

**THE IMPACT OF TEACHER DEVELOPMENT SCIENCE EQUIPMENT  
TRAINING WORKSHOPS IN THE NORTH WEST PROVINCE**

**SEGWE SUZAN SELINA KELEBOGILE**

**STUDENT NO. 16956702**

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**SUPERVISOR: PROF. WASHINGTON T. DUDU**

**MARCH 2017**

## DECLARATION

I, **SEGWE SUZAN SELINA KELEBOGILE** declare that the dissertation entitled:

**THE IMPACT OF TEACHER DEVELOPMENT SCIENCE EQUIPMENT TRAINING  
WORKSHOPS IN THE NORTH WEST PROVINCE**

is my own work and that all sources quoted have been indicated and acknowledged by means of complete references and my dissertation has not been previously submitted by me for a degree at this or any another university.

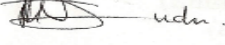


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S.S.K. SEGWE

**DATE:** 13 March 2017

**CERTIFICATE OF ACCEPTANCE FOR EXAMINATION**

This dissertation entitled, *The Impact of Teacher Development Science Equipment Training Workshops in the North West Province* by SEGWE SUZAN SELINA KELEBOGILE is hereby recommended for acceptance for examination.



Handwritten signature of Prof. Washington T. Dudu.

Supervisor: Prof. Washington T. Dudu: .....

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## ABSTRACT

This study investigates the impact of teacher development science equipment training workshops in the teaching of Physical sciences in the North West Province. The study sought to explore the nature of the current workshops, the influence of the workshops in the teaching and learning of Physical sciences and to determine if teachers are empowered by these workshops. Implications of the impact of these workshops in relation to the expected outcomes of the curriculum were inferred. The study employed the eclectic-mixed research methods pragmatic paradigm. Quantitative data was first collected and analysed. This was followed by qualitative data which was also collected and analysed. The rationale for this approach was that the quantitative data and their subsequent analyses provided a general understanding of the Science Equipment Training workshops in relation to how the workshops empower teachers. The qualitative data and their analyses refined and explained statistical results by exploring participants' views in depth. A total sample of 60 Physical Science teachers was selected using the stratified random sampling technique. The strata in this study were in four North West Province districts. Data was collected using a questionnaire, classroom observations and interviews. Microsoft Excel programme version 2013 was used for constructing graphs and carrying out calculations. Minitab was used for performing tests of hypotheses. The results indicate that there is some statistically significant difference in the way the current workshops are being run as compared to the previous ones. The teachers acknowledged the workshops are fairly well organised and meet their set objectives. To a greater extent, the teachers benefit from the Department of Education's follow-up evaluation on equipment training workshops. The other main finding is that the science training workshops influenced the way teachers are now teaching science. The teachers' confidence in performing practical activities was found to have also increased. The implication of these findings is that teachers who took part in the study can be made to reflect on the link between the training and their practice. This might help them change their approach in ways they present scientific concepts. To a certain extent, the success of the workshops can be identified in teachers using science equipment in the teaching of Physical Sciences in the North-West province. The study recommends that future studies should investigate if there is a relationship between science equipment training and improvement of Physical sciences results.

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# CHAPTER 1

## BACKGROUND AND RATIONALE OF THE STUDY

### 1.1 INTRODUCTION

This study investigates the impact of developmental equipment training science workshops in the teaching of physical sciences in the North West province of South Africa. The Department of Education (DoE) is rising to the challenge of improving achievement of physical science learners by investing in the professional development of their teachers. Several factors have been linked to the poor performance of learners in Physical sciences at Grades 10 - 12 level (DoE, 2013). The question is raised why there is a need to improve physical sciences pass rate in South Africa. Among a plethora of reasons, one of the reasons is that a great number of physical sciences teaching graduates leads to more skilled disciplines such as engineering and the medical sciences and therefore a more productive work force (Van der Wende, 2015: 1). Teacher and teaching quality are the most powerful predictors of learner success, and investing in teacher development could result in higher learner achievement (Fraser-Abner, 2002). Teacher knowledge, performance and training is tied to learner achievement (Greenwald, Hedges, & Laine, 1996), therefore, teacher capacity becomes critical for school improvement efforts.

What keeps good teachers are customized, sustained professional development programmes that align with policy documents and intended outcomes of the education system. It is along this line of thinking that the North West Department of Education introduced science equipment training Workshops for its teachers in Physical sciences and Natural sciences. Research shows that basic concepts in physical sciences are still problematic in the South African education system (Mogodi, 2013; Ramnarain, 2013; Taylor & Prinsloo, 2005). Some teachers are not prepared to use new laboratory equipment (Muwanga-Zake, 2001), whereas others fail to deal with curriculum changes (DoE, 2013). Furthermore, other teachers fail to manage large classes whilst the majority of the teachers cannot adapt to teaching environments with limited teaching resources (Ramnarain, 2013). The severity of the challenge has been evident in the learners' achievement outcomes, which are low in a subject such as Physical sciences. This necessitated the Department of Education rising to the challenge of improving the achievement of learners in physical sciences in line with the

Dinaledi conditional grant output. The Department has invested in the professional development of teachers through laboratory equipment developmental training workshops.

## **1.2 THE SOUTH AFRICAN CURRICULUM CONTEXT**

After the apartheid era the education system changed from Bantu education to Curriculum 2005. The change was marked by a radical transition from text book teaching to practical teaching (Ramnarain & Joseph, 2012). With such a mammoth curriculum change, science education was affected by these changes, especially from curriculum and syllabi changes since 1994. After democracy in 1994, the education system witnessed changes to undo the damages of racial discrimination (Chisholm and Leyendecker, 2008). These changes started with the introduction of Curriculum 2005 (C2005) in 1998. The curriculum overhaul was an effort to eliminate rote learning of content which characterized education prior to the democratization of South Africa (DoE, 1997). Every time the curriculum changes teachers are also affected and are taken for training to effectively apply the curriculum. According to Muwanga-Zake (2001) the shift to C2005 was not accompanied by a change in resources (including textbooks, which simply change covers).

Based on Spady's (1994) vision that outcomes be focussed on higher levels of skills and life performance roles rather than on learning prescribed content, the new curriculum introduced Outcomes Based Education (OBE). Actually, C2005 did not prescribe any content, expecting teachers to develop their own learning materials suitable for their situations. Jansen (1999) points out that this ideal was particularly difficult to achieve in previously disadvantaged schools where resources were lacking and teachers were poorly trained. Consequently, C2005 did not succeed in improving the quality of education for the disadvantaged majority for whom it was meant to secure a better future. Teachers still had many questions about C2005 (Moon, 2006). Additionally, the short timeframe of introducing the curriculum change and the complex curriculum design resulted in implementation problems and severe criticism, leading to an early revision of C2005 (Chisholm, 2000).

