. The department of basic education have programs put in place for teacher development. To mention just a few, Sediba project for maths and science, PGCE, ACE per subject specialization. SACE ensures the promotion of professionalism amongst all educators in South Africa through its vision statement. The programs mentioned above encourage teachers to stay in the profession and are thus applied by the department of education as a strategy to retain teachers.

The process of career development, according to the Human Resource dictionary, involves five concepts; namely, self-assessment, career awareness, goal setting, skill training and performing. The process is described in the diagram below:



Figure 2.2: The process of career development

Source: www.pinterest.com

2.4.9 Compensation and benefits

Attraction and retention of quality teachers is one of the most important drivers of a functional education system because the system is faced with a challenge of preparing diverse students with complex needs to allow them to participate in today's knowledge-driven economy. (Podolsky *et al.*, 2016).

Defined benefit pension plan by the South African Government is a strategy to retain public servants, including teachers. A defined benefit plan guarantees a predictable monthly payment at retirement calculated by using an established formula which includes employee's salary, years of service and age.

Podolsky(2016), further suggests in South Africa, aspiring teachers are being offered an opportunity to study a degree in teaching or to pursue a post graduate certificate in education(PGCE) by universities. The marketing strategies for teaching positions by

Employment agencies are irresistible, especially by young job seekers. A package offered by schools, being it private or public, is usually inclusive of irresistible benefits.

The benefits can provide a peace of mind for employees and this will lead to productivity and job satisfaction. If employees find the coverage they receive from their employers satisfactory, they can feel a sense of pride in their employers.

Teachers' salaries seem to be one of the major problems for attracting individuals into the fraternity; however, there are other benefits such as housing allowance, accessibility of medical aids, the unemployment insurance fund, teacher development programs, induction and support for the newly appointed teachers and pension fund.

In the teaching process, passion is a driving force. This means that the rewards are not measured by the salary type. The teaching rewards are, inter alia, the learners' success, growth and development of learners' skills. These rewards outweigh the challenges that might be faced by teachers. South Africa is a nation that is hungry for new generation of leaders and educated youth, which makes teachers an essential resource (PNET, 2017).

The researcher argues that teachers are less compensated as compared to the efforts they take to develop learners in totality. The challenges teachers are facing everyday calls for the department of education to think again about the salaries thereof.

2.4.10 Communication

Communication is a very important skill that every individual needs. It is one of basic needs of any organization as it serves four major functions within an organization namely; control, motivation, emotional expression and information. It is a control tool for employees' behaviour. A framework of a communication process is given below:

The communication process

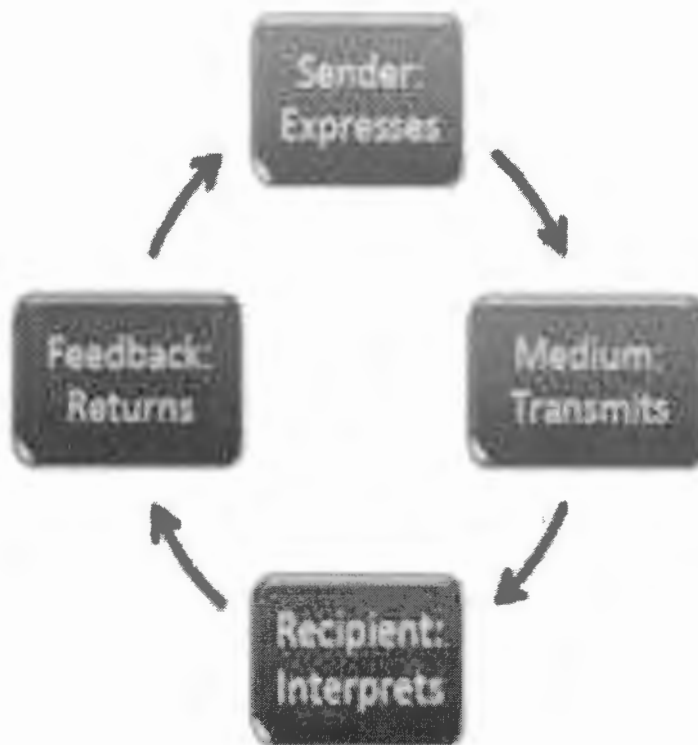


Figure 2.3: The communication process

Source: <https://www.ellenfinkelstein.com/pptblog/use-feedback-to-completethe-communication-cycle/>

The process of communication indicated in the figure above, serves very well in the teaching and learning process. Teachers transfer knowledge, verbally or via technology, learners interpret the information and feedback will be seen after assessment as teachers go through learners' responses and use the feedback as a tool to measure whether the objectives are achieved or not.

Teaching career is one that meets the objectives of communication; to motivate, to give information, to teaching, to persuade to make a certain decision, to entertain and to inspire (Finkelstein, 2002).

In a classroom situation, a teacher needs to involve learners in the teaching learning process, and it is through communication that this can be achieved. Math and science in particular, are subjects that require learners to be active participants during the lesson as the content in the two subjects need to be discussed because allowing them to work together make them feel excited about the concepts and can, as a result motivate one another to reach the goals. IQMS encourages communication as one of the performance standards is to actively involve learners in the lesson for the objectives of the lesson to be achieved and creating a positive learning environment. Communication is therefore crucial and is the transfer of knowledge. This is why the researcher aligns herself with Finkelstein.

Again the researcher points out that good practice of communication in the classroom will encourage learners to be active participants and teachers to build a relationship with the learners so as to address their problems related to the subject. This alone is enough to keep good, dedicated, passionate and determined teachers in the classrooms.

The figure below supports the factors keeping the teachers in the classroom:



Figure 2.4: Summary of the factors keeping teachers in the classroom. **Source:** <https://mentor.lxl.in/retaining-our-teachers>

2.5 THE IMPORTANCE OF TEACHER RETENTION

Many organizations are currently faced with the problem of inability to recruit and retain top talent. After detailed analysis of trends pertaining to the workforce, it is discovered that there is an increasing shortage of employees with exceptional skills that have the necessary knowledge and skills to perform at an advanced level because of the failure of employee retention in the education sector. This means that eventually organizations that do not put in more effort towards retention could be facing issues like understaffing, workforce with only basic qualifications in the future which will ultimately hinder their ability of competitiveness in their field (Owens, 2010).

From a different perspective, reports from Goggle search show that 32% of the respondents think that technology can replace teachers and 64% say technology is not cap able for replacing teachers.

The retention of an employee is important because of the direct costs of replacement, which can include a lengthy training period. The loss of a single key teacher, for example, a mathematics and physical science teacher can cause a huge problem in the outcomes of the learners as they need these teachers on daily basis to take them through the understanding of difficult concepts. If teachers are not retained, the Department of Education will then have to deal with a decrease in competitive advantage, particularly if the teacher had developed productive working relationships with other key personnel. The morale within the workforce may be affected by the high rate of turnover, this also happens in the Department of Education and it may be a symptom of an underlying problem within the department.

Teachers are like brain surgeons because they have the ability to develop the mental and intellectual capacities of the learners to become value-added citizens in different societies (Adelman and Taylor 2011).

The above point by Adelman is very true, from the angle of inclination, the researcher views, a teacher as a salt bridge that completes the circuit so as to allow the flow of charges from known to unknown, and as an equilibrant erisuring that all the forces acting on leamers are balanced. The researcher further regards teachers as backbones and torch barriers of any educational programme as they transform the

learners to be responsible citizens by playing the pivotal role in the holistic development of these young individuals

2.6 THE SIGNIFICANCE OF STUDYING MATHS

Mathematics is the study of quality, structure, space and change. Mathematics seeks out patterns, formulae, new conjectures, where appropriately chosen axioms and definitions are used to establish axiomatic systems. Axiomatics is one way of establishing mathematical truth, for example, Euclidean Geometry., For thousands of years, mathematics has been a distinctly human activity practiced by all cultures with mathematical problem solving, one may be able to understand the world (physically and economically), and most of all, learners can think critically. Basically, mathematics is the epitome of all the disciplines, because people need a little bit of mathematical knowledge as they talk about statistics, law, health, education, business, engineering and science (DoE, 2009).

Based on the above facts, the researcher therefore sees it very important for learners to be taught mathematics, hence the need of mathematics teachers in every country. The Department of Education in South Africa realised a dire need for learning mathematics, hence they have introduced mathematical literacy, where learners who are not gifted intellectually could be able to learn mathematics in a way which is practical and is easier to understand as it deals more with context. It is vital for every individual to be mathematically literate. Some managers lack mathematical knowledge and therefore are making unwise decisions, hence most of the countries, families and businesses and organizations are running in a deficit. It is clear that leaders need not be only chosen politically, but they should also be mathematically literate. If leaders were chosen based on their mathematical knowledge, they would have made the wise decisions economically, and the world would have been a better place. Given a chance, I would employ mathematically literate managers.

Principals, as managers, need to be mathematically literate, as they form part of the school financial management, without which there will be financial entropy, meaning,

financial planning, financial organization, financial leadership and financial control will not be possible

The financial school management is a process of ensuring that planning, organising, delegating and controlling the school funds by the school governing body and the school management team, it is done in such a way as to achieve the goals of the school (Mestry, 2004).

Galileo Galilei (1564 -1642) said: "The universe cannot be read until we have learned the language and become familiar with the characters in which it is written. It is written in mathematical language and the letters are triangles, circles and other geometrical figures, without which means it is impossible to comprehend to a single work. Without these, one is wondering in a dark labyrinth." Car Frederich Gauss (1777 – 1855) referred to mathematics as "the Queen of all the Sciences".

The theories above provide a clear understanding of the significance of mathematics. From the theories, it can be deduced that significance of mathematics is two sided, technological innovations can be progressed through maths and, secondly, it essential for allowing people to know of the technicalities of the galaxy. Through mathematics learners are provided with exclusively high effective set of resources enabling them to understand and change the globe. The capabilities that are designed in mathematics are thinking and troubleshooting. These capabilities are the reason why most companies are in dire need of mathematically literate individuals.

2.7 SIGNIFICANCE OF STUDYING PHYSICAL SCIENCES

Physical science is the science of investigating physical and chemical phenomena. It consists of two main modules, that is, physics and chemistry. In order to have a clear explanation and prediction of events in the physical environment, the investigation thereof is done through scientific inquiry, application of scientific models, theories, and laws. As indicated in the CAPS document, physical science is vital with regards to humans understanding how the physical environment works, which will give a better understanding as to how it should be cared for and how to maximize the benefits from the environment. All scientific knowledge, including IKS (Indigenous Knowledge System) is used to address challenges facing society (DoE, CAPS Document, 2009).

Through physical sciences learners become aware of their environment and they develop investigative skills with relation to physical and chemical concepts. Like mathematics, physical science promotes problem solving skills, construction and application of technical knowledge. Physical sciences also use scientific inquiry to promote application of scientific knowledge and give an understanding of the nature of science and its relationship with the environment. Through the subject, learners are prepared for future learning because they do not have limited access to academic courses at a higher level of education. Physical science plays an increasingly important role in the lives of all South Africans and as far as the technology development is concerned for the country's economic growth (CAPS document, 2009).

The two sections, in which the subject is divided, are very different in the sense that they deal with different content and therefore the concepts thereof vary a lot.

Physics is considered by learners as the most difficult subject as it has a reputation that learners do not generally perform well in the subject because one needs to understand the different mathematical approaches in problem solving and most of the learners have difficulty in studying maths (Ó'Keefee, 2018).

Webster (2015) Physics is the study of the interrelationship between energy and matter, without referring to chemical change. This section of the subject is divided into the study of mechanics, electricity and magnetism, heat and thermodynamics, optics, quantum mechanics, relativity, nuclear, particle physics, solid-state physics and astrophysics.

According to Webster, study of matter, especially the changes and interactions it can undergo form basics of chemistry. The Aristotle's four elements, namely, earth, air, fire and water, contributed to the origin of chemistry.

Most of the scientists made contributions towards the study of chemistry as a course. For example, for the development of atomic model, J.J Thomson, Ernest Rutherford, John Dalton, James Chadwick, and Neils Bohr put ideas together and the study of chemistry was made possible in schools. What is interesting about chemistry is that there is still a chance for new scientific ideas that learners can apply and that could possibly add to the atomic model or to any concept studied before because 'entropy of the universe is always increasing'(Third law of Thermodynamics).

Science increases peoples' understanding of nature through scientific inquiry. Scientific inquiry is the body of scientific knowledge which takes four forms, that is, hypothesis, facts, laws and theories (Bybee et al, 2007).

2.8 THE IMPORTANCE TO RETAIN MATHEMATICS AND PHYSICAL SCIENCES TEACHERS

Of all school subjects, physics has the most severe teacher shortage, followed by mathematics and chemistry. Unlike other countries, in South Africa, the subject is being taught as physical sciences, but consists of two sections, the physics and chemistry part. In other countries the two sections are separated and are taught as individual subjects, hence the excellence in the subjects in other countries compared to South Africa. Most of physical sciences teachers have majored in physics or chemistry at the institutions of higher learning, and this alone, is a challenge to the Department of Education as one could find that the teacher is only capable of teaching physics not chemistry, but the department can only afford to hire one teacher for the subject. This is why there is a dire need of these teachers in our schools.

In actual fact, two teachers are needed to teach physical sciences, because the two sections into which the subject is divided are equally challenging and they need special attention from grade 10. The same applies to mathematics, Algebra needs to be separated from geometry and trigonometry. This alone is enough to attract new teachers into the system and retain old ones. It is quite disturbing that the grade 12 output results are used as a measure of mathematics and science performance whereas the problem is not in the final class but in the lower grades. The physical sciences and mathematics topics taught in grade 10 are an introduction to grade 12, of which learners do not happen to remember when they are in the exit class.

Moloi(2013) indicated that the topics in which learners did not perform well in grade 10 are the same topics they fail in grade 12.

The effectiveness of experienced teachers in raising student achievement make them differ from their less experienced counterparts. This doesn't just happen because teachers with more experience are more likely to work in schools and classrooms with more advantaged students. Experience plays an important role in the teacher performance and self-development. The greater effectiveness of experienced teachers in boosting student achievement is clear for primary and secondary schools

alike. A well-experienced mathematics and science teacher will have a better approach to challenging topics. The teacher will come up with new strategies on how to deal with the problems in the classroom, and the problems they may encounter as curriculum changes. The old methods of teaching will always have its way in the new system of education; hence the experienced teachers are needed in schools. Subjects like mathematics and physical sciences need those experienced teachers.

The introduction of mathematical literacy as a subject in the secondary school curriculum, also added problems in shortage of mathematics teachers as only few teachers were trained to teach mathematical literacy and most of the learners who were performing poorly in mathematics were advised by the department of basic education to take mathematical literacy. Mathematics teachers had to teach mathematical literacy. This adds to work overload that teachers already had. It is therefore very important to retain these mathematics and science teachers.

Teachers are people to which any society is looking up to, to model the learners. Students also look up to the teachers for motivation. Over the years, students' performance in maths, science and technology (STM) have been poor in some countries, and the shortage of teachers for these subjects is one of the sources of poor performance (Mafora, 2013).

The parents to the students are also dependent on the teachers to build a better future for their children.

2.9 TEACHERS DO BETTER AS THEY GAIN EXPERIENCE.

Researchers have long documented that teachers improve dramatically during their first few years on the job. Today's education allows learners to explore, seek for information via technology, read about the classroom content further, and in that regard, learners get more information, that sometimes the teacher is not aware of, the teacher then learns as he or she teaches. If a teacher has been in the classroom for fifteen years or more, the teacher is twice effective at raising the test scores of their learners. What is not yet clear is what happens following those early years. The increase in productivity for English teachers in secondary schools fluctuates at an acceptable rate, but follows the same path. Based on research, teachers with more years of experience currently have an effectiveness rate higher than they did in the early years of their careers.

An experienced teacher knows how to make learning an enjoyable venture. In this regard, a mathematics teacher will help the learners enjoy mathematics and those learners cannot afford to miss the class. As a result, there is a huge reduction in the rate of absenteeism in schools. For example, mathematics can be used for extracurricular purposes, as the teacher may introduce the learners to games like chess, in order to put mathematics into practice, learners gain knowledge on how to solve geometric axioms in the class, by just playing chess. Schools rely on more experienced teachers often mentor young teachers and help to create and maintain a strong school community.

2.10 THE MAGNITUDE AND DEMAND FOR MATHEMATICS AND SCIENCE TEACHERS

There is a demand for teachers in general, in South Africa as the teachers are leaving the teaching fraternity like nobody's business. To be specific, mathematics and science teachers are also leaving the system in large numbers. The department of basic education shows that there is a need for teachers in the country. That is why the department is giving free bursaries to young people who are interested in studying Education. The saddest part is that these young people have their own agenda, that is, to serve the department for a while and then look for greener pastures as they are not borne teachers. Most of them just grasped the opportunity of having a bursary to obtain tertiary education.

According to the Human Sciences Research Council(HSRC), it was found that 55% of teachers in South Africa, given a chance, can leave the system (Mafora, 2013).

The challenge to the department is that, most of these teachers major in mathematics and science. What could be the danger in this instant is that the department is taking no pains to induct these beginning teachers after they have completed their degree. As a matter of fact, these beginning teachers need support and assistance in these three set of outcomes: commitment and retention of teachers, classroom instructional practices of the teacher and student achievement (Ingersoll, 2011).

There is a high shortage of mathematics and science teachers in the Ngaka Modiri Molema, as research show that the teacher: learner ratio is still not met in other schools especially in rural and sub urban areas. Therefore, the magnitude of demand for new teachers for maths and science is high and hence the magnitude of the school staffing problems becomes larger.

There is a strategy used by the Department of Basic Education In North West to employ a certain number of teachers looking at the total roll of the teacher not the roll per subject and that also creates a problem in staffing, as mathematics and science teachers are in most cases fewer that the rest, but expected to perform miracles.

In the legislature about challenges faced by certain schools, released in 26 January 2012, the principal of Mafanele High School in Klipgat complained about the PPM as one of the major challenges they have at school. The school had 18 teachers but qualified for only 11 teachers and they did not have a mathematics and science teacher since October 2010 when their only mathematics teacher died. The principal said” we could not get a replacement for our maths and science teacher because our number was still higher than the PPM number allocated for the school. The Department only sent us a teacher in August 2011 when our learners were threatening to strike. The school obtained 47.1% for 2011 grade 12 results, with maths sitting at 13 %. (North West Legislature, 2015)”

Before transformation, some areas in the North West, there had been middle and high schools, the middle schools started from grade 7 – 9 and the high schools from grade 10 – 12. After transformation, some schools merged (middle and high schools) and some high schools were turned into secondary schools, meaning grade 9 and 8 were introduced, in this regard, the mathematics and science teachers had to teach Economic and Management sciences, Natural Sciences, Technology and GET mathematics. The workload of these teachers was increased.

One will find that the then high school maths and science teachers are not capable of teaching technology, natural sciences and economic and management sciences, but

because of the shortage of teachers who can offer those subjects, these maths and science teachers find themselves teaching the subject they were not trained to teach at all. This creates a lot of problems to the particular teachers and result in unpleasant working condition. If we take an example of technology, the teacher thereof should understand technical drawing, which was not studied by most of mathematics and science teachers, but they will be expected to teach the subject. The theory is understandable, but the section of graphics and design needs experts. The poor teachers become frustrated as they are unable to explain the concepts to the learners. The learners are thus not ready to study technical subjects in grade 10 to 12. What a disadvantage!

To show that there is indeed a shortage of mathematics and science teachers, some of the mathematics and science teachers are employed from our neighbouring African countries such as Zimbabwe, Ghana, Uganda and Tanzania. These African brothers and sisters are employed on temporary basis by the North West Department of Education, and the Department ran out of funds, thereafter the office of the treasury released a circular (Department of Basic Education Circular No 18 of 2015) that there are no funds in the department and as a result, the contracts of these temporary, qualified and skilled teachers were terminated with immediate effect, after being in the system for four months without getting paid. This also left a gap in several schools and the mathematics and science teachers are now overloaded as they are supposed to teach the learners left behind by those teachers.

In one of the schools in Itsoseng, 4 mathematics and science teachers fell among the foreign teachers I am talking about and 3 left, only 1 was retained and is being paid by the SGB (School Governing Body) as there was no South African teacher available in the school to teach the learners these subjects. The teacher, who was retained, also left because she was not being paid her salary by the Department as because she was not in the pay roll. (SES-Subject Education Specialist of physical sciences at the PSF-Professional Support Forum, 2015).

The 2016 state of affairs in our tertiary institutions, the fees-must-fall protests, also added towards the shortage of teachers in general, let alone the mathematics and physical science teachers. If one could bear in mind that the Fundza Lushaka bursary has been issued for these teacher trainees and it is really disturbing to think that they

might have not being able to write their exams and therefore would have been unable to complete their degree in teaching, meaning the demand for teachers will rise at a very high rate.

2.11 THE ROLE OF MATHEMATICS AND SCIENCE TEACHER TURNOVER IN SCHOOL STAFFING PROBLEMS

Once a mathematics and science teacher moves from one school to another, or retire, there is a gap left behind and it takes time to fill the gap as there is already a shortage and mathematics as science are scarce skills subjects. This creates a problem in as far as staffing is concerned because the remaining teachers in the maths and science department, which are overloaded, will have to share the classes of that particular teacher who left. The fact is that the teachers will only strive to cover the curriculum, but will not be able to give the learners the necessary attention. As a result, only the gifted learners will meet the passing requirements in the subject concerned. The question now arises, how are the learners expected to perform in the next grade if there is no proper foundation?

The seriousness of the matter is, there will be work overload and the teacher learner ratio is going to be highly affected and as a result, the performance of the learners will drop due to ineffective teaching and learning.

The issue of teacher attraction and retention has become a critical issue that has gained a massive amount of attention across the country. This is because as time passes there has proven to be inability of schools to keep a substantial amount of qualified teachers in the classroom. This issue has been receiving widespread media coverage and has been the central focus of various reform and policy initiatives.

The term shortage, according to commentators, researchers and reformers, is viewed in a generic sense to refer to any school staffing problems, which points to any difficulties that schools encounter when staffing classrooms with qualified teachers. On the other hand, the roots of the school staffing problems were invariably assumed by researchers, commentators and reformers, to primarily lie on an inadequate supply of new teachers. Thus the term shortage, in the context of teachers and schools, almost always connotes an insufficient production of new teachers (Ingersoll, 2009).

2.12 IS THE SUPPLY OF NEW MATHEMATICS AND SCIENCE TEACHERS ADEQUATE?

In South Africa as a whole, it has been realized that there is a shortage of teachers in the system but the Department of basic education is in dire need of maths and science teachers as compared to other subjects.

This resulted in the Department attracting new students for education by giving out the Fundza Lushaka bursaries to students who want to study education, but the fear is that they do not take the profession with passion; they just take it for the sake of getting a bursary and furthering the studies. The said students do not have learners' interest at heart. There is also a one-year course given to students already graduated their junior degrees, called PGCE (Post Graduate Certificate in Education). The PGCE is normally taken by students who are not professionally qualified and would like to hide behind the teaching profession. The fact of the matter is, these recruited students study education without passion and are therefore not having the learners' interest at heart and are therefore impatient, and as a result, there can never be effective teaching and learning.

In a research conducted at the Vaal University of Technology, some students studying for PGCE indicated that they were studying education because they had no alternative as some were from other countries and are being funded by the governments to study for PGCE. During teaching practice, these teachers experience challenges that force them to think twice about taking teaching as a career (Kiggundu and Nayimuli, 2009).

The challenges that are relating to the unsatisfying quality of mathematics and science education in South Africa can be derived from the poor knowledge and understanding of subject content by teachers in their subject field, which will inevitably lead to poor content delivery to the learners and that eventually yields poor results.

Mathematics is described as a part of general education requirement as it assists in enhancing learners' critical thinking skills. (Tarver, 2015). "The most definite point of convergence across the [President's Education Initiative] studies is the conclusion that teachers' poor conceptual knowledge of the subjects they are teaching is a

fundamental constraint on the quality of teaching and learning activities, and consequently on the quality of learning outcomes.” (Venkat and Spaul, 2015)

The forging of professional learning communities can serve as meaningful platforms for teacher empowerment. As a result, institutions of higher learning could be pathfinders in terms of the improvement of the overall quality of mathematics and science education.

At our tertiary institutions, physical sciences teachers are allowed to major in physics or chemistry, which also creates a problem, because, as outlined earlier, from Webster’s point of view, physics and chemistry are totally different and they need to be treated as such. If a teacher is qualified to teach physics only, and not chemistry, the other part of the subject, physical sciences, is going to suffer as the teacher will have inadequate information in chemistry. The learners automatically lose confidence in the teacher and the performance ultimately, drops.

The most important factor identified in the implementation of the science curriculum is the professional development of teachers. The government gave a firm mandate in teacher training and provision of additional training for those already in service in its efforts to address the shortage of qualified teachers to teach physical sciences. An example of this initiative is the training of teachers in physical sciences and other subjects by way of the Advanced Certificate in Education (ACE) in mathematics and physical sciences, for FET band. The ACE was envisaged as a way to professional development to maths and science teachers and to improve their qualification levels, their competencies or to change their career path and adopt new educator roles (Department of Education [DoE], 2000).

The mathematics and science teacher development was done by the North West University in the Sediba project. The project allowed only the mathematics and science teachers from secondary schools to apply. The GET teachers were left out. As a matter of fact, high failure rate of mathematics and science in secondary schools comes from improper foundation in our primary schools. If only the secondary school mathematics and science teachers are equipped with knowledge and information, there is still going to be a high shortage in teaching these subjects in general (Nel, 2010).

The Department of Basic Education was doing this to try to overcome the shortage of physical sciences teachers in the system. However, most of the teachers still find a way to leave the system because other issues are still not addressed. After studying so hard for these advanced certificates, teachers are told that they have reached the notch, meaning, their salaries will not be adjusted.

The above points suggest that the effort taken by the Department of education to minimize the shortage of mathematics and science teachers seem to be in vain, as these teachers are using the profession as a stopgap while waiting for better career opportunities in other fields. Much money is used to fund these education programmes, only to find that they benefit other departments and companies as teachers are leaving the system. The only solution is to treat retention of teachers, in particular, mathematics and science teachers, as an epitome to quality results and to put South Africa on the map, economically and academically as compared to other countries.

If one can look back, and recall how, tertiary institutions were structured in South Africa during the apartheid regime. Sayed (2004, p. 248), as cited by Venkat, indicated that by the time of transition, there were 32 universities and 105 colleges of education. The latter were subsequently integrated into higher education institutions. Thereafter, the in-service teacher training institutions were also introduced. The former college teachers still populated our schools alongside the post-apartheid teachers. However, lack of content knowledge required to provide access to the disciplinary ideas of mathematics remains a problem faced by these teachers (Venkat and Spaul, 2015).