The curricula changed from C2005 to the National Curriculum Statement (NCS) for Grade 10-12 as a second generation of curricula reform was developed following C2005. For these reforms, however, the outcomes based principles and focuses on skills envisaged in C2005 were retained. The NCS curricula were also criticized in the South African media for their

lack of emphasis on content. In actual fact, they were blamed for learners' poor performance in final school examinations (Sunday Times, 2009) and in international achievement tests such as Trends in International Mathematics and Science Study (TIMSS) (Martin, Mullis, Gonzales and Chrostowski, 2004; Reddy, 2006; Reddy, Prinsloo, Visser, Arends, Winnaar, Rodgers, Van Rensburg, Juan, Feza and Mthethwa, 2012). The criticism resulted in the return to a content driven curriculum - the Curriculum Assessment Policy Statement (CAPS) which came into vogue in 2012.

Research laments that OBE traits such as the transmission of knowledge and teaching through chalk and talk still dominate South African classrooms despite these curricula changes (Van Wyk, 2006; Ono, 2010; Mutivhi, 2008). Attending practical laboratory sessions is important in learning physical sciences because practical work brings to life what is explained in the textbooks. By seeing educators demonstrating and conducting experiments themselves, the learners supplement what is in the textbooks and as a result, constructivist learning is enhanced. The principal advantage of laboratory usage is that it helps improve learners' higher order learning skills such as analysis, problem solving, and evaluating (Haury & Rillero, 1994; Olufunke, 2012). The use of practical work as a tool for teaching physical science in the current CAPS curriculum is a major strategy aimed at attaining learner success and improving the ultimate results in the subject. This study investigates the impact of teacher development through equipment training in science workshops for the teaching of Physical sciences.

### **1.3 THE NATURE OF THE PROFESSIONAL DEVELOPMENT INTERVENTION PROGRAMME**

The National Curriculum Statements, introduced together with the Outcomes-Based Education philosophy in 2005, have recently been revisited with a view to simplifying the original documents and the subsequent supporting documents (Subject and Learning Area Statements, Learning Programme Guidelines and Subject Assessment Guidelines) for all subjects. The aim was to produce national Curriculum and Assessment Policy Statements (CAPS) as a "refined and repackaged" version of the original documents, and not to create new curricula. This refining and repackaging of both the GET and FET college Science documents was completed, and CAPS was launched at FET colleges, starting at the Grade 10 level in 2012. As part of the refinement, Prescribed Practical Activities (PPA) and

Recommended Practical Activities (RPA) were introduced for the science subjects. The learning outcomes in the NCS were replaced by content standards in the CAPS curriculum. However, the changes in classroom practices demanded by such reform visions ultimately rely on teachers (Fullan & Miles, 1992; Spillane, 1999). Changes of this magnitude require a great deal of learning on the part of teachers and are difficult to make without support and guidance (Ball & Cohen, 1999; Borko & Putnam, 1996).

In order to support and guide the teachers, the Department of Education's Mathematics, Science and Technology Services (MSTS), North-West province, decided to collaborate with a large research university in the province, Somerset Educational (Pvt) Limited and the schools. The university provided quality professional development such as the expertise needed by teachers in terms of content, processes, strategies and structures, and contexts. Somerset Educational (Pvt) Limited which supplies chemicals to 85 countries in the world, including South Africa, provided the chemicals to be used during training and was eventually contracted to supply the chemicals to all participating schools within two weeks after the training intervention. The schools fall under the DoE, and each participating school was compelled to release one Physical Science and one Natural Science teacher for the workshops. Teacher training in this regard entails knowledge; skills and beliefs; content; pedagogy; leadership skills; and improved teacher practices. The workshops were run along seven principles for effective professional development identified by the Professional Development Project of the National Institute for Science Education in the USA (Loucks-Horsley & Stiles, 2001). These principles are: (1) having a clear image of effective classroom learning and teaching; (2) developing teachers' knowledge and skills to broaden teaching approaches; (3) using instructional methods that mirror the methods to be used with learners; (4) building or strengthening the learning community of Science teachers; (5) preparing and supporting teachers to serve in leadership roles; (6) providing links with other parts of the educational system; and (7) helping teachers frame appropriate continuous assessment tasks. The Department of Education (DoE) Mathematics, Science and Technology Services (MSTS) North West Province, which is part of general and further Education Training Services, holds professional development equipment training programmes at the beginning of every year which involve teacher laboratory equipment training workshops. This study reports on the five consecutive full-day workshops which teachers attended on regular school days in February 2013 and February 2014. The purpose of the training was three fold, namely

- To train science teachers on science equipment so that they can conduct practicals with learners during science lessons inside the classroom.
- To ensure that teachers are knowledgeable and skilled regarding the proper use and handling of laboratory science equipment.
- To perform and conduct the actual experiments for Grade 4-12.

The focus for this study is only at the Grade 10 to 12 level.

#### **1.4 PROBLEM STATEMENT**

This study is prompted by the low percentage of learners passing physical science at Further Education and Training (FET) level, that is, Grade 10 to 12. Recent studies show that South Africa obtained the lowest ranking in an international measure of the quality of mathematics and science education (Gernetzky, 2012). This poor performance in subjects like science and mathematics is not unique to South Africa. Several European and African countries have been experiencing such problems. For example, Punch (2005) reports that some countries like Tanzania have done away with practical examinations altogether as a result of consistently poor results in science where the teachers in that country do not see the need to spend time on practicals which are not examined. Howie (2003) further states that in such a scenario, a laboratory therefore does not make much difference to their teaching methods. Teachers then just concentrate on the lecture method and use demonstrations and explanations for the practical aspects of the syllabus. In other words, the problem has overwhelmed the education system in that country to the extent of completely relegating the practical aspects of scientific enquiry. However, South Africa is not going that route as she is running teacher development workshops to rectify this problem. Though prescribed practical activities are not examined at national level, they are assessed at district level in the South African context. Can workshops such as the teacher development science equipment workshops conducted by the North West Province be one of the solutions in alleviating this problem of poor quality teaching in physical sciences? What is the impact of such workshops? The study explores and answers these questions.

### **1.4.1 Purpose of the Study**

This study investigates the impact of teacher development science equipment training workshops at Further Education and Training (FET) level and their implications in relation to practical activities of the CAPS curriculum in the North West province, South Africa.

### **1.4.2 Research Questions**

The following main research question therefore is addressed:

What is the impact of teacher development science equipment training workshops in the teaching of Physical sciences in the North West Province?

The following sub-questions are posed:

- (i) What is the nature of the current teacher development workshops?
- (ii) What is the influence of Teacher development science equipment training workshops in the teaching and learning of Physical sciences? and
- (iii) How are science teachers empowered by the science equipment training workshops?

### **1.4.3 Aims of the Study**

The main aim of this study is to investigate the impact of Teacher Development Science Equipment Training workshops in the teaching of physical sciences in the North West Province.