The researcher aligns herself with the above statement by Venkat and Spaul, because the teacher colleges used to serve a purpose in as far as quality teaching is concerned. At those institutions, teacher training was done in an excellent way, as more focus was based on the subject methodology. Compared to PGCE, the old teacher training is outstanding in the sense that in PGCE methodology is done only for one year, whereas in teacher training colleges it was done in three years. Discipline of learners would also not be a problem as compared to what is happening in the classrooms nowadays.

2.13 UTILIZATION OF PERFORMANCE MANAGEMENT SYSTEM BY THE NORTH WEST DEPARTMENT OF EDUCATION TO RETAIN MATH AND SCIENCE TEACHERS

In public organizations, including schools, managing performance and development of employees have become a bone of contention between managers and employees. The fact of the matter is, it is impossible for a public organization to achieve their objective of quality public service delivery if there is ineffective and inefficient management and development of employees (Van Dijk and Legalatladi, 2015). Implementation of performance management systems is therefore very crucial and needs serious attention. Through effectiveness an organization is able to achieve set goals and objectives. According to the Performance Management and Development System (PMDS), employers have a responsibility to ensure that the management and development of performance is done appropriately and that there is a common understanding of the objectives of the organization and the PMDS between managers and employees.

Over the years, there has been a shortage of Mathematics, Accounting and Physical Science Educators in the North West Department of Education which lead the department to finding human resource supply from the neighbouring countries. The intervention assisted the province in achieving better results. Going forward, the department is planning to have enough educators to teach in the North West schools in ten years to come. Teachers are encouraged to participate in the National Teaching Awards (NTA), which adds to teacher development and motivation, as one of the teachers in the province obtained position one at the national level in the category of Teaching Mathematics in FET. Teacher Development Directorate trained 11609 teachers, including mathematics and science teachers in the 2016/17 financial year. The North West Department of Education also implemented the Girl Learner Intervention Programme (GLIP) for mathematics, physical sciences and accounting and for underperforming learners. The programme is conducted on Saturdays in which the teachers are remunerated, (Departmental Budget Speech Presented by the MEC for education, Sello Lehari).

The quality of teaching improved nationally and internationally for the past 30 years (Masoge and Pilane, 2009). What is worrying is the negligence of the department of education in the implementation of performance management system. The implementation of the system through IQMS is not good enough to keep teachers in the system. (Masoge and Pilane, 2009).

Based on the above points by the MEC, the researcher still sees it a need for the department of basic education in the North West to triple their efforts in retaining the math and science teachers. The department cannot just be in the comfort zone while employing teachers from the other counties. The performance management system is not properly in place. The researcher therefore aligns herself with Masoge and Pilane because the 1% salary adjustment does not match the efforts put by the teachers, especially the mathematics and science teachers who always sacrifice their time to go an extra mile to take the learners into a journey of understanding the mathematical and scientific concepts.

2.14 THE EFFECT OF SHORTAGE OF MATH AND SCIENCE TEACHERS ON LEARNER PERFORMANCE

As stated in the introduction, teachers and learners are the role players in the system of education, but in particular, teachers play the leading role, as the learners depend on them in terms of knowledge, guidance and information.

Year after year when the minister of education announces the grade 12 results, mathematics and science are mentioned to have poor performance; it shows that there could be a very serious problem, either shortage of teachers or unqualified teachers. It is with great concern to note that the number of learners registering for mathematics and physical sciences are lower than that of other subjects and a few of the learners who register the two subjects poorly perform. Some teachers fail to deliver the content to the learners as they also do not have a clear understanding of the subject matter (Mokgato & Mji, 2006). This point indicates that some teachers are not qualified to teach physical sciences and mathematics.

2.15 SPECIFIC IDENTIFIABLE ATTRIBUTES OR COMPETENCIES OF A GOOD MATHEMATICS AND SCIENCE TEACHER IN SECONDARY SCHOOLING SYSTEM

Most of the learners do not like mathematics, but it takes a good mathematics teacher, who is passionate about the subject, to make them love the subject. The higher the level of proficiency, the more effective and consistent is mathematics. In mathematics teaching, success is measured by the teacher's extensive knowledge of the subject. One of the strengths of a good math teacher is the ability to gather confidence by explaining processes and concepts to the learners (Zeiger 2000). A mathematics and science teacher should be able to solve problems using different approaches, because all textbooks may have the same meaning about a particular concept but use different methods to explain it.

A good math and science teacher is strategic and understands that learners learn concepts in different ways and therefore allows them to voice out their opinions and to debate about concepts as this will help learners to feel confident in their mathematical abilities. Above all, she cares about her learners and goes out of her way to help learners catch up. Zeiger listed the key characteristics of a good mathematics teacher as follows: A good math teacher has:

- knowledge of mathematics
- teaching strategies
- personable approach
- classroom leadership
- care and concern

Based on the said characteristics of a good mathematics teacher, the researcher views a science teacher the same way. What characterizes a mathematics teacher also applies to a science teacher.

2.16 CONCEPTUAL FRAMEWORK

Conceptual framework refers to a process of presenting background of the concepts and the variables in terms of definitions available in the literature and the operational definitions adopted by the researcher. The framework consists of several variations and contexts and assists in make conceptual distinctions and organizing ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply.

The conceptual framework depicts the student's map or idea of how s/he seeks to undertake the study. A good comprehension of the frameworks would normally culminate in a good investigation. It also serves as the foundation upon which a research is constructed. The framework should have independent and dependent variables that would give the study a scientific direction.(Denzin and Yvonna, 2005)
The following section deals with the conceptual framework as outlined from the point of view of the researcher, in figure 2.5 below:

CONCEPTUAL FRAMEWORK

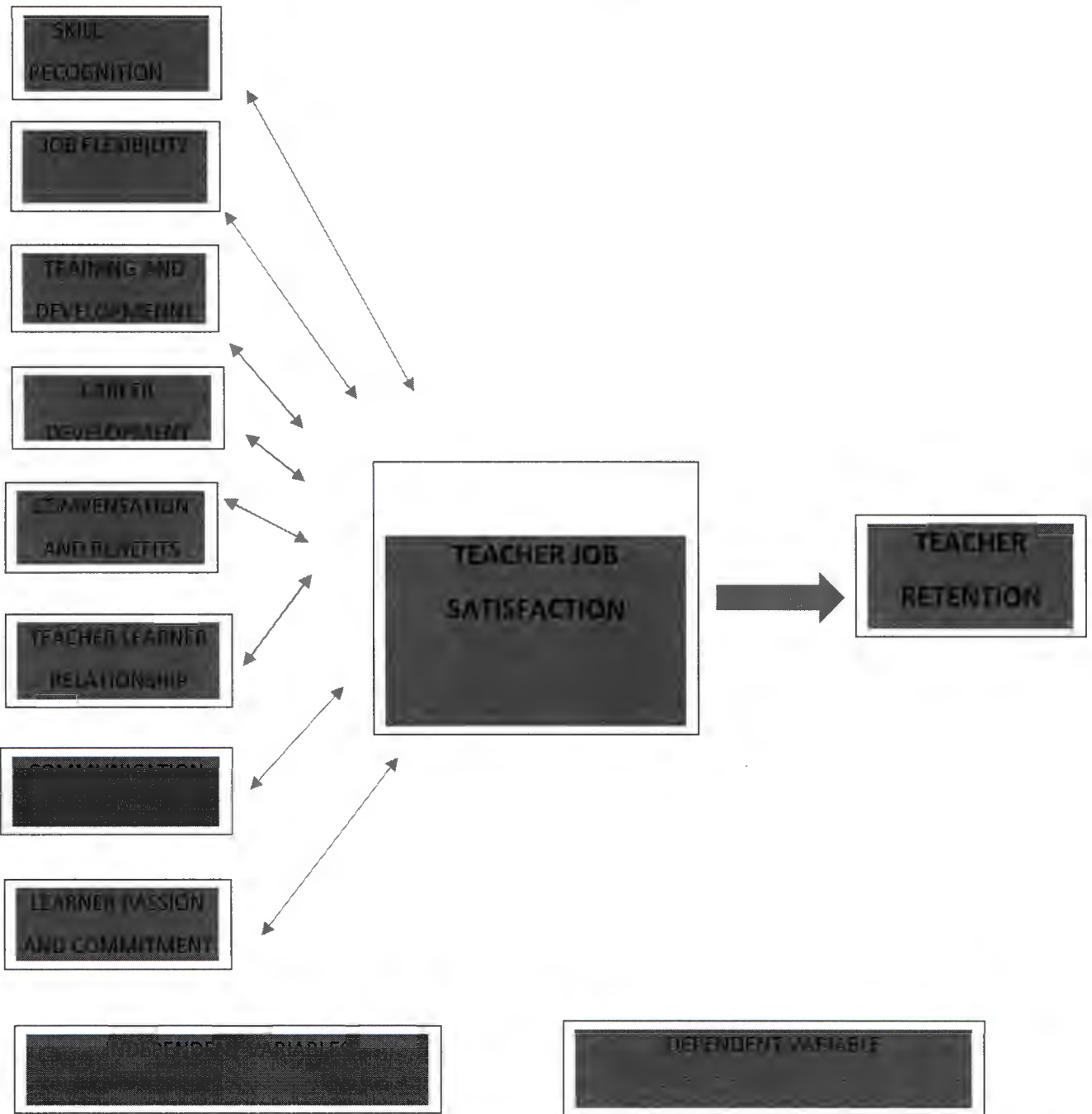


Figure 2.5: Link between dimensions of teacher satisfaction and teacher retention

2.16 BRIEF REMARKS ON THE ELEMENTS OF THE FRAMEWORK

The following are brief remarks on the conceptual framework as outlined in figure 2.1:

2.16.1 Skill recognition

Providing an ability and skill recognition of personal job accomplishments is an effective retention strategy for employees at any age. Studies indicate that, this fulfils people's needs. Therefore, by acceptance and acknowledging individual work accomplishments, this promotes employee happiness and individual fulfilment and thus encourages retention and prolonged stay in the organization (Russo-Netzer and Shoshni, 2018).

2.16.2 Job Flexibility

For every organization, job flexibility is very essential for both employers and employees. Job flexibility assists an employee to embrace change and expand opportunities; and employers to make good management decisions and to value diversity in the workplace. The result of which is the creation of a positive working environment leading to retention (Glazer, 2016)

2.16.3 Training and Development

In a training process employees have an opportunity to gain knowledge and a set of skills that contribute towards the improvement of their overall performance in their current positions; while on the other hand, development expands employee growth and future performance instead of the current role of the employee in the organization. Training and development programs and learning experiences fall under three basic categories, i.e., Job Training, Self-Development Training, and Job Experience. A well trained and developed employee is unlikely to leave the job. Improving the leadership effectiveness through planned and structured learning is the core purpose of development. A planned approach will assist developing managers and leaders to grow and it will also provide for the future needs of the business or organization (Asfaw, Argaw and Bayissa, 2015).

2.16.4 Career Development

It is a process that is mainly led by an employee and does not need an employer in order to be implemented because it is directly linked to the employee's self-growth and satisfaction.

It is the responsibility of every employee to manage their growth. The main advantage of career development is to assist an individual to move in the right direction based on goal setting and achievement of objectives (HR Dictionary, 2011-2018).

Career development in teaching is better explained through professional development as it is specifically focused on the profession itself. In every organization, management need to give the employees support and supply them with tools and training in order to create a good atmosphere that will motivate the employees to stay in the organization. School management are not exceptional (Olsen and Anderson, 2007).

An employee provided with career development will contribute positively to the economic growth of the organization and will definitely be an asset to the particular organization. The retention of such individual is thus very important.

2.16.5 Compensation and benefits

Compensation is an integral part of human resource management which is important for every organization as it motivates the employees and helps the particular organization to run smooth and effectively. A well-compensated employee will obviously be competent enough to contribute towards the healthy economic and social growth of the organization because the welfare of any organization depends on the employee satisfaction addressed by compensation (Arslan et.al, 2014).

2.16.6 Teacher-learner relationship:

IQMS performance standard number 6 encourage teachers to have good human relations with all stakeholders including learners.

Teachers who are able to maintain good relations with their learners, by encouraging self-discipline and dignity, are said to be successful in managing misbehaviour in the classrooms (Mokhele, 2006).

The preferred teaching styles of teachers correlate with the preferred learning styles of their learners (Dixon and Woolhouse, 2006). This statement by Dixon and Woolhouse suggests that the preferred teaching style corresponds with the preferred learning style and as a consequence, the relationship thereof becomes stronger, keeping teachers in the classroom.

2.16.7 Communication

Webster (2018) defines communication as a process of exchanging information between two or more individuals by making use of common signs, symbols, or behaviour.

No company, institution or organization can be run smoothly without communication between employees and employers. It is thus a driving force for every decision making and problem solving processes.

In a schooling system, it is very important for a teacher to have good communication skills as the transfer of knowledge is vital and individuals are given an opportunity to express their views, share and persuade information and to express emotions (Munodawafa, 2008).

2.16.7 Learner passion and commitment

Albert Einstein, one of the world's greatest philosophers believed that students learn from meaningful experiences and that a learner engages in a reflection process that relies on the outside world. His thinking and passion for learning were the basis of his genius.

Quoted here, Einstein said: "Any intelligent fool can make things bigger and more complex... It takes a touch of a genius – and a lot of courage to move in the opposite direction." (Cross, 2015). Now this, according to the researcher, defines passion in totality because courage, as defined by the researcher, is the ability to say "no" when others say "yes".

The researcher therefore views passion in learning, as a strong factor that will always encourage teachers to go to classes and do the right thing, transferring knowledge and information to these information-hungry individuals.

2.16.8 Teacher Expertise

Expert teachers can be characterized by years of experience, social recognition or nomination, professional or social group membership and performance- based criteria (Palmer *et al.*, 2001).

An article from The Guardian indicates that teachers deserve to have a continuing professional development(CPD) throughout their career in order to improve learners' performance and that as this will assist teachers to be experts in their fields and increase their confidence and desire to stay in the profession (Brighouse and Moon, 2011).

The researcher's definition of teacher expert is one who excels in the knowledge of the subject matter, general pedagogical knowledge, classroom management, knowledge of learners and learning development.

2.16.9 Good conditions: Learning and Working Climate

In order for teachers to improve their performance as a sustainable attitude and behaviour, the school management and the Department of Education need to understand a teacher's main tasks and his or her expected performance (Kuncoro and Dartiri, 2017).

Maintaining a pleasant work environment will attract the best teachers. There will, as a result, be effective teachers that will lead to high quality education (Kaur, 2017).

The researcher views the above points as follows: Creating a safe environment that is conducive to teaching and learning should therefore be a priority in all schools. Creation of a safe environment is one of the strategies that can be used to keep every employee in the work place, teachers are no exceptions. Learners' safety should also be considered as it will help them to avoid drug abuse and violence. Support from teachers as parents, challenging environment (having high expectations for all learners) and developing learners' abilities to cope with social and emotional challenges are some of the factors that helps in creating a positive learning environment. In a positive teaching and learning environment, there is always quality performance of both teachers and learners and retention of teachers will be a success.

2.16.10 Job Satisfaction

Job satisfaction describes how content and satisfied employees are with their jobs (Javed, Balouch and Hassan, 2014). They further explained job satisfaction as a measure that have a lot to tell about employees' general emotion about the workplace and their job as it measures the approach towards the job and the extent to which job is gratifying the employees' needs. The concepts discussed in the conceptual framework, lead to the understanding of job satisfaction, because if they can be all implemented in a workplace, it is a sure case that the organization concerned will be able to keep its employees.

Job satisfaction, according to the researcher, is enough to retain existing employees and to attract new employees into the workplace. For example, in teaching, if teachers are satisfied, it is obvious that they will love to remain in the classrooms and the attraction into the teaching fraternity will never be a problem.

2.17 CHAPTER SUMMARY

The chapter reviews the different theories from different researchers based on the retention of mathematics and physical sciences teachers. The advantages and disadvantages of retention are also listed and explained. Talent management and performance management are explained and are taken as the key to retention; therefore, the terms related to teacher retention are defined.

The chapter also outlines the significance of studying mathematics and science as well as the reasons for retaining the teachers thereof and attracting new teachers into the system. In this chapter the researcher is interested on the views of others as related to the contents of the study. Mathematics and physical sciences are regarded as scare skills subjects, hence the retention of teachers thereof is of utmost importance. The factors that motivate the teachers to stay in the classroom are also discussed. South Africa is rated very low considering the performance in math and science as compared to other countries, the retention of math and science teachers will assist in solving the problem. Job satisfaction plays a role in retention of employees, the factors that lead to job satisfaction in teaching are summarized in the conceptual framework.

The next chapter deals with Research design and methodology.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

In the previous chapter, relevant literature was reviewed in respect of factors affecting retention of mathematics and physical sciences teachers in selected secondary schools in the North West Province. This chapter's focal point will be the research methodology which gives a clear demonstration of a variety of sections in the study that address the design of the research, the population that is targeted, instruments used in the collection of data, procedures used to gather the data and finally analysis of the data and its interpretation. The methods for revealing answers to the research questions and objectives are planned in this section. The purpose of this chapter is therefore to describe the research methodology employed to answer the research questions and to prove the objectives listed below.

In this section of the study the researcher discusses the research methodology that was utilized in a structured research enquiry to gather, examine and construe data that will be utilized to find answers to the research questions through thorough investigations in order to achieve the objectives of the study, which are:

- To investigate what the Department of Education in the North West is doing to address the problem of the shortage of mathematics and science teachers.
- To investigate the strategies put in place by management of secondary schools to retain the mathematics and science teachers.
- To determine the effect of shortage of mathematics and science teachers on the performance of learners at the selected secondary schools.
- To determine specific identifiable qualities of a good mathematics and science teacher in secondary schooling system.
- To determine the effect of working conditions on the attraction and retention of mathematics and science teachers at selected secondary schools.
- To determine the impact of compensation on the attraction and retention of mathematics and science teachers at the selected secondary schools.

3.2 RESEARCH METHODOLOGY AND RESEARCH DESIGN

Research Methodology, according to Kallet(2004), is the process whereby the reader is allowed to critically evaluate the validity and reliability of the study that was done by the researcher through the description of methods taken for the investigation of the research problem and the rationale for the specific procedure applications used for the identification, selection, processing and analysis of applied information in understanding the problem. Creswell (2014) also defines research methodology as a process of describing, explaining and predicting a phenomenon.

Research Design on the other hand, is a strategy for coherently and logically integrating different components of the study to ensure that the research problem is effectively addressed (De Vaus, 2001). The design gives a deeper understanding of the research problem as it intends to clearly explain the hypotheses central to the problem (De Vaus, 2001). Based on the above statements, research design, from the researcher's point of view, gives a clear indication that the research is well structured as it also ensures that the research problem is adequately addressed.

3.2.1 Overview of the Possible Research Methods Available

There are three types of research methods that can be used, namely, the quantitative, the qualitative and the mixed method. The qualitative research method emphasizes on explaining concepts that are not experimentally proven or measured in terms of quantity, amount, intensity and frequency (Denzin *et al*, 2005). The quantitative research method, on the other hand, deals with numerical data collected through questionnaires and the data can be generalized across groups of people thereby explaining a particular phenomenon (Muijs, 2010). In as far as the mixed method is concerned, it consists of both quantitative and qualitative research methods. The use of both qualitative and quantitative research methods can assist to back up one set of results from one method underpinned by one methodology, with another method underpinned by another methodology (Cotrell, 2013).

In this study, the researcher intends using the quantitative research method because the relationship between variables can be easily explained and the method is suitable

for testing the hypothesis of the study if necessary. The quantitative method applies statistics which helps to quantify attitudes, opinions and behaviours (Albers, 2017).

According to Daniel(2016), the quantitative data collection methods are more structured and the data collection methods thereto include surveys. Hence the researcher will use the survey method for collecting quantitative data for this study. Figure 3.1 below reflects the nature of the quantitative research method, as summarized by the researcher.

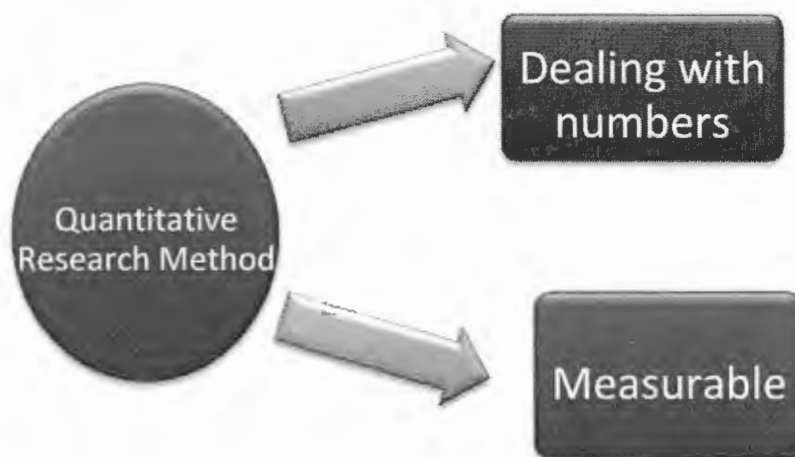


Figure 3.1: Description of Quantitative Research Method

3.2.2 Significance of Using Quantitative Research Method

Quantitative research method is the most reliable and objective method in which data can be easily analysed using statistics. A complex problem can be reduced and restructured to a limited number of variables. With the quantitative research method one is able to establish the cause and effect of relationship between variables in highly controlled circumstances. This research method is used to test theories and hypotheses. The sample represents the sub-set of the whole population of the study. The researcher's subjectivity is less recognised (Albers, 2017).

3.3 RESEARCH METHODOLOGY PROCEDURE

In order to achieve the purpose of a study, it is vital for a researcher to plan the entire process of the study in terms of research plan and design suited to the study and this is done following the predetermine objectives thereof (Mishra, 2016).

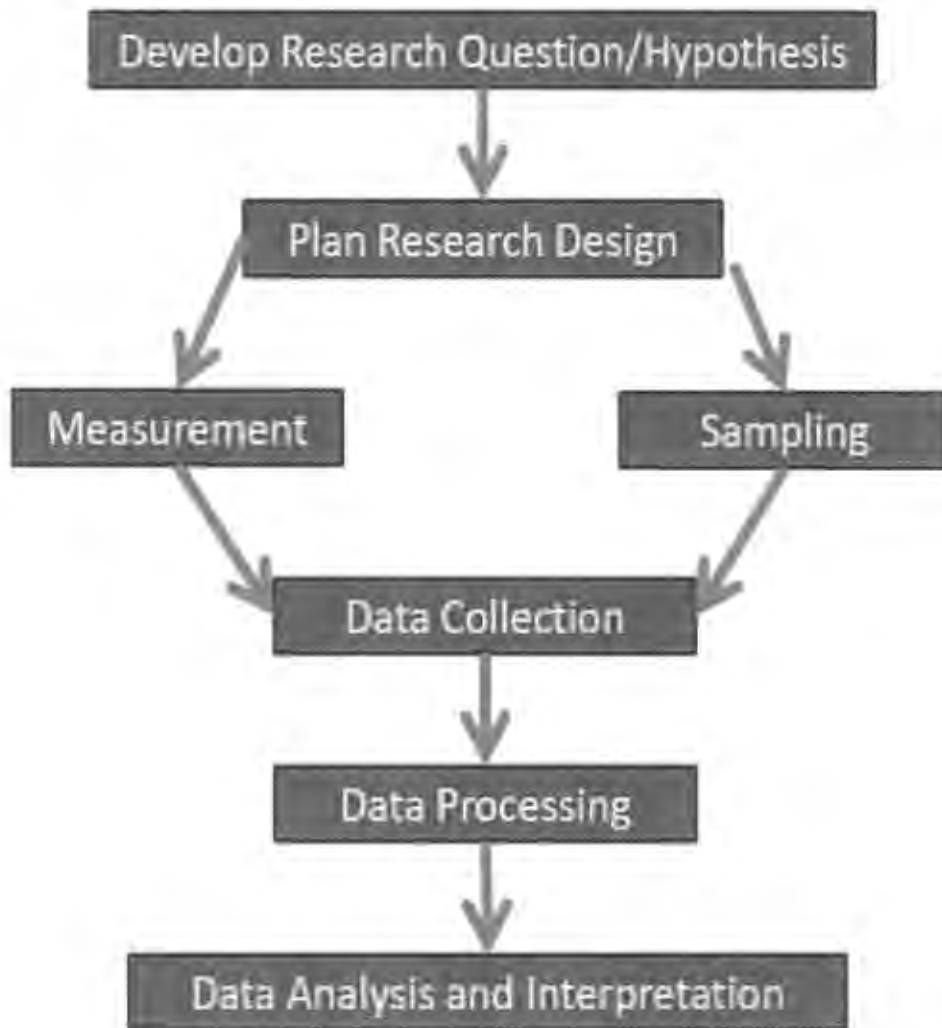


Figure 3.2: Research Procedure - **Source:**Singleton and Straits 2010

3.3.1 Formulating a hypothesis

A hypothesis is a prediction statement based on the researcher's observations and is aimed at ensuring that the entire research remains scientific and reliable. a hypothesis consists of dependent and independent variables, where the independent variable can

be changed and tested but is not affected by the dependent variable. Dependent variable, on the other hand relies on the changing variable (Bradford, 2017).

3.3.2 Planning Research Design

Mishra(2016) defines planning (also called forethought) as the process whereby a researcher thinks about and organizes the activities required to achieve a desired goal (Thompson and Panacek, 2006). A study design can generally be described as a plan used to set and test a hypothesis. The design gives direction on the who, what, when and how of the research project. The design is therefore the basic foundation of the infrastructure of the study (Thompson, 2016). Based on the above facts, the researcher views the research design as the mother body of the whole research process as it deals with planning.

3.3.3 Measurement and sampling

Measurement is characterized by validity, accuracy and precision (Rahi, 2017). Validity refers to the quantity that corresponds to the measured variable, accuracy is the closeness of measurement to an expected outcome and is inversely proportional to error, and finally, precision is the closeness of repeated measurement to one another (Kamau *et al*, 2018).

Sampling on the other hand, is a process of gaining impression of an area in order to estimate a population parameter and to test the hypotheses (Kutsanedzie *et al*, 2016).

3.3.4 Data collection

Data collection is a process that involves the gathering of information from various trustworthy and relevant sources, in order to efficiently answer the research problem, to test hypothesis and make a detailed evaluation of the results (Dudovskiy, 2018).

Based on the above description of data collection, the researcher gives an explanation of the quantitative data collection method used in this study, as based in mathematical calculations where the instrument is the questionnaire with open-ended and close-

ended questions, and the close-ended questions are analysed using measures of central tendency (mean, median and mode).

3.3.5 Data processing

Data processing is defined as the process whereby raw data is converted to meaningful information during which data is collected, manipulated, coded, processed, interpreted and stored (Rudo, 2013).