The following secondary aims provide orientation for this study, which seeks to:

- (i) Establish the nature of the current workshops;
- (ii) Determine the influence of Teacher Development science equipment training workshops; and
- (iii) Determine if teachers are empowered by the workshops.

## **1.5 THEORETICAL FRAMEWORK**

A theoretical framework is a set of interrelated concepts which guide the research, determining what the researcher investigates and how the researcher analyses and interprets data (Borgatti & Foster, 1996). The study is framed along the constructs of Bell and Gilbert's (1996) Science teacher development model and Stufflebeam's (2003) Context, Input, Process

and Product (CIPP) evaluation model which provides timely information in a systematic way for decision-making and accountability needs.

Bell and Gilbert's (1996) Science teacher development model emphasises three components, namely: (a) Personal development in which the teacher must be aware that there is a need for professional development and acknowledges the desire to acquire new ideas or strategies, (b) Social development in which the teachers have opportunities to discuss ideas with other teachers, and to collectively renegotiate what it means to teach Science and be a teacher of Science, and (c) Professional development in which the teachers are supported in implementing the new ideas and strategies in their classroom practice, drawing on the changes they make personally and socially. These three components are viewed as essential to building on teachers' commitment to enact change within their own classrooms and professional communities. Identifying teachers who are committed to personal development can be useful in selecting participants while social and professional development aspects of the model can be used in designing teacher development programmes. The three components emphasised by Bell and Gilbert's (1996) Science teacher development model became the backbone and guiding principle of exploring the idea of teachers as learners by synthesising a range of accounts of teacher learning in the intervention programme described in this study.

Stufflebeam's (2003) CIPP evaluation model falls under the improvement-and accountability-oriented evaluation category. The category is oriented towards determining the merit and worth of the project being evaluated in this case, Teacher development science equipment training workshops . According to Zhang, Zeller, Griffith, Metcalf, et al., (2011), the CIPP evaluation model is systematically designed to guide evaluators and stakeholders in posing relevant questions and conducting assessments at the beginning of the project (context and input evaluation), while it is in progress (input and process evaluation), and at its end (product evaluation). Since the study focuses on the impact, it is within the realm of evaluation hence this model was deemed relevant considering the main aim of the study.

## **1.6 SIGNIFICANCE OF THE STUDY**

The introduction of the CAPS curriculum brought with it the concept of prescribed and recommended experiments which was not part of the old curriculum. Teachers are required to conduct these experiments with their learners during the teaching and learning process. Some

of the content which the teachers are expected to teach is new to the teachers because they never covered the content and performed experiments themselves during their training. To develop its personnel, the Department of Education introduced these teacher training workshops on laboratory material. This study attempts to get insights into the impact of these workshops. Findings of this study might go a long way in evaluating the success and shortfalls of such workshops on teacher professional development. Teachers who have taken part in the study reflect on the link between the training and their practice. This might help them change their approach in presenting scientific concepts. To a certain extent, the success of the workshops is a measure of an increase or decrease in the Physical Science pass-rate.

### **1.7 DELIMITATION OF THE STUDY**

The study is delimited to two teacher development science equipment training workshops which were conducted in 2013 and 2014. From a total number of 250 teacher participants, 60 teachers from 60 schools (one teacher from each school) were selected using the stratified random sampling technique from four districts of the North West Province. The study was conducted from a mixed method perspective. Observation and interview data was collected from eight teachers purposively sampled, two from each of the four districts of North West province.

### **1.8 DEFINITION OF KEY TERMS**

#### **Impact**

The term *impact* refers to a powerful effect that something, especially something new, has on a situation or person. In this study, the term refers to the effect the teacher development science equipment training workshops have on the teaching of Physical sciences at Grades 10 to 12 in the North West province of South Africa. The training workshops are new in the sense that they are targeting the new sections of the new CAPS curriculum.

#### **Science equipment**

Science equipment refers to the type of equipment found in a laboratory for conducting scientific research or for teaching practical scientific experiments. In this study, science equipment is used for training by the teachers and the subsequent similar equipment bought

by the Department of Education and delivered to schools for teachers who attended the training.

### **Training workshops**

In this study training workshops denote interactive training where participants carry out a number of training activities rather than passively listening to a lecture or presentation. The activities in this case are practical activities, both prescribed and recommended, as stipulated in the CAPS curriculum.

### **Empowerment**

Empowerment is based on the idea that giving employees skills, resources, opportunity and motivation as well as holding them responsible and accountable for outcomes of their actions contributes to their competence and satisfaction. For science teachers, asking them to teach appropriately without science equipment is a mammoth task. In this study, one of the purposes was to determine if teachers were empowered by giving them the opportunity of sharing information during training so that they take initiative and make decisions to improve service and performance.

### **Teacher development**

Development means change and growth. Teacher development is the process of becoming 'the best kind of teacher that I personally can be' (Underhill 1986:1). Thus, teacher development focuses on individual needs. It takes on different specific meanings and forms depending on where one is working and what one's desired direction for development is. In learning, the teachers develop beliefs and ideas, develop their classroom practice, and attend to their feelings associated with change (Bell & Gilbert, 1994). Teacher development in this study is viewed as teachers learning, rather than as getting teachers to change.

## 1.9 CHAPTER DIVISION

The chapters for this dissertation are outlined as follows:

**Chapter 1 - Problem Orientation:** This chapter serves as an orientation to the problem of the study; it covers background, statement of the problem, aims of the research, research questions, significance of the study, delimitations of the study and definition of terms.

**Chapter 2 - Literature Review:** This chapter focuses on the review of recent and relevant literature covering the scope of the research topic. Key theoretical constructs of the study and previous works is analysed critically. The literature review is done in relation to the research questions which posed at the beginning of the study. The chapter reviews literature on teacher development, training workshops, Bell and Gilbert's (1996) Science teacher development model and Stufflebeam's (2003) Context, Input, Process and Product (CIPP) evaluation model which form the theoretical framework of the study.

**Chapter 3 - Research Methodology:** this chapter offers a description of the methodology used to achieve the objectives of the under the topics – Research Design, methodology, site (or social network), Participant selection, Data collection strategies, Data analysis, Trustworthiness, Researcher's role and Ethical considerations. The instruments for data collection are described together with their validation.

**Chapter 4 - Data Presentation and Discussion:** Presentation of data is done first and the discussion follows. Presentation of data is in the form of descriptive and inferential statistics for quantitative data. Qualitative data is presented in the form of themes from classroom observations and interviews. This is followed by a discussion of results where an evaluation and interpretation of the findings is done with inferences drawn.

**Chapter 5 - Summary, Conclusion and Recommendations:** This chapter presents a summary of the entire study with reference to the purpose of study as well as the findings and recommendations made. Conclusions and recommendations based on the key findings of the study are presented. Limitations of the study are clearly indicated.

## **1.10 CHAPTER SUMMARY**

This chapter provided the orientation for the study by providing the background and rationale for conducting the study. The South African curriculum context was outlined as well as the nature of the teacher development science equipment training workshops. The research questions guiding the study were stated. The next chapter focuses on the review of literature relevant to the study. A critical analysis of the literature is done in relative to the constructs raised in the research questions.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter provides a review of related literature. The main aim is to present a synthesis of the literature in the field where the research aims to investigate the impact of teacher development science equipment training workshops. This chapter focuses on the following constructs: teacher development; professional development; training workshops; the Bell and Gilbert's (1996) Science teacher development model and Stufflebeam's (2003) Context, Input, Process and Product (CIPP) evaluation model as theoretical models informing this study. All this is done in the context of the review's contribution to the understanding of the research topic. The chapter ends by giving a summary of the concepts identified in the review process.

#### **2.2 TEACHER DEVELOPMENT**

The concept of teacher development is a contested territory where a number of interpretations abound (Evan, 2002). Definitions of teacher development are almost entirely absent from the literature of leading writers in the field and they do not define precisely what they mean by the term. Darling-Hammond (1994), Leithwood (1992, p.87), Fullan and Hargreaves (1992) and Hargreaves and Fullan (1992) all skirt offering succinct definitions of teacher development. However, Glatthorn (1995:41) defines "teacher development as the professional growth a teacher achieves as a result of gaining increased experience and examining their teaching systematically." Bell and Gilbert (1994) do not define teacher development but they describe very clearly what it looks like. They offer that "Teacher development can be viewed as teachers learning, rather than as others getting teachers to change. In learning, the teachers develop their beliefs and ideas, develop their classroom practice, and attend to their feelings associated with the change" (p.493). This description provides ground for the trajectory adopted by this study.

Bell and Gilbert (1994:494) also describe what they consider to be key features of the teacher development process:

Teacher development can be seen as having two aspects. One is the input of new theoretical ideas and new teaching suggestions... The second is trying out, evaluation, and practice of these new theoretical and teaching ideas over an extended period of time in a collaborative situation where the teachers are able to receive support and feedback, and where they are able to reflect critically... Both are important if all three aspects of teacher development - personal, professional, and social development - are to occur.

Implicit in this description is an interpretation of teacher development as a comparatively longitudinal process. In the extended period of teacher development, teachers undergo behavioural change that is guided by, and focused upon, practical application of suggested innovations. It appears to be a process involving, sequentially: the generation of ideas that may be applicable to teaching; trying out these ideas; discussing in collegial contexts the viability and implications of the ideas as they emerge and weighing their potential value-addition to practice. There is an implied understanding and adoption of new practices that emanate from the ideas (Evans, 2002). In the process of professional growth, teachers learn. Such learning is thus seen as enhanced when there is collective participation and effective communication promoted by teacher networks and training groups (Hofman & Dijkstra, 2010; Darling-Hammond & Richardson, 2009). Implicit in this description is an interpretation of teacher development focused upon practical application of suggested innovations.

Teacher development has emerged over the last decade as a relevant area of research and sustained study (Evans, 2002). Chisholm (2000) defines two constituent elements of teacher development namely, attitudinal development and functional development. Each element reflects specific foci of change. Chisholm further defines attitudinal development as the process whereby teachers' attitudes to their work are modified. She perceives attitudinal development as incorporating two constituent change features: intellectual and motivational. These respectively refer to teachers' development in relation to their intellect and their motivation. A teacher who becomes more reflective and analytical, for example, would be manifesting intellectual development. The teacher who becomes more highly motivated in general or in relation to specific aspects of their work would be manifesting motivational development. The intellectual change pertains to attitudinal development and incorporates the enhancement of understanding.

Chisholm (2000) further defines functional development as a process whereby teachers' professional performance may be improved. She describes functional development as incorporating two constituent change features: procedural and productive. These respectively refer to teachers' development in relation to the procedures they utilise and how much they 'produce' or 'do' at work. A teacher who, for example, changes way(s) of carrying out some aspect - no matter how small - of her job would be manifesting procedural development. The teacher who starts working longer hours and produces more resources – one who begins to 'do' more - would be manifesting productive development. Functional development includes learning new ways of working, learning how to apply new processes within one's practice, and how to be more productive.

In the South African context, the reason why teacher development needs to be taken seriously is because of the paucity in the quality of teachers available in the education sector which has been reported in media and various other sources. According to Read (2004), out-dated teaching practices and lack of basic content knowledge have resulted in poor teaching in many-a-South African school. Read (2004) goes on to say the poor teaching standards have also been exacerbated by a large number of under-qualified teachers who teach in overcrowded. This scenario is exacerbated by trained teachers who also work in under-resourced schools and these add to the poor quality of education, especially where equipment lacks in classrooms. Teacher development for both experienced and inexperienced teachers is an urgent matter. Some experienced teachers received their qualifications at teacher training colleges during the apartheid era. These colleges, especially those that were situated in the homelands, had deficiencies in the teaching of specific content knowledge, leaving their trainee teachers with worrisome knowledge gaps (Dudu, 2014). Some of these teachers went on to upgrade themselves professionally by taking in-service courses at universities after the closure of teachers' colleges. Such teachers ended up graduating with qualifications such as the Advanced Certificate in Education (ACE). Despite the said upgrading, most teachers still have knowledge gaps since in-service courses at universities such as the ACE focus more on pedagogy than content (Van der Horst and McDonald, 2003).

Inexperienced teachers who received their qualifications only from universities since the closure of teachers' colleges also demonstrate marked knowledge gaps, especially in content-

specific matters. They go through the nationally designed curriculum in ways that are not likely to equip any student with robust content knowledge (Dudu, 2014). In other words, the students are churned out half-baked. Most of the teachers are under-qualified and some are unqualified in the areas of Science and pedagogical content knowledge. Most of these teachers are not specialists in teaching science (physics, chemistry or earth science) though they are often compelled to teach these science subjects, mostly due to lack of teachers in mathematics and science subjects. The combination of all these factors has in turn produced a new generation teachers who are further perpetuating the vicious cycle of mediocrity in South African schools, and the North-West Province in particular (DoE,2001).

The National Teacher Education (2011), followed by Mathematics and Science Audit of 2012, produced statistical revelations about the low quality of teachers and teaching in these disciplines (DoE.2001) whilst policies and programmes have been on a general static scale. Very little has happened at a systemic level to address the challenges of providing quality mathematics and physical science teachers (DoE, 2001). In fact, the national audit for mathematics and science revealed that more than 68 % of science teachers across the country have had no formal subject training in the discipline (DoE, 2001) particularly identified in the general education phase of schooling system. It has been revealed that teacher's classroom practices often demonstrate few instances or no use of laboratory equipment at all (Dudu, 2014; Makgato & Mji, 2006). Thus teacher development is needed and highly valued to serve the dissemination of information on and ideas for improving teachers' and, by extension, schools' performances. The next section looks at professional development.