3.3.6 Data Analysis and Interpretation

Vosloo(2013) indicates that while data analysis is aimed at data presentation in an intelligible and interpretable form thereby identifying trends and relations according to the research objectives, data interpretation on the other hand, is the process of reviewing data purposefully to arrive at an informed conclusion. Therefore, data interpretation provides a meaning to the analysed information and determines its significance and implications (Rucker, 2018).

3.4 TOTAL POPULATION

There are 174 secondary schools in the Ngaka Modiri Molema District and 696 mathematics and science teachers in the said secondary school, 174 principals and 10 subject specialists. Two sub-Districts in the Ngaka Modiri Molema District will be investigated, that is, Ditsobotla Sub-District and Mahikeng Sub-district. The mathematics and science teachers in the said sub-districts are 81 with 20 principals and 4 Subject Education specialists. The total population is therefore 101.

3.5 SAMPLE SIZE WITH REFERENCE TO THE TOTAL POPULATION

An appropriate sample size is essential because it allows one to make inferences about the population based on the particular sample (Statistic Solutions, 2018).

In this study, out of 174 secondary schools in the Ngaka Modiri Molema District, 10 underperforming Secondary schools and 10 best performing secondary schools (on average), were selected and quota proportion sampling was used to calculate the sample size which is indicated in table 3.1 below, to acquire information on retention and factors affecting teacher retention, attraction and turnover. Only the mathematics and science teachers, principals of the said schools and the subject education specialists for mathematics and physical sciences formed part of the population.

Annexure B, the table for determining the sample size was also used.

3.6 SAMPLING AND DATA COLLECTION STRATEGY

A quota sampling method (Taherdoost, 2016) using a Sakaran (2003:253) table for sampling; where group of maths and science teachers from selected schools will be conveniently selected.

Quota sampling is a non- probability type of sampling that is commonly used. For sampling to be done, specific units (quotas) for various sub populations are to be selected. *Quota sampling* is basically a method for ensuring that the objectives set for the sample size are satisfied for certain sub-populations because there are no particular guidelines as to how the quotas are supposed to be filled. The quotas may be on the basis of the proportions of the population (Taherdoost, 2016).

Furthermore, quota sampling is somewhat similar to stratified sampling in that similar sampling units are grouped together, but it differs in the selection of units. As opposed to probability sampling, where the units are selected randomly while in quota sampling, as a non-probability sampling, this matter is usually left up to the researcher and they are given a chance to decide about the sample. Therefore, in most cases researchers prefer the usage of quota sampling over stratified sampling, because it accommodates financial restrictions and the administration thereof is easier; furthermore, it has a higher probability of satisfying population proportions (Taherdoost, 2016).

In terms of the aforementioned Sakaran table as shown in Annexure B, a total sample from the population of 880 up to 900 should be 269 teachers.

Although a quota proportional sampling would have been used in the study, the researcher decided to rely on the existing sample for maths and science teachers instead of a sample suggested by the Sakaran Table which would have been 269 taken from a population of 880 teachers. Based on the foregoing, it is clear that the existing number of maths and science teachers including their principals is calculated to be 101, which is rather small as compared to 269 suggested by the table referred to above. The sample for this study will therefore be 101 teachers and their school principals as shown in tables 3.1, 3.2 and 3.3.

Only the mathematics and science teachers, principals of the said schools and the subject education specialists for mathematics and physical sciences will form part of the sample.

3.7 THE SELECTED UNDERPERFORMING SECONDARY SCHOOLS

The schools are within the Ditsobotla and Mahikeng sub districts situated in the Ngaka Modiri Molema District. The schools perform below the Provincial target of 70% in mathematics and physical sciences.

3.7.1 Reasons for selecting the schools

- They are under performing in math and science
- They do not have enough math and science teachers
- A high number of math and science teachers in these schools are inexperienced
- They experience a lot of maths and science teacher turnover
- They are within the researcher's easier reach

The selection for the particular best performing schools on the other hand, was because of the following reasons:

- They were amongst the best performing schools on average in the district
- They had sufficient number of mathematics and science teachers
- They have experienced maths and science teachers
- Learner discipline at these schools is a priority

The selected schools, the number of maths and science teacher, including their principals, are shown in Tables 3.1; 3.2 and 3.3 below.

Table 3.1: Selected Poor performing Secondary Schools

	Selected Secondary School	Teacher Population	Number of Maths and Science teachers	Area
1.	Baitshoki	28	02	Itsoseng
2.	Bophirima	24	01	Itsoseng
3.	Bodibe	27	03	Bodibe
4.	Gaetsho	21	02	Lichtenburg
5.	Kopanelo	12	01	Skoongezight
6.	F.M Ramaboa	29	02	Itsoseng

7.	Regolotswe	26	03	Itsoseng
8.	Reboneilwe	25	03	Coligny
9.	Tau Rapulana	23	04	Bodibe
10.	Ramaine	27	04	Magogwe
A	Totals (maths and science teachers)	217	25	

Table 3.2: Selected Best Performing Secondary Schools on Average

	Selected Secondary School	Teacher Population	Number of Maths and Science teachers	Area
1.	Batswana	36	06	Montshioa
2.	Sol Plaatjie	30	08	Mmabatho
3.	Boitseanape	29	06	Montshioa
4.	Mmabatho	25	05	Mmabatho
5.	Letsatsing	26	06	Mmabatho
6.	Lichtenburg	22	04	Lichtenburg
7.	Mafikeng	23	05	Mahikeng
8.	Coligny	15	03	Coligny
9.	Danville	23	05	Danville
10.	Barolong	45	08	Magogwe
B	Totals (maths and science teachers)	274	56	

Table 3.3: Maths and Science Teachers and Principals from the Selected Poor and Best Performing Secondary schools

	Number of Schools	Secondary Schools Principals	Number of maths and Science Teachers	Areas where Maths and Science Teacher were drawn including their school Principals
	20	20	81	Itsoseng, Bodibe, Lichtenburg, Schoongezicht, Coligny, Magogwe, Montshiwa, Mmabatho, Mahikeng and Danville
C	Grand Total	20	81	101

3.8 SAMPLING CRITERIA

Potential respondents will have to comply with the following criteria:

- Be South African citizens
- Be working in the selected secondary schools in the Ngaka Modiri Molema District
- Be willing participants
- Be over the age of 18
- Be of any gender or race

The potential teacher respondents in any secondary school selected the school should be:

- qualified mathematics and physical sciences teachers
- experienced maths and science teachers
- registered with South African Council of Educators

The potential management respondents in the Secondary schools selected should:

- be principals
- have knowledge of the curriculum
- have a fair knowledge of retention strategies in the schooling system

The sample size is worked out of the population of mathematics and science teachers in the selected secondary school for both under performing and best performing schools.

3.9 RESEARCH INSTRUMENT USED, ITS NATURE AND COMPONENTS

It is important to collect data using a specific instrument, for accurate readings and to assist in analysing data. As the study is descriptive and has a quantitative nature, quantitative methods of data collection will be applied. A questionnaire will be developed for data collection and analysis purposes. Furthermore, the questionnaire will consist of a demographic section, close-ended questions in a 5 – point Likert scale format and some open-ended interview questions as shown in annexure A.

3.9.1 Advantages of a Questionnaire

As indicated by Debois (2018), questionnaires:

- Are useful for data collection because they let one to record people's responses quickly and reduce a lot of writing.
- Are practical in the sense that one can choose the questions asked as well as the format, either open-ended or multiple choice
- Allow the researcher to gather data in quick way even from a large audience
- Allow an easy analysis of results
- Allow scientific analysis and predictions
- Give the respondents the right to remain anonymous and can their time to answer the questions
- Are one of the most affordable way of data gathering, and therefore cost efficient.

3.9.2 Disadvantages of Questionnaires

As declared by Debois(2016), the following are the disadvantages of a questionnaire:

- Some people can be dishonest, not giving the correct answers
- The respondents might not read questions with understanding
- Respondents might find some of the questions too difficult to analyse.
- Respondents may have hidden agenda in the sense that some respondents may have interest in the researcher's idea
- There is a possibility that some questions might be ignored
- If the researcher is unable to add some personalization touches, some potential respondents may be put off and ignore it.

3.10 MEASURES TO ENSURE VALIDITY AND RELIABILITY OF DATA COLLECTED

Reliability is an extent to which the measuring instrument can produce the accurate, consistent and stable results and a reliable data also needs to be valid (Phelan and Wren, 2006). Designed and methodological strategies will therefore be applied to ensure the trustworthiness of the findings. In order to use data with confidence and knowledge of its limitations, it is important for the researcher to understand the validity and accuracy of the particular data collected (Otieno-Odawa and Kaseje, 2017). The type of reliability used in this study is the internal consistency which measures consistency of peoples' responses and can only be assessed through data collection and analysis (Price, Jhangaini and Chang, 2017). Validity on the other hand, is the extent to which the scores gathered from data through questionnaires are used to represent the variable they intended to in the study (Price *et al*, 2017).

3.11 ETHICAL CONSIDERATIONS

Ethics are norms or standards for behaviour that tend to differentiate between right and wrong and also determine the difference between acceptable and unacceptable behaviour (Munhall, 2009). Ethical issues considered in this study are, inter alia, human rights, compliance with the law, confidentiality and safety.

3.11.1 Human Rights

In this study the respondents will be afforded the right to refuse or withdraw, as the decision to take part in the study depends on how comfortable the respondents feel with participation. In this regard, the researcher will give all the respondents an opportunity to refuse to respond to questions set by the researcher being it a questionnaire or interview. In addition to human rights, the researcher will treat all participants equally and with dignity and respect.

3.11.2 Confidentiality

The respondents will be assured that whatever information they will give to the researcher will be taken as confidential and will not be communicated to anyone else and that they will remain anonymous as there is no identity of any sort that could possibly describe the respondents.

3.11.3 Compliance with the law

The researcher is aware that irrespective of the information she wants to gather, the respondents have the right to be treated with respect they should not be put in any risk be it physical or psychological. The information gathered will not be used against them in a court of law in future.

3.11.4 Safety

It will be the responsibility of the researcher to ensure safety of the respondents, by conducting the research in a safe environment and during the day to make sure that all participants are safe.

3.12 CHAPTER SUMMARY

The chapter outlined the methodology and design of the research that provided guidance to the researcher on how to investigate about factors affecting teacher retention, attraction and turnover in the selected North West Province secondary schools in the Ngaka Modiri Molema District. Data collected will address the problem statement and the retention and attraction of math and science teachers. The description of the methods used was outlined and the research procedure was explained. The instrument used, the questionnaire was critically explained. The

population, as well as the sample size were indicated and the criteria to be followed when gathering information were also outlined.

Ethical issues were taken into consideration to ensure that none of the participants could be linked to information provided as well as ensuring safety of participants and protection of their human rights.

The next chapter will deal with research results, findings and analysis.

CHAPTER 4: RESEARCH FINDINGS

4.1 INTRODUCTION

In the previous chapter, the researcher accurately outlined the research design and methodology which served as guidance towards data collection. The chapter deals with analysis and presentation of data collected quantitatively. The data collected were analysed categorically based on the study objectives. Research findings were done in correspondence with the responses.

4.2 ANALYSES OF THE RESPONSES

4.2.1 Gender

Table 4.1: Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	51	50.5	51.0	51.0
	Female	49	48.5	49.0	100.0
	Total	100	99.0	100.0	
Missing	System	1	1.0		
Total		101	100.0		

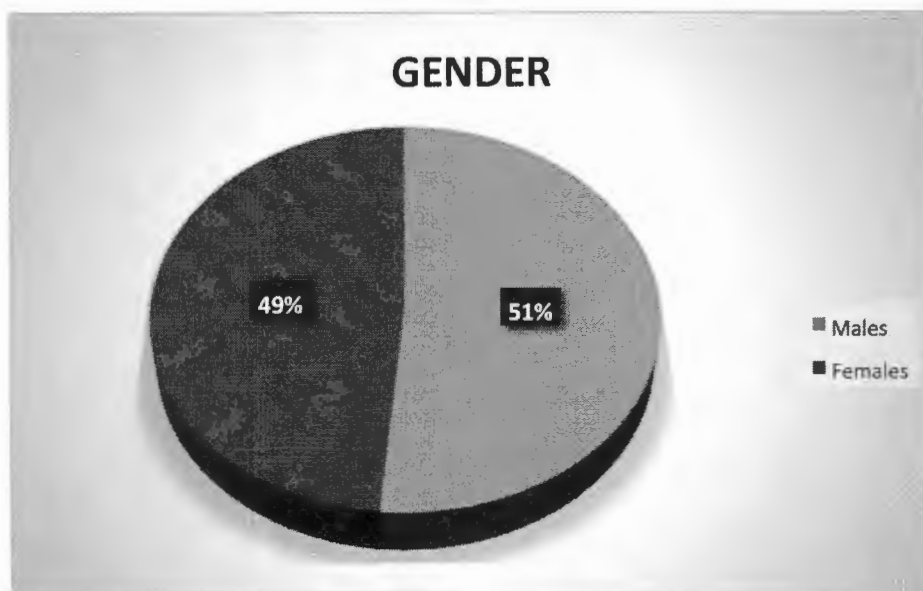


Figure 4.1: Gender

Of the 101 participants, 49 % were females and 51% represented the male respondents. This shows that there is a slight difference (2%) in the number of male and female teachers present in the system. The study is therefore not biased.

4.2.2 Race

Table 4.2: Race

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Black	80	79.2	79.2	79.2
	White	12	11.9	11.9	91.1
	Indian	4	4.0	4.0	95.0
	Colored	5	5.0	5.0	100.0
Total		101	100.0	100.0	

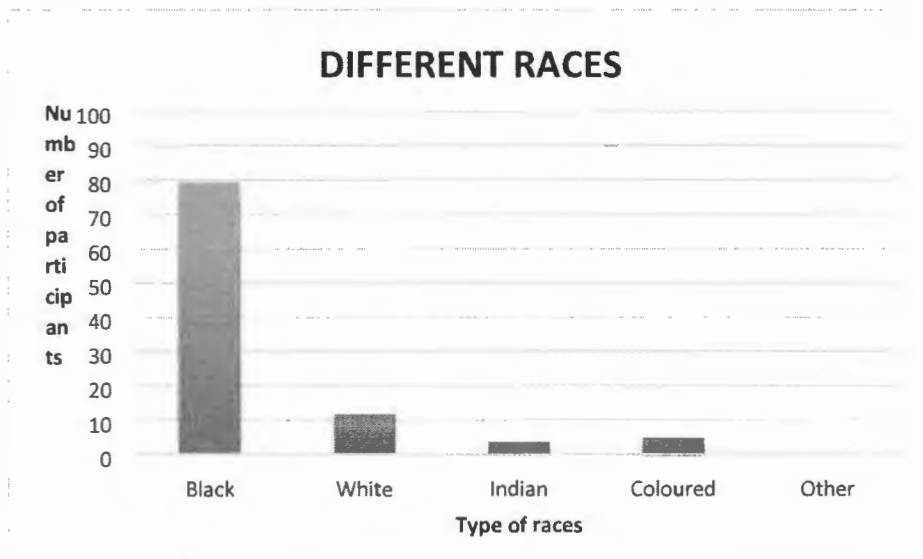


Figure 4.2: Race

The population consists of mainly black teachers as they are at a very high percentage as compared to other races, according to the statistics of the respondents. Ngaka

Modiri Molema consists of black communities in general, and at the most, teachers of the black race are the ones employed in the selected secondary schools.

4.2.3 Age

Table 4.3: Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 25 years	25	24.8	24.8	24.8
	25 - 30 years	38	37.6	37.6	62.4
	30 - 35 years	18	17.8	17.8	80.2
	35 - 40 years	16	15.8	15.8	96.0
	40 - 50 years	3	3.0	3.0	99.0
	50 - 55 years	1	1.0	1.0	100.0
	Total	101	100.0	100.0	

According to the table above, it is quite clear that the maths and science teachers are of the younger generation and it also suggests that they might have a problem of discipline in their classes as some of the learners are

4.2.4 Qualifications

Table 4.4: Qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	89	88.1	88.1	88.1
	No	12	11.9	11.9	100.0
	Total	101	100.0	100.0	

The data indicates that there is still a shortage of well-qualified maths and science teachers in some schools. Literature also reveals that some teachers fail to deliver the content to the learners as they also do not have a clear understanding of the subject

matter (Mokgato & Mji, 2006). This contributes to poor performance of the learners in the said subjects.

4.2.5 Type of qualification

Table 4.5: Types of qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Academic	59	58.4	58.4	58.4
	Professional	42	41.6	41.6	100.0
Total		101	100.0	100.0	

4.2.6 Accreditation

Table 4.6: Accreditation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	68	67.3	67.3	67.3
	No	33	32.7	32.7	100.0
Total		101	100.0	100.0	

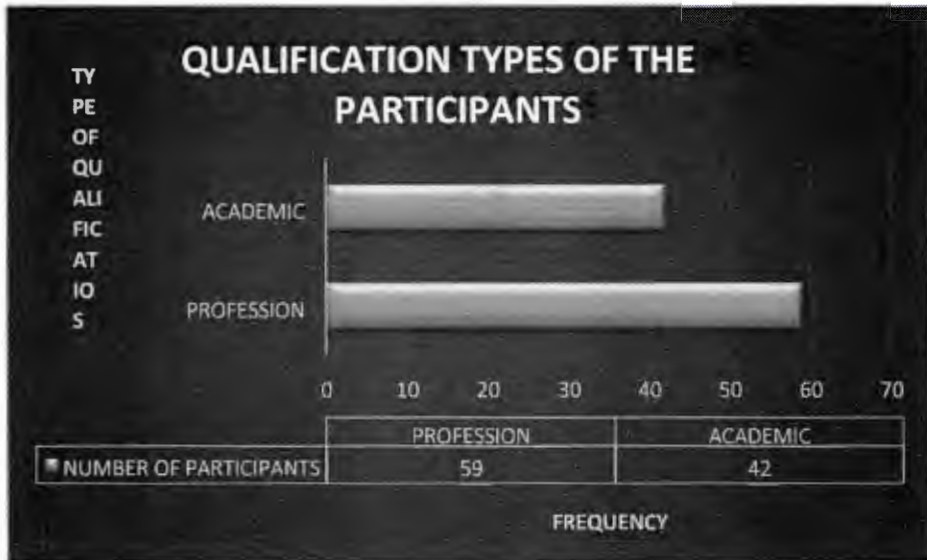


Figure 4.3: Types of qualifications

Of the 101 teachers, 42 are academically qualified. This is a cause for concern as it shows that they are not passionate for teaching, they teach because they had nowhere else to go. Teaching is used by these individuals to earn a living. Literature points out that passionate teachers are committed and dedicated to their work and will, as a result, encourage their learners to do their best and model them (Alam and Farid, 2011).

4.2.7 Qualification Level

Table 4.7: Qualification levels

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
None	10	9.9	9.9	9.9
Diploma	6	5.9	5.9	15.8
Degree	45	44.6	44.6	60.4
Higher	35	34.7	34.7	95.0
Masters	5	5.0	5.0	100.0
Total	101	100.0	100.0	

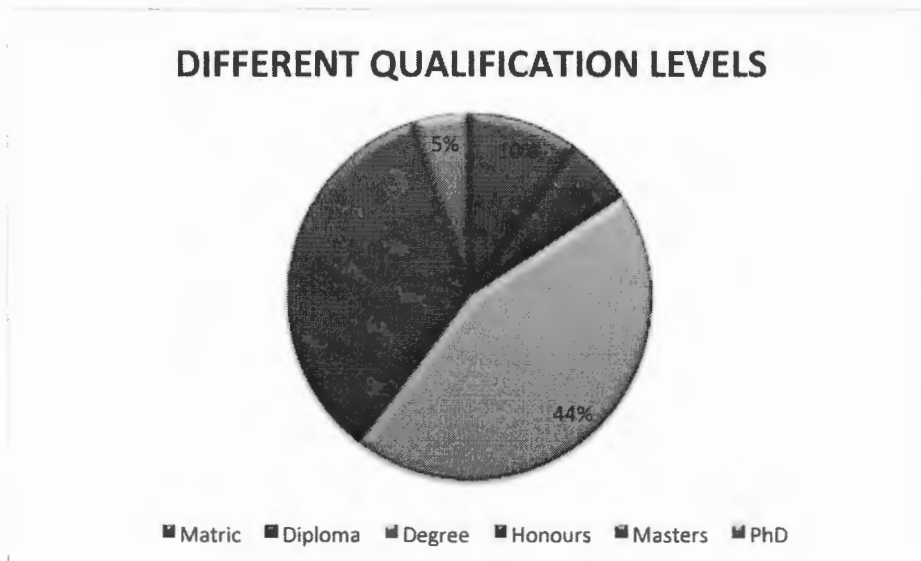


Figure 4.4: Qualification levels

Most of the maths and science teachers have a higher level of qualifications because 44% of the sample are in a possession of a Degree.

4.2.8 Religion

Table 4.8: Types of Religion

		Frequency	percentage	Valid Percent	Cumulative Percent
Valid	Christian	79	78.2	78.2	78.2
	Islamic	8	7.9	7.9	86.1
	Buddhism	10	9.9	9.9	96.0
	Bahai Faith	3	3.0	3.0	99.0
	African	1	1.0	1.0	100.0
	Total	101	100.0	100.0	

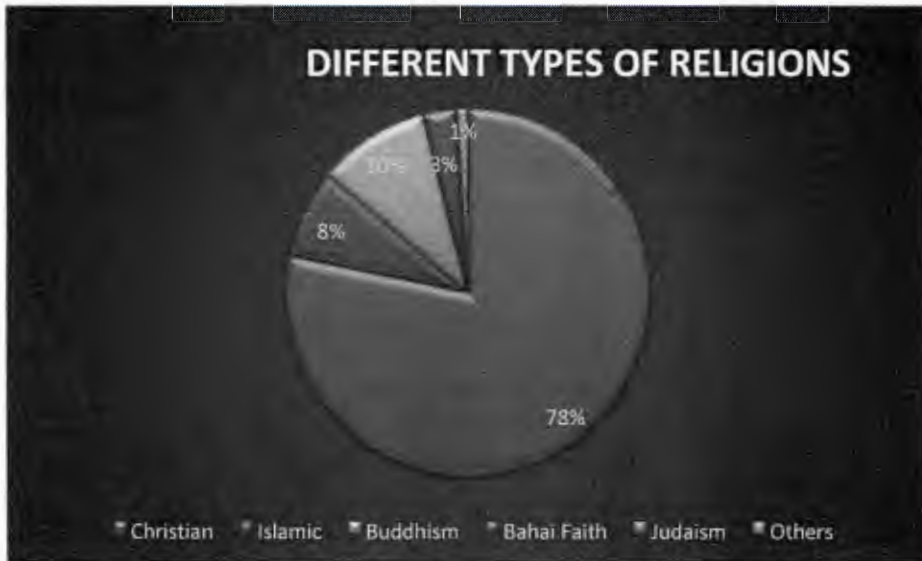


Figure 4.5: Types of Religion
 Most teachers are of the Christian religion.

4.2.9 Years of experience

Table 4.9 Years of Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 - 5 years	54	53.5	53.5	53.5
	5 - 10 years	31	30.7	30.7	84.2
	10 - 15 years	13	12.9	12.9	97.0
	15 - 20 years	3	3.0	3.0	100.0
	Total	101	100.0	100.0	

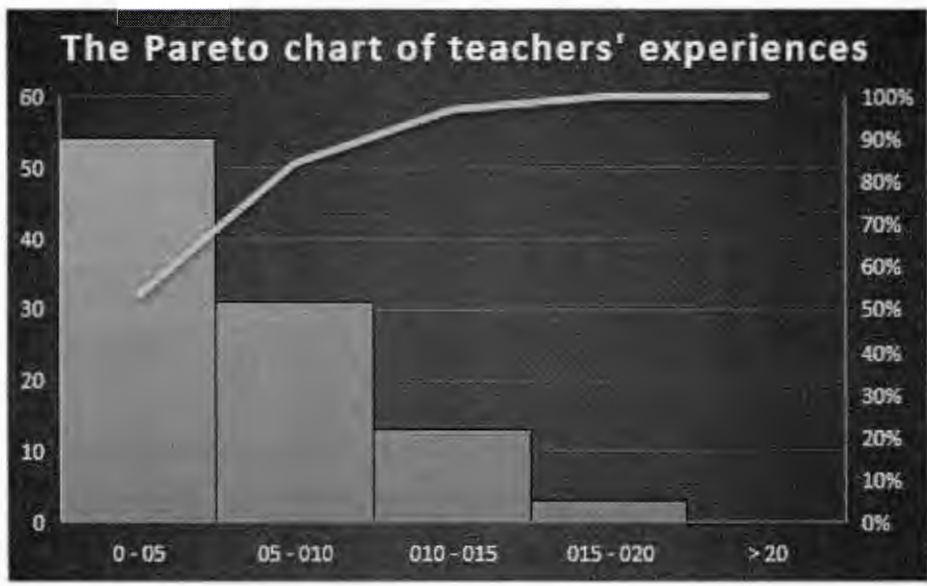


Figure 4.6: Experience period

Quite a number of maths and science teachers have little experience in teaching. According to the statistics given above, over 90% of the sample served the Department for less than 6 years. Literature suggests that experience is very important in teaching because teachers are responsible for promoting growth amongst learners and must be in a position to deal with different personality types and ability levels while treating all learners equally, which is a well-known fact to an experienced teacher (Kini and Podolsky, 2016).

Palmer *et al* (2001) indicated that expert teachers can be characterized by years of experience, social recognition or nomination, professional or social group membership and performance-based criteria.

Teachers who are able to maintain good relations with their learners, by encouraging self-discipline and dignity, are said to be successful in managing misbehaviour in the classrooms (Mokhele, 2006).

4.2.10 Sufficiency of the number of maths and science teachers in the school

Table 4.10: Sufficiency of the number of math and science teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	8.9	8.9	8.9
	Disagree	12	11.9	11.9	20.8
	Neutral	13	12.9	12.9	33.7
	Agree	39	38.6	38.6	72.3
	Strongly Agree	28	27.7	27.7	100.0
	Total	101	100.0	100.0	

In this question, it is found that 38.6% of the respondents agree that the schools have a sufficient number of math and science teachers, but 20.8% disagrees, which suggests that the selected secondary schools might be having sufficient number of math and science teachers, which does not mean that there is no shortage of math and science teachers. The 34 respondents in other schools indicated that there is still a shortage of math and science teachers, which might suggest that the schools may under perform as the shortage will affect the performance of the learners. One might ask if these teachers have experience, passion and commitment. From the literature review, Draper (1998) argued that learning is only the transmission of information from expert to learner.