### **2.3 WHAT IS PROFESSIONAL DEVELOPMENT?**

Questions are posed in connection to professional development: Is there a difference between professional development (PD) and teacher development? Can the two terms be used interchangeably? Do they really mean the same thing? The starting point is to acknowledge that professional development (PD) is defined differently depending on the focus. Mizel (2010) defines PD as a variety of learning experiences related to ones' work. Mizel (2010) elaborates on this further by pointing out that the role of any PD is to provide new knowledge and skills that improve participants' performance on the job. In a related but broader definition of PD, Organization for Economic Co-operation and Development (OECD, 2009) refers to PD as actions that enhance one's skills, knowledge, expertise and other critical

aspects of teaching. Villegas-Reimers (2003:11) defines professional development in a broad sense, referring to it as the development of a person in her professional role. Development means, invariably, change and growth. Looking at the definitions of PD given above, there are some common traits in the definitions of teacher development. No wonder others use the terms interchangeably though they do not mean the same thing. Aspects from these definitions have been adopted in this study since they cover aspects of the equipment training workshops which are taken as professional development initiatives.

The above definitions recognise that development can be provided in many ways, ranging from the formal to the informal. It can be made available through external expertise in the form of courses, workshops or formal qualification programmes, and through collaboration between schools or teachers across schools (e.g. observational visits to other schools or teacher networks) or within the schools in which teachers work. As Shanker (1996) noted,

For professional development to be effective, it must offer serious intellectual content, take explicit account of the various contexts of teaching and experiences of teachers, offer support for informed dissent, be ongoing and embedded in the purposes and practices of schooling, help teachers to change within an environment that is often hostile to change, and involve teachers in defining the purposes of the offerings.

Implicit in this description is an interpretation of professional development as a comparatively longitudinal process carefully designed, sustained, providing opportunities that actively involve teachers in the learning process.

Sustained professional development workshops in science instruction are vital for the development of a grounded understanding of science concepts for teachers and students. A study of seven urban districts in South Africa (Cross & Rigned, 2002) reported that the only effort that clearly resulted in student achievement gains had clear instructional expectations, supported by extensive professional development over a period of several years. The critical feature is to engage in practice that is sustained and aims at continuous progress toward a performance goal over time. Principals and teacher leaders have the largest roles to play in fostering a culture of professional learning particularly in hard-to-staff schools. As articulated by Hottecke (2015:14), professional development “is a key aspect that underpins professional development planning. It comprises the knowledge amongst school staff to share an understanding of why ongoing training is an integral part of a professional culture and how it

can be fostered in schools.” At this juncture, professional development in South Africa has been fostered mainly through professional learning communities. Most recently, studies by Crawford, Capps, van Driel, Lederman, Lederman et al (2013) in Europe, North America, Australia, and Asia demonstrate that science teachers’ professional learning is effectively supported by providing opportunities to experiment with new teaching approaches in their classroom, sometimes in combination with authentic experiences to learn science (i.e. scientific inquiry), and to reflect on these experiences, both individually and collectively.

Professional learning communities serve as the most obvious catalyst for teacher professional growth in a collaborative setting (Vescio, Ross, & Adams, 2008). As one avenue for teacher learning, professional learning communities are based on the concept that professional knowledge resides internally in schools and is cultivated both individually and socially (Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004). Professional learning communities are vital to teachers’ identity formation, acting as the primary motivation for professional growth (Butler et al., 2004; Lieberman, 2009). Within professional learning communities, teachers do more than share direct evidence of student learning; they also elicit feedback on how to improve their instructional practices while acting within a safe, stable structure of support for trying new approaches to teaching. A growing number of studies that have promoted the values of collaborative professional learning communities have emerged to show that collaborative learning contributes significantly to the improvement of teachers learning and instruction (Wray, 2007; Glazer & Hannafin, 2006; Burbank & Kauchak, 2003). However, much of the analytic research on professional learning communities has remained focused on changes in teacher perceptions of their practice rather than actual change observed in the classroom or documented through other sources of evidence.

Nigeria has developed projects which specifically focus on professional development, especially professional learning communities recognised by the Ministry of Education in that country. One of them is the Plan, Do, See, Improve (PDSI) project which aims at helping teachers to effectively practice Activities, Student-centred teaching, Experiments, and Improvisation (ASEI) at the classroom level. Important aspects of effective lesson delivery such as work planning and evaluation are emphasized. The ASEI-PDSI equips teachers for effective classroom practices believing that the battle against poor performance in Mathematics and the Science must be won in the classroom. The ASEI-PDSI is based on the

premise that learners learn better when they are involved in doing, through discussions, experiments and other activities, hence the emphasis on the learners as the central focus of learning. This is in recognition of the fact that for a long time, teaching in Nigerian schools has predominantly been traditional where the teacher has been the centre of the learning process while current trends in education advocate for a learner-centred teaching-learning approach. Through in-service education training (INSET) activities, teachers have been empowered with skills to develop innovative lessons through group planning, peer teaching and peer review.

It is critical for veteran teachers to have ongoing and regular opportunities to learn from each other. Ongoing professional development keeps teachers up-to-date on new research on how children learn, emerging technology tools for the classroom, new curriculum resources, and more. The best professional development is ongoing, experiential, and collaborative. To be effective, professional development should be based on curricular and instructional strategies that have a high probability of affecting student learning and, just as important, students' ability to learn (Joyce & Showers, 2002). In addition, professional development should

- (1) deepen teachers' knowledge of the subjects being taught;
- (2) sharpen teaching skills in the classroom;
- (3) keep up with developments in the individual fields, and in education generally;
- (4) generate and contribute new knowledge to the profession; and
- (5) increase the ability to monitor students' work, in order to provide constructive feedback to students and appropriately redirect teaching (The National Commission on Mathematics and Science Teaching for the 21st Century, 2000).

These traits can be inferred from the professional development workshops that are the formative bedrock from which this study is conducted.

## **2.4 THEORETICAL FRAMEWORK**

This study is guided by two frameworks namely, Bell and Gilbert's (1996) Science teacher development model which focuses on improving teaching and learning and Stufflebeam's (2003) Context, Input, Process and Product (CIPP) evaluation model which provides timely information in a systematic way for decision-making and accountability.

Bell and Gilbert (1996: 494) identify and describe ‘three main types of development’: personal, professional and social. They contend that “the process of teacher development can be seen as one in which personal, professional, and social development occurs, and one in which development in one aspect cannot proceed unless the other aspects develop also.” As a part of teacher development, professional development involves not only the use of different assessment activities by teachers but also the development of the beliefs and conceptions underlying these activities. On the other hand, personal development, as part of teacher development, involves each individual teacher constructing, evaluating and accepting or rejecting the new socially constructed knowledge about what it means to be a teacher (of science, for example). It also involves managing the feelings associated with changing their activities and beliefs about education, particularly when they go "against the grain" of the current or proposed socially constructed and accepted knowledge (Cochran-Smith, 1991: 279). As part of teacher development, social development involves the renegotiation and reconstruction of being a teacher of science. It also involves the development of ways of working with others that enable social interaction necessary for renegotiating and reconstructing what it means to be a teacher. These three aspects necessarily interact and are interwoven. Given the objectives of the intervention workshops described in Chapter 1, this framework was deemed appropriate for this study.

A look at the way the workshops were conducted falls in the realm of the traditional paradigm of professional development. Professional development of teachers, often called in-service education or staff development, has been conducted for different purposes and in different forms. Greenland (cited in Villegas-Reimers, 2003) identifies four categories of in-service education by purpose:

- for certification of unqualified teachers,
- to upgrade teachers,
- to prepare teachers for new roles, and
- curriculum-related dissemination or refresher courses.

Regardless of the purpose, traditional in-service teacher professional development programmes are delivered in the form of workshops, seminars, conferences or courses (Schwille & Dembélé, 2007; Villegas-Reimers, 2003). These efforts have been criticised by many researchers as being brief, fragmented, incoherent encounters that are decontextualised and isolated from real classroom situations (OECD, 2005; Vonk, 1995). The traditional

approaches to professional development of teachers, which Kelleher (2003:751) calls “adult pull-out programs”, are less likely to result in any significant improvement of teaching. Fullan (1991:315) states the following:

Nothing has promised so much and has been so frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when the teachers returned to their classrooms.

In many developing countries, professional development of teachers has been neglected because of budget constraints and heavy emphasis on pre-service education, but when it is provided, the cascade approach is popular for reaching many participants in a short time (Leu, 2004). The same dissatisfaction might apply to the workshops described in this study.

Given that the main aim of this study was to investigate the impact of Teacher development Science Equipment Training workshops in the teaching of physical sciences, Stufflebeam’s (2003) Context, Input, Process and Product (CIPP) model was used to evaluate the workshops. The model provides both quantitative and qualitative measures at three levels of assessment: diagnostic, formative and summative. However, in this study the evaluation is only at the summative level as it was done at the end of the training workshops. In education settings, the CIPP evaluation model has been used to evaluate numerous educational projects and entities (Zhang, Griffith, et al., 2009). The *Context evaluation* component addresses the question: What needs to be done, versus, were important needs addressed? (Stufflebeam & Shinkfield, 2007). According to, Zhang et al. (2011), the objective of context evaluation is to define relevant context, assess its needs, to identify opportunities for addressing the need and to judge whether project goals are sufficiently robust to assess the needs (p.64). An effective learning project starts with identifying the needs of learners and other stakeholders. The methods for context evaluation include document reviews, secondary data analyses, interviews and diagnostic tests.

The *Input evaluation* component asks, “How should it be done?” (Zhang et al., 2011:64) and identifies procedural designs and educational strategies that will most likely achieve the desired results. Methods used to execute an input evaluation include analysing and inventorying available human and material resources, recommending solution strategies and procedural designs, and proposed budgets and schedules.

*Process evaluation* is the third component which asks, “Is it being done?” (Zhang et al., 2011:65). This provides an ongoing check on the project’s implementation process and includes regularly interacting with and observing the activities of project participants (Stufflebeam & Shinkfield, 2007). Objectives of process evaluation include documenting the process and providing feedback regarding (i) the extent to which planned activities are carried out, and (ii) whether adjustments or revisions of the plan are needed (Zhang et al., 2011). Process evaluation techniques include on-site observation, participant interviews, focus group interviews and self-reflection sessions with participants.

The fourth and last component is *Product evaluation* assesses project outcomes, and asks, “Did the project succeed?” (Zhang et al., 2011:66). The purpose is to measure, interpret, and judge a project’s outcomes by assessing their merit, worth, significance and probity. A combination of techniques to assess a comprehensive set of outcomes is used (Stufflebeam & Shinkfield, 2007). These include interviews of beneficiaries and other stakeholders, focus group interviews, and document analysis among others.

## **2.5 TRAINING WORKSHOPS**

Science workshops are designed to help teachers learn science concepts at the same time as they are refining their investigation abilities (Battista & Foster, 1999). Each workshop consists of three phases:

- (1) an introductory phase, where the workshop facilitator explains the concept and the task,
- (2) activity phase consisting of engaging in hands-on activity, and sharing with their group about their experience with activity, and
- (3) a period for reflection and discussion where the facilitator sums up the lesson.

According to Varga (2007) the introductory phase is a time for the facilitator to spur interest and prior knowledge in the workshop topic, to explain the activity, and to go over safety issues so that the activity period goes smoothly. This is also the time for clarification and ensuring the activity specifications and procedures have been understood by the participants. This phase helps to learn about participants’ interests and to determine their content knowledge before beginning the activity.

In the activity phase participants form groups and engage in activities, taking notes, dialoguing, and engaging in the hands-on activity. This is the time for negotiation among group members, resolving problems, proposing solutions and staying on task. Participants' first hands experiences are accompanied by discussion and writing that help process their investigations. The facilitator's role during the activity period includes questioning, observing and assessing participants, as well as monitoring the activity.

Training workshops are generally organized by an institution or association in order to develop certain instructional materials, books, resource materials, supportive materials and oftentimes workbooks. Workshops can be organized to develop certain skills of teachers. A workshop could mean hard and concentrated work on the part of experienced teachers to create certain educational materials. A workshop comprises a small, selected group of teachers or experts drawn from actual working situations or related experts who understand theories on the activities. Workshop training provides the resources and support to propel teachers not only to be proficient in knowledge and skills as spelled out in the state standards but also to become engaged in the learning process with their students. It is expected that the training in content, science education, inquiry and curricula provides teachers with the resources as well as preparation to support learning for all students.

A teacher professional development study was conducted by Ono and Ferreira (2010) in South Africa. The study was conducted using the Lesson study which has been practised in Japan for so long that it has been taken for granted by Japanese teachers and administrators. The most salient feature of lesson study is that teachers were collaboratively engaged in action research in order to improve quality of instruction. Over 313 schools in Mpumalanga were involved by the end of the project. An interesting finding from this study is that the Mpumalanga Secondary School Initiative was not successful in its attempt to institutionalise lesson study as a school-based professional development programme for teachers during the project period, although it did contribute to the establishment of a cluster system throughout the province. Another interesting finding is that although lesson study did not take off in Mpumalanga, the results of this research revealed that teachers who were involved in lesson study have improved their lessons, mostly in lesson planning. The take home message from this study is that provincial Departments of Education may run a variety of workshops but

their success is dependent on the teachers who are the implementers of the ideas pushed for in workshops.