4.2.11 Measures put together to address the problem of the shortage of mathematics and physical sciences teachers in the school

Table 4.11: Measures to address math and science teacher shortage in schools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	10	9.9	9.9	9.9
	Neutral	74	73.3	73.3	83.2
	Agree	11	10.9	10.9	94.1
	Strongly Agree	6	5.9	5.9	100.0
	Total	101	100.0	100.0	

A large percentage of the respondents are confused at this stage because the school management teams are the ones who feed the school governing bodies with relevant information based on the needs of the learners, curriculum wise and as the population is consist of young people, they might not know the strategies put in place by the school management teams to retain math and science teachers.

4.2.12 The department of Education in the North West Province put measures together to address the problem of shortage of mathematics and physical sciences teachers in the Ngaka Modiri Molema District

Table 4.12: Measures to address math and science teacher shortage in the District

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	8	7.9	7.9	7.9
	Neutral	78	77.2	77.2	85.1
	Agree	13	12.9	12.9	98.0
	Strongly Agree	2	2.0	2.0	100.0
Total		101	100.0	100.0	

It is found that respondents are neutral because they are unable to tell the position of the Department of Education concerning the retention of math and science teachers. Most of the teachers here are on temporary basis with the Department of Basic Education. This means that their contracts have to be renewed by the end of 2018 and some may not come back as they are not accredited. Therefore, the Department is still to face the shortage of math and science teachers in future.

4.2.13 It is important to retain math and science teachers in the Secondary Schools

Table 4.13: Importance of retaining math and science teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	2.0	2.0	2.0
	Neutral	42	41.6	41.6	43.6
	Agree	44	43.6	43.6	87.1
	Strongly Agree	13	12.9	12.9	100.0
	Total	101	100.0	100.0	

56.5% of the respondents agree with the retention of math and science teachers. If literature is recalled, teacher retention may affect learners' performance because if teacher turnover happens, learners are likely to have inexperienced teachers who are not effective (Owens, 2010). It is therefore, based on the findings, vital to retain math and science teachers.

4.2.14 The school prioritizes retention of math and science

Table 4.14: The retention of math and science teachers as a priority to the school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	12	11.9	11.9	11.9
	Neutral	70	69.3	69.3	81.2
	Agree	16	15.8	15.8	97.0
	Strongly Agree	3	3.0	3.0	100.0
	Total	101	100.0	100.0	

Most of the respondents are not sure in terms of the schools' intention to retain math and science teachers. The school management teams are tasked by the Department of Basic Education to see in to it that relevant teachers for the specific subjects are employed, but the staff establishment depends on the school's roll for the previous year. If the enrolment decreases, the number of teachers is expected to decrease, this, in turn, puts the school management in a predicament as teachers are given a

chance to volunteer, and math and science teachers are no exception. Meaning, they may also volunteer, which might cause a huge problem as it is very difficult for a school to find a replacement for a math and science teacher.

4.2.15 The shortage of math and science teachers have an effect on the learners' performance

Table 4.15: Effect of math and science teacher shortage on learners' performance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	2.0	2.0	2.0
	Disagree	9	8.9	8.9	10.9
	Neutral	24	23.8	23.8	34.7
	Agree	32	31.7	31.7	66.3
	Strongly Agree	34	33.7	33.7	100.0
	Total	101	100.0	100.0	

A large number of respondents agree that performance of the learners depends on the number of math and science teachers. Learners need teachers to explain concepts in the classroom. Math and science teachers need to be always there when learners need them. If a school experiences a shortage of math and science teachers, those who remain will have an increased workload leading to teacher dissatisfaction at work and demoralization. Literature reveals that teachers are a pillar to the education system as they instill knowledge and information to the minds of the learners and according to Mart (2013), most of the countries are not doing well in math and science and the shortage of the teachers for these subjects is a major cause of this poor performance.

4.2.16 I am motivated to teach mathematics and physical sciences

Table 4.16: motivation to teach math and science

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	3.0	3.0	3.0
	Disagree	22	21.8	21.8	24.8
	Neutral	36	35.6	35.6	60.4
	Agree	28	27.7	27.7	88.1
	Strongly Agree	12	11.9	11.9	100.0
	Total	101	100.0	100.0	

Most teachers are motivated to teach math and science but others are confused, whereas a small number is not motivated. It is really disturbing to find teachers not knowing what to say about their work. This calls for the intervention of the top management to uplift confidence and self-motivation to teachers because if they are not motivated, there is going to be poor results again. Literature indicates that South Africa is rated 144th out of 144 countries in math and science performance, (Williams, 2014). As a matter of fact, the top management in the Department of Basic Education need to ensure that math and science teachers are highly motivated in order to win learners confidence.

4.2.17 I am motivated by the discipline of the learners in my school

Table 4.17: Motivation through learner discipline

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	20	19.8	19.8	19.8
	Disagree	40	39.6	39.6	59.4
	Neutral	25	24.8	24.8	84.2
	Agree	13	12.9	12.9	97.0
	Strongly Agree	3	3.0	3.0	100.0
	Total	101	100.0	100.0	

It is found that teachers are not satisfied about the discipline of the learners in secondary schools. Teachers are faced with the biggest challenge of teaching while watching their backs. Learners who are ill disciplined will obviously influence others not to do the work and to disrespect the teachers. Discipline is generally difficult to maintain in our schools. This results in the department failure to attract new teachers into the system. Mokhele (2006) indicated that teachers ought to encourage self-discipline amongst learners in order to manage classroom behaviour successfully.

4.2.18 The working conditions are good, and lead to job satisfaction

Table 4.18: Effect of working conditions on job satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	19	18.8	18.8	18.8
	Disagree	35	34.7	34.7	53.5
	Neutral	42	41.6	41.6	95.0
	Agree	4	4.0	4.0	99.0
	Strongly Agree	1	1.0	1.0	100.0
	Total	101	100.0	100.0	

The conditions under which the teachers are working are not convincing to making teacher want to stay in the system. Teachers are experiencing work overload. The merging of high schools and middle schools brought problems to maths and science teachers because they had to teach technology, economic and management sciences, natural sciences and GET mathematics. The poor teachers find themselves working under pressure. According to literature, if teachers perceive lack of support in the environment, the involvement will decrease. (Alvarado and Britones, 2018). If this happens, the learners' performance is negatively affected.

4.2.19 I think of leaving the teaching career

Table 4.19: Intention to leave the teaching career

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	3.0	3.0	3.0
	Disagree	11	10.9	10.9	13.9
	Neutral	54	53.5	53.5	67.3
	Agree	28	27.7	27.7	95.0
	Strongly Agree	5	5.0	5.0	100.0
	Total	101	100.0	100.0	

More than 30% of math and science teachers are thinking of leaving the system. It is quite a lot. 53.5% are undecided mainly because some teachers, though unhappy, have created a comfort zone in the system and as a result, are fearful to move to other departments of sectors, some of the teachers are afraid to leave the system without being sure of where to go since the rate of unemployment in our country is very high. The fact of the matter is, if these men and women can decide to leave, there is going to be a problem in the learner performance and the education system in North West and South Africa as a whole will die.

4.2.20 I'm correctly compensated and enjoy the benefits of teaching math and science

Table 4.20: Effect of compensation on retention of math and science teachers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	21	20.8	20.8	20.8
	Disagree	42	41.6	41.6	62.4
	Neutral	31	30.7	30.7	93.1
	Agree	7	6.9	6.9	100.0
	Total	101	100.0	100.0	

Math and science teachers are generally not happy about the compensation and benefits of teaching. Literature suggests that attraction and retention of teachers is one of the key aspects in an education system that is fully functioning (Podolsky et al, 2006). The retention attraction of math and science teachers will no be possible if compensation of these skilled individuals is ignored.

CHAPTER SUMMARY

In this chapter, the data collection and analysis guided the researcher to summarize the findings of the study. The chapter relates the literature review and the summary of the analysis. The data collected was analysed and explained in the form of statistical graphs and tables. The response from teachers and principals from selected secondary schools in the North West Province were used to answer the research questions about math and science teacher retention and attraction.

The next chapter focuses on the recommendations, informed by the findings. The conclusion of the study will also be drawn in the next chapter.

CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The previous chapter dealt with the summary of data analysis and findings. Based on the findings mentioned after the survey, in chapter 4, there are some factors to be considered to help solve the problem of mathematics and science teachers leaving the system or mathematics and science teacher turnover.

Factors that affect the retention of math and science teachers in the North West Province secondary schools are therefore, according to the findings of the study:

- Learner discipline
- Teacher compensation and benefits
- Working conditions of teachers
- Quality of math and science teaching



Figure 5.1: Factors affecting retention and attraction of math and science teachers

5.2 RESEARCH OBJECTIVES RESTATED

5.2.1 To investigate what the secondary schools are doing to address the problem of the shortage of mathematics and science teachers.

5.2.2 To investigate how the management of North West secondary schools retain the mathematics and science teachers.

5.2.3 To determine how the shortage of mathematics and science teachers affect the performance of learners at the North West secondary schools.

5.2.4 To determine qualities of a good mathematics and science teacher in secondary schooling system.

5.2.5 To determine the effect of working conditions on attraction and retention of mathematics and science in the North West secondary schools.

5.2.6 To determine the effect of compensation on the attraction and retention of maths and science teachers in the North West secondary schools.

5.3 ACHIEVEMENTS OF OBJECTIVES

5.3.1 To investigate what the secondary schools are doing to address the problem of the shortage of mathematics and science teachers

Based on the analysis, the schools are not doing well in terms of addressing the problem of math and science teacher shortage in the province. The schools are channelled by the post provisioning model, and as a result, the SMT and the SGB are unable to employ the relevant people even if there is a need, unless the schools financially stable and can afford to pay the particular math and science teachers.

5.3.2 To investigate how the management of North West secondary schools retain the mathematics and science teachers.

Data analysis show that there is a lot of work to be done in the process of retaining maths and science teachers because the working conditions of teachers in general seem to affect the retention of teachers heavily. Strategic planning is needed by the school management teams.

5.3.3 To determine how the shortage of mathematics and science teachers affect the performance of learners at the North West secondary schools.

Research shows that one of the factors affecting the performance of the learners in maths and science is the shortage of teachers. Teachers are the driving force in the teaching and learning processes, without which, learners will go astray. For curriculum to be delivered, teachers are needed. If learners have to spend a day without a maths or science teacher, curriculum is going to be affected and obviously, the performance.

5.3.4 To determine qualities of a good mathematics and science teacher in secondary schooling system.

The teachers' qualifications are satisfactory. What worries is the accreditation of other teachers. Some teachers are academically qualified, but are not accredited, which creates a problem because some of them do not even have the PGCE and the SACE do not recognize such teachers. The teachers can therefore not be kept for a long time in the system. Some of these teachers are not intending to stay long n

5.3.5 To determine the effect of working conditions on attraction and retention of mathematics and science teachers in the North West secondary schools.

The working conditions, inter alia, the workload, changing policies, learner discipline and learners' performance, in the North West secondary schools are very bad, they are actually the reason why teachers want to leave the fraternity. Most of the teachers joining the system are young, and they sometimes find themselves competing with the learners because some learners are of their age, or even older than them.

5.3.6 To determine the effect of compensation on the attraction and retention of maths and science teachers in the North West secondary schools.

The study shows that maths and science teachers are generally unhappy about what they take home after hard-work. Only in the education system, can one say hard-work does not pay. Low compensation is the teachers' strongest point to leave the system.

5.4 RECOMMENDATIONS

The research questions and objectives were addressed by the findings and the recommendations will explain what the results of the study are.

5.4.1 RECOMMENDATION 1

Compensation is said to be the factor with a high rate, influencing retention of mathematics and science teachers. Teaching is regarded as the mother of all professions, but the teachers are the most underpaid public servants. In every institution, well-compensated employees feel appreciated and are motivated to put more effort in whatever they do. Mathematics and science teachers, in particular are having a problem of not being liked or favoured by learners, as the learners have negative attitude towards learning the subjects and as a result, it is difficult to win these learners to develop a positive attitude.

It is rather difficult to gain the learners' confidence into learning the subjects and to prepare their mind set. It takes a lot of energy from the teacher to transfer knowledge and information to these learners. Therefore, they have to be paid more.

Considering the extra lessons conducted by these dedicated men and women, there should be a fixed rate for this extra time worked. Teachers are the only public servants who take work home every day, meaning the knock-off time is not real for them as they work from home yet they have served their seven hours required by the Department of Education.

During the grade 12 results celebrations, teachers should be given a performance bonus. A thank you is not enough for the efforts made by these teachers.

From time to time teachers are being called for workshops and Professional Support Forums, which simply suggest that they require transport to attend those professional activities, which is why it is recommended that there should be a car allowance for each teacher with 5 years of teaching experience.

5.4.2 RECOMMENDATION 2

There is nothing as elusive as leadership. All the money in the world can make you rich, and all the power in the world can make you strong, but these things can never make you a leader. One can inherit a fortune but never leadership (Munroe, 2009).

Principals as line managers ought to be good leaders and adapt to a democratic leadership style and prevent teacher turnover, by encouraging teachers to work together in a collegial atmosphere, promoting the development of skills directly related to teaching and enabling skilled teachers to remain in the classrooms.

For a true leader, the time is always right to do the right thing (Martin Luther King Jnr) It is recommended that the Department of Education should equip principals with more knowledge and information concerning leadership and types of leadership styles to enable them to lead their subordinates well. Principal workshops should be conducted by the tertiary institutions and the principals should be certificated. This calls for motivation to the principals who will in turn motivate teachers.

5.4.3 RECOMMEDATION 3

Workload is one of the factors under working conditions that makes it difficult for maths and science teachers to cope. It is therefore recommended that there should be a departmental head for maths and a departmental head for science in secondary schools. The departmental head for maths will handle maths, mathematical literacy and economic and management sciences, while the departmental head for science handles physical sciences, natural sciences and technology. One departmental head cannot handle six subjects and expected to perform. Maths and science teachers also, should not be given many classes, as there will obviously be poor performance. The Department should therefore increase the number of maths and science teachers in secondary schools.