## **2.6 STUDIES ON LABORATORY EQUIPMENT ON TEACHING AND LEARNING**

Studies have been done globally investigating how teachers benefit from running workshops on science laboratory equipment and materials to improve teaching and learning. Literature has it on good ground that laboratory resources have a positive impact on the teaching and learning science (Sunal, Wright & Sundberg, 2008). One of the reasons is that it gives an opportunity to both teachers and learners to perform practical activities and manipulate scientific materials thereby developing learners' understanding and appreciation in science subjects. Where there are limited resources, demonstrations could be used to help learners conceptualise the scientific concepts more effectively than chalk and talk where learners are severely challenged to connect theories to actual practice (Kandjeo-Marenga, 2011; McKee, Williamson & Ruebush, 2007).

A study carried out by Cachapuz, Malaquias, Martins, Thomaz and Vasconcelos (1989) in Portugal has shown that although laboratory work is often used in Physical Sciences classes, in-service Portuguese teachers nevertheless do it mainly as demonstrations to confirm and validate previously taught knowledge. It should be noticed that this is the prevalent style of using laboratory activities by prospective teachers from several European countries (Jong, 1997; Jong *et al.*, 1999), including Portugal (Afonso and Leite, 2000), when they are asked to plan lessons on science topics. It is obvious that demonstrations do not engage the learners from a psychomotor point of view. The point is that demonstrations performed with the objective referred to above prevent learners from being mentally involved with the laboratory activity. According to Corominas and Lozano (1994), well-conducted teacher's demonstrations could generate interest from learners when they are to learn a specific scientific concept when activities are carried out by the learners (Roth *et al.*, 1997). It is empirically established that types of procedural knowledge can only be developed if learners carry out the activities themselves (Leite, 2001).

Cossa and Uamusse (2014) conducted a study with 17 senior secondary school teachers of the Zambezia province, in Quelimane city, Mozambique, on effects of an in-service programme on Biology and Chemistry teachers' perceptions of the role of laboratory work. Using

participatory methodologies such as small group discussions, brainstorming and presentations at plenary sessions, the overall findings of this study suggested that teachers improved their level of understanding of the importance of using laboratory work to teach Biology and Chemistry subjects through the practical component. However, the same teachers feel that the lack of well-equipped laboratories in most of their schools is a great barrier for them to conduct laboratory work of any kind.

Teachers complained about the length of the Biology and Chemistry syllabuses and recommended a thorough revision if the Ministry of Education wants them to conduct laboratory work in their classes. The fact that most of the teachers during their initial training did not have laboratory work effectively resulted in the fragility of content mastery and fear to use any kind of laboratory work. Therefore, the schools are urged to organise on-going professional development programmes that meet the teachers' specific needs. Similar findings were found in Tanzania in studies conducted by Haielimu (2010) and Sitta (2006). It is the intention in the current study to establish if similar challenges found with Maputo teachers are bedevilling teachers in the North West province of South Africa.

In another study in South Africa, Mokima (2014) conducted a study to investigate Physical science teachers' use of laboratory equipment. Using classroom observations and interviews with four teachers, results showed that most teachers have a fairly limited understanding of equipment use which made them resort to teacher-centred approaches to science teaching. Essential features of understanding the method on using laboratory equipment were observed in less than half their lessons. The other teachers in the study used traditional teaching methods approaches. The other finding was that some of the schools did not have laboratory equipment at all. A similar finding of inadequate laboratory equipment has been found in a study by Bhukuvhani, Kusure, Munodawafa and Sana (2010) who found that schools in Zimbabwe, like many developing countries, face challenges of limited resources for imparting effective and efficient science education. Similar findings were found in Tanzania (Hakielimu, 2010, 2011; Ndibalema, 2012; Mabula, 2012) and Namibia (Walker, 2012). Similar findings were also revealed by FEMSA (2010) in their study conducted in four countries - Cameroon, Ghana, Tanzania and Uganda which observed that in some high schools, laboratory resources were limited compared to the number of learners per class. This might lead to a situation where teachers are curtailed in organising hands-on activities and

even when they try, such limited resources obstruct opportunities for effective and meaningful classroom interactions.

## **2.7 CONCLUSION**

This chapter provided an overview of the science education research literature related to teacher and professional development. It explained that a central and recurring element of teachers' professional development remains that of reinforcement. The attainment of the goals of science education is largely dependent on the quality of teachers. Therefore there should be quality teacher development. Opportunities to enrich teachers' practices through workshops should be provided on a regular basis to help them keep abreast with recent developments in the field of science and broaden their knowledge of subject matter. Literature on training workshops, the theoretical framework used in this study and studies on laboratory equipment on the teaching and learning of science subjects was reviewed. The next chapter focuses on the research methodology.

## **CHAPTER 3**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **3.1 INTRODUCTION**

The previous chapter focused on reviewing the literature pertinent to this study. The literature review showed the importance of this study by expounding on the theoretical framework, which functions as a guideline for setting the parameters for comparing this study to other similar studies. It also served as a guide to selecting the research design and most appropriate methods in executing this study (Brown & Dowling, 2000; Millar, 1998). This chapter describes the research design, sampling, and the four stage process that was implemented in the data collection phase in order to achieve the aims and objectives of the research. Lastly the ethical considerations for research are discussed. The purpose of this study was to address the following research objectives which are targeted to:

- (i) establish the nature of the current teacher development workshops;
- (ii) determine the influence of Teacher development science equipment training workshops; and
- (iii) determine if teachers are empowered by the workshops.

This chapter provides an argument for the choice of a research paradigm, research approach and research design in order to address the research objectives set above.

#### **3.2 RESEARCH PARADIGM**

Researchers have schools of thought which they subscribe to, in terms of how to conduct a study. Such schools of thought are called research paradigms. According to Arthur, Waring, Coe and Hedges (2012) and Johnson and Christensen (2008), research paradigm refers to the common views held by a community of researchers. Such views are informed by shared ideas, values and practices. It is such views that influence decisions taken by a community of researchers with regard to which research problems must be investigated. Not only do they influence research problems, but also research designs, research questions, data collection methods and analysis and results presentation (Johnson, Onwuegbuzie & Turner 2007). Filstead (1979:34) defines a paradigm as “a set of interrelated assumptions about the social world which provides a philosophical and conceptual framework for the organized studies of

that world.” Philosophically, the methodology, research design and data analysis ought to align to one or a mixture of research paradigms befitting the study (Merriam, 2004:3). As such, examples that link research and philosophical traditions help to situate the characteristics of different research orientations or paradigms.