Mathematical literacy also added a load on the teachers' shoulders as all classes have to be taught mathematics or mathematical literacy. If a school has 17 classes, and only 4 maths and science teachers, one can imagine what these teachers are going through. These teachers are expected to teach also EMS, technology, Natural sciences, physical sciences and mathematics. On the other hand, paper work for teachers is way too much, for example, after a formal assessment task, teachers are expected to mark; record and analyse for progressed and non-progressed learners separately.

5.4.4 RECOMMENDATION 4

Secondary school learners are becoming more difficult to handle by the day. Teachers find it very difficult to deal with bad behaviour of learners; therefore, it is a plea to the department of Education to provide a teacher with alternative measures to be taken in as far as discipline is concerned. For learning to be effective, learners ought to be disciplined, especially when learning challenging subjects like mathematics and science as learners' progress should be checked every day.

In addition to discipline, safety of learners and teachers is also challenged by learners who bring weapons to school, acting under the influence of drugs and bullying other learners or killing the teachers like the recent Ramotshere secondary school case where a teacher lost his life after being stabbed to death by a learner, It is highly

recommended that the Department should employ security guards in each school to allow a safe teaching and learning environment.

5.4.5 RECOMMENDATION 5

For South Africa to be able to compete with other countries in as far as maths and science performance is concerned, there must be efforts to improve the quality of maths and science teaching. It is, as a result, recommended that the Department of Education should have programmes of teacher development in place and employ qualified maths and science teachers. Staff establishment should not affect maths and science teachers. Talent management, as a human resource component should be highly considered by the top management of the North West Department of Education as a strategy to retain maths and science teachers. Teachers qualified to teach mathematical literacy only should not be allocated maths classes as mathematical literacy is also a challenge to many maths teachers. Only teachers specialized in maths should be allowed to teach maths. The same applies to science, teachers who specialized in physics should teach physics only and those specialized in chemistry should teach chemistry only. This will better the maths and science learners' performance in the province.

5.4.6 RECOMMENDATION 6

The pass percentage of maths in grade 8 and 9 should go back to strictly 40%. Learners should be encouraged to pass maths with good marks. One of the factors discouraging maths and science teachers is to see learners studying maths in grade 10 with a pass percentage of 20 in grade 9 maths. The poor teacher is expected to take this level 1 learner to level 3, because the analysis is reported at 40% pass percentage. Furthermore, mark adjustments and condoned percentage in mathematics need to be discouraged as it allows learners to proceed to the next grade without passing. According to the policy, if a learner has passed all subjects but failed maths, the maths percentage will be condoned to 40%, regardless of the percentage the learner scored in maths, even if it can be 10%.

Maths and science adjustments in grade 10 and 11 ought to be revisited. Learners are not encouraged to do their best because they know that teachers are magicians who always make them pass, even if they do not deserve it.

Learners' progression also plays a role in the grade 12 output results. One will find that a learner has been progressed from grade 10 to grade 11 due to number of years in a phase; the particular learner qualifies for progression to grade 12 because of the same reason. In grade 12, it becomes a problem as the learner may not be able to write all the subjects registered for should he or she fail the preparatory examinations.

5.4.7 RECOMMENDATION 7

Human resource managers within the North West Province should revisit the qualifications of maths and science teachers to ensure that the right people are employed, for the right positions, at the right time. The promotional posts for maths and science should also be monitored accordingly throughout the province.

It is further recommended that temporarily employed maths and science teachers should be a priority when coming to absorbing teachers for permanent posts, because, as a matter of fact, science and engineering companies need qualified and skilled people.

Attraction and recruitment strategies should also be put in place to ensure that relevant people are employed and qualified, experienced teachers are retained.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

The study could not reveal everything regarding retention of mathematics and physical sciences teachers because some concepts need to be discussed in details and will also require special survey, review of literature and further investigations. The researcher therefore suggests some topics for future research.

5.5.1 Strategies to retain mathematics and physical sciences in secondary school in the North West Province, South Africa

The North West Province is still experiencing a problem of shortage of mathematics and physical sciences teachers in secondary schools. Study has shown that some maths and science teachers are not qualified to teach maths and others are not

accredited, this shows that a lot needs to be done in recruiting and retaining maths and science teachers. The study listed the factors affecting retention but these factors need to be unpacked and ultimately, strategies should be put in place.

5.5.2 The progression of maths and science learners to the next grade in North West Province Primary and Secondary Schools

Study reveals that South Africa came 144th out of 144 countries in maths and science learner performance (Williams, 2014). It is disturbing to find learners progressed to the next grade while failed maths and science in the previous grade and still be allowed to continue with maths and science. It is clear that those learners are not the maths and science material, so they also become frustrated and perform even the worst in the next grade. In grade 12, it is the same learners who now have to be given multiple opportunities where they usually do not do well. Progression is therefore found by the researcher a problem over a problem. This is why the researcher recommends that the issue of learner progression should be reviewed.

5.6 LIMITATIONS OF THE STUDY

5.6.1 Scope of discussions

The researcher is inexperienced in conducting researches and producing academic papers of such a large size individually. The scope and depth of discussions in this study is compromised in many levels compared to the work of experienced scholars.

5.6.2 Lack of previous studies

Literature review forms a very important part of the research as it assists one to create a sense of rapport with the researcher's audience and as a result, more books and articles are required for the trustworthiness of the study. In this study, the researcher found it difficult to find the scholarly articles based on the study because most of the researchers did not focus on the retention but on the shortage of maths and science teachers, some researchers based their focus on the shortage of teachers in general.

5.6.3 Time

Time management became a challenge in this study because of the workload of the researcher as a maths and science teacher and the Departmental Head for

mathematics, physical sciences, technology, economic and management sciences and mathematical literacy. The time to conduct the research was limited.

5.6.4 Timing of study

The data collection was done during the time that was not exactly suitable for respondents as teachers. The reason being, teachers are not available during school days and even weekends because maths and science teachers conduct extra classes and therefore found responding to the questionnaires as a time consuming exercise. During school holidays, some of the maths and science teachers go for camps and having their learners' test or exam answer sheets to mark, because immediately after the schools reopening, the marks are to be captured. The researcher had to use online data collection method as it was easier to distribute the questionnaires and to get responses quickly, unlike waiting to collect from the respondents and get excuses every time. With online data collection, the researcher need not to go and collect, she will just write an email as a reminder and the respondents will post their responses. The problem with online was that some respondents did not have access to internet and some are born before technology, hence the delay at some stage.

5.6.5 Research area

The research area for the study is too large(North West Province), while the focus area was only one District (Ngaka Modiri Molema). The selected secondary schools are in the Ngaka Modiri Molema District, with Rekopantswe, Mahikeng and Ditsobotla Sub Districts used for the whole of North West Province. The reason being the researcher planned the research for Ngaka Modiri Molema hence the chosen three sub districts but the research committee changed the topic to cover for the whole of North West.

5.6 IMPORTANT CONCLUSIONS AND LESSONS LEARNED FROM THE STUDY

From the study findings, it is clear that most of the secondary schools in North West have insufficient number of maths and science teachers and that the teachers are working under challenging conditions which results in job dissatisfaction. Teachers are faced with two major problems, that is, compensation and learners discipline. Maths and science teachers are generally overloaded and the quality of results affects the morale of the teachers which leads to the decision of leaving the system.

The study made me realize that teachers are troubled and need someone to have an ear to their challenges. Literature shows that studies have been conducted, but there is still a shortage of maths and science teachers, meaning much need to be done to address the problem.

Time management is a factor that I need to work on because if time was correctly managed much could have been found. At some instances the researcher found herself working under pressure trying to meet the deadlines. The fact remains, if time management is taken into consideration, it will encourage planning, as proper planning prevents poor performance.

Before this study, the researcher did not know of the South African status in maths and science education as compared to the other countries. One's vocabulary and knowledge and information have improved. The researcher also learned some ethics. Human relations was a good practise during this study, as one is forced to talk to people, listen to their views and try to come up with words of motivation to other colleagues as participants in the study.

One other thing is that, we all have the potential to put South Africa on the map, if we can only make inputs to the success of the country by making studies that will help solve problems in our communities, different companies and different departments.

5.7 CONCLUSION OF THE STUDY

In this study, I tried to identify and explore the factors that affect retention and attraction of mathematics and physical sciences teachers in the North West Province secondary schools and whether the strategies implemented by the Department of Basic Education contributed to meeting the demand and supply of mathematics and science teachers in the North West secondary schools. My main challenge was the lack of quality numerical data on the size and shape of teacher workforce.

I managed to find out the factors affecting the retention of mathematics and science teachers from survey in which I used questionnaires. The objectives were achieved and research questions were answered.

From the information gathered, I realized that teachers are troubled. They want to see themselves out of the system. The factors that were rated very high were learners' discipline, compensation and benefits, working conditions and quality of maths and science teaching.

Chapter 1 introduced the study, explained the purpose of the study and listed the objectives and research questions.

Chapter 2 reviewed the literature that explains the concepts of the study.

Chapter 3 dealt with methodology and gave direction as how to collect relevant information.

Chapter 4 collection and analysis of data were done and the summary of the analysis informed the study findings

Chapter 5 outlines the factors affecting the attraction and retention of maths and science teachers in the selected secondary schools in the North West province.

Recommendations based on the findings, were done.

The research questions and objectives were addressed by the findings and the recommendations well explained what the results of the study were.

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APPENDIX A: QUESTIONNAIRE

**EXPLORING FACTORS THAT AFFECT ATTRACTION AND RETENTION OF
MATHEMATICS AND PHYSICAL SCIENCES TEACHERS IN SELECTED SECONDARY
SCHOOLS, NORTH WEST PROVINCE**

SECTION A: Demographic Information (Please cross in the appropriate box) 1.

What is your gender?

M	F
<input type="checkbox"/>	<input type="checkbox"/>

2. What is your race?

Black	White	Indian	Coloured	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. What is your age?

Below 25 years	25-30 Years	30-35 years	35-40 years	40-50 years	50-55 years	Above 55 years
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Are you a qualified teacher?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

5. What are your qualifications?

Academic	Professional
<input type="checkbox"/>	<input type="checkbox"/>

5. If academic, are you accredited?

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

6. What is your qualification level?

Matric	Diploma	Degree	Honours	Masters	PhD

7. What is your religion?

Christian	Islamic	Buddhism	Bahai Faith	Judaism	African	Others

8. What are your years of experience?

0-5 years	5-10 years	10-15 years	15-20 years	20-25 years

EXPLORING FACTORS THAT AFFECT ATTRACTION AND RETENTION OF MATHEMATICS AND PHYSICAL SCIENCES TEACHERS IN SELECTED SECONDARY SCHOOLS, NORTH WEST PROVINCE.

SECTION B: Multiple choice

Cross one of the five categories from *Strongly disagree (1)* to *Strongly agree (5)* for each statement as it applies to you:

Objectives		Statements	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree 5
Objective 1	1	Does the school have a sufficient number of math and science teachers?					
	2	Does your school put measures together to address the problem of shortage of math and science teachers?					
	3	Does the Department of Education in the North West Province put measures together to address the problem of shortage of math and science teachers in the Ngaka Modiri Molema District?					
Objective 2	4	It is important to retain math and science teachers					

	5	The school prioritizes retention of math and science teachers					
Objective 3	6	Does the shortage of math and science teachers have any effect on the learners' performance?					
Objective 4	7	I am motivated to teach math and science					
Objective 5	8	I am motivated by the discipline of learners in my school					
	9	The working conditions are good and lead to job satisfaction					
	10	I think of leaving the teaching career					
Objective 6	11	I am correctly compensated and enjoy the benefits of teaching math and science					

EXPLORING FACTORS THAT AFFECT ATTRACTION AND RETENTION OF MATHEMATICS AND PHYSICAL SCIENCES TEACHERS IN SELECTED SECONDARY SCHOOLS, NORTH WEST PROVINCE

SECTION C: Open-ended Questions

- 1. What effect does the learner' behaviour has on the retention of teachers?

- 2. Do you think the Department is doing enough to keep math and science teachers in the class? Explain

.....
.....
.....

- 3 What strategies can be implemented to improve the learners' performance in math and science?

.....
.....
.....

- 4. What measures have the department of Education in the North West Province put together to address the problem of the shortage of mathematics and physical sciences teachers?

.....
.....
.....

- 5 What are the specific identifiable attributes or competencies of a good mathematics and science teacher in secondary schooling system?

.....
.....
.....

- 6. Is there sufficient support to the math and science teachers from the top management? Please explain.

.....
.....

APPENDIX B: TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	50	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367

130	97	65 0	24 2	9000	368
140	103	70 0	24 8	10000	370
150	108	75 0	25 4	15000	375
160	113	80 0	26 0	20000	377
170	118	85 0	26 5	30000	379
180	123	900	269	40000	380
190	127	95 0	27 5	50000	381
200	132	10 0 0	27 8	75000	382
210	136	11 0 0	28 5	1000000	384

Source: Sekaran, 2003; 253.

Where: N = the population size and S = the sample size

Declaration

This is to declare that I, Annette L Combrink, accredited language editor and translator of the South African Translators' Institute, have languageedited the dissertation by

by

SM Shole

With the title

Exploring Factors that Affect the Attraction and Retention of Mathematics and Physical Sciences Teachers in Selected Secondary Schools, North West Province



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