It was important to conduct this particular study within a philosophical research tradition. Merriam (2004) argues that the research paradigm chosen determines the research methodology and anchors the study within appropriate ontological (the nature of reality and being) and epistemological (the study of knowledge, the acquisition of knowledge, and the relationship between the respondent and researcher) perspectives. This is vital because different research paradigms offer different views on the nature of knowledge and how we come to know of that knowledge. It is crucial to assess and discuss the competing research paradigms as they relate to research in science education. Narins (2004:1) argues that the research paradigms constitute “the foundation on which one builds knowledge about human nature and society; about why people and societies are troubled; about how to change them for the better. Because human beings actively create their societies, nothing less than the future of our society is at stake in the choice of paradigms.” According to Olsen, Lodwick and Dunlop (1992:16), a research paradigm refers to “what should be studied, what questions should be asked and what rules should be followed in interpreting the answers obtained.” As Ponterotto (2005) puts it, the research paradigm is crucial as it sets the context for study.

This study employed the eclectic-mixed methods pragmatic paradigm because the method values both qualitative and quantitative research approaches. Johnson, Onwuegbuzie and Turner (2007) define the eclectic-mixed methods pragmatic paradigm as a category of research that uses a combination of qualitative and quantitative methods and approaches in a research study. Proponents of this paradigm view it as the most appropriate paradigm because they see qualitative and quantitative paradigms as more complementary than competitive (Johnson, Onwuegbuzie & Turner, 2007). The two are seen as complementary rather than conflicting. The strengths of one paradigm make up for the weaknesses of the other (Creswell & Plano Clark, 2011; Johnson, Onwuegbuzie & Turner 2007). Mixed methods research is both a method and methodology for conducting research that involves collecting, analyzing, and integrating quantitative and qualitative research in a single programme of inquiry. According to Creswell (2012), the purpose of this form of research is that both qualitative and

quantitative research, in combination, provides a better understanding of a research problem than either research approach alone. Looking at the research problem of the current study, the eclectic-mixed methods pragmatic paradigm was found appropriate.

### **3.3 RESEARCH DESIGN**

Merriam (1998:6) compares research design “to an architectural blueprint explaining that research is a plan for assembling, organising and interpreting data, which results in research findings.” According to Lancy (1997:65) there are two main designs that are widely discussed in the literature, namely qualitative and quantitative designs. Henning, van Rensburg and Smit (2004) explain that the distinction between the qualitative and quantitative designs lies in the quest for understanding and for in-depth investigation. “The quantitative in general is supported by the positivist paradigm, which leads us to regard the world in terms of observable, measurable facts” (2004:3) In contrast, qualitative research methods are “generally supported by the interpretivist paradigm, which portray a world in which reality is socially constructed, complex and ever changing” (Henning et al., 2004:3).

Johnson and Onwuegbuzie, (2004) present a third design called mixed methods which this study employed. According to Creswell, Plano Clark, Gutmann, & Hanson (2003), mixed methods research is a methodology for conducting research that involves collecting, analysing, and integrating quantitative and qualitative research (and data) in a single study or a longitudinal programme of inquiry. In particular, the mixed-methods sequential explanatory design Creswell (2013) was employed in this study. It was informed by the nature of data that was to be collected. Although this design was chosen for the study, it is important to appreciate that it also has its own problems. Despite its popularity and straightforwardness, this mixed methods design is not easy to implement (Ivankova, Creswell & Stick, 2006). Examples of certain methodological issues that were considered in advance in the study included: the priority or weight given to the quantitative and qualitative data collection and analysis; the sequence of the data collection and analysis; and the stages in the research process at which the quantitative and qualitative phases were connected and the integration of results (Creswell, et al., 2003; Morgan, 1988).

According to Creswell et al. (2003), the mixed-methods sequential explanatory design consists of two distinct phases: quantitative followed by qualitative (Creswell et al., 2003).

For the study reported here, quantitative (numeric) data was first collected and analysed. Qualitative (text) data was then collected and analysed. This helped explain and elaborate the quantitative results obtained in the first phase. The second, qualitative phase built on the first, quantitative phase, and the two phases were connected in the intermediate stage in the study (Ivankova, Creswell, & Stick, 2006). The rationale for this approach was that the quantitative data and their subsequent analyses provided a general understanding of the science equipment training workshops in relation to how the workshops empower teachers. The qualitative data and their analyses refined and explained statistical results by exploring participants' views in more depth (Creswell, 2003; Moghaddam, Walker, & Harre, 2003; Tashakkori & Teddlie, 1998). Some of the advantages of the mixed-methods design include straightforwardness and opportunities for the exploration of the quantitative results in more detail (Creswell, 2003; 2005). For this study the approach adopted was found useful because the impact of the science equipment training workshops was unknown at the beginning of the investigation.

### **3.4 METHODOLOGY**

This study utilised both quantitative and qualitative approaches. Firstly, the quantitative approach is discussed.

#### **3.4.1 THE QUANTITATIVE PHASE**

McMillan and Schumacher (2006:15) describe quantitative methodology as more closely aligned with the positivist research paradigm. It involves gathering data such as numerical data, which can be examined in an unbiased manner. When utilising this approach, at the onset the researcher generally has a clear idea about what variables are to be measured and how to go about measuring these various variables. The results of quantitative research are collections of numbers which can be subjected to statistical analysis to corroborate or negate a pre-set research question. The purpose therefore is to “qualify data and generalise results from a sample to the population interest” (Henning et al., 2004). According to Fraenkel and Wallen (1994) a quantitative researcher keeps the researcher away from influencing data collection. This is achieved firstly by assuming that the researcher operates from a positivist research paradigm where the researcher is detached from the study, and therefore the researcher's feelings and beliefs do not influence the study, resulting in the study being unbiased. Being objective, emotionally detached and separate from the research data is a key aspect of this approach. Secondly, this type of research design seeks to establish relationships

and explain causes to changes in measured social facts. Thirdly there is an established set of procedures and steps that guide the researcher during the study

McMillan and Schumacher (2006:20) explains that quantitative research methods can be classified into experimental and non-experimental designs. Experimental designs involve investigating the cause and effect relationships between interventions and measuring outcomes. The researcher is therefore able to compare the results of the subjects who were exposed to the intervention and those who were not exposed to intervention. Also the researcher can compare the effectiveness of different interventions. McMillan and Schumacher (2006) further explain that non-experimental design involves the research where the researcher cannot control or manipulate the subjects; instead the researcher needs to rely on observation and interpretations to come to a conclusion. Data is therefore collected without any external variables being introduced and without making changes to or introducing any intervention. The type of design therefore relies heavily on connections evident in the survey or a case study. This study adopted the non-experimental design and collected data from subjects who participated in science equipment training workshops. There was no room for having an experimental group and non-experimental group. The purpose and focus of the study was to determine the impact of teacher development science equipment training workshops in the North West Province on all participants who attended the workshops and not on the cause and effect relationships.

### **3.4.2 SITE SELECTION**

Four North West districts namely: Ngaka Modiri Molema (100 schools), Dr. Kenneth Kaunda (75 schools), Dr. Ruth Segomotso Momphati (50 schools) and Bojanala (25 schools) provided the participants for this study. The total number of schools who participated in the years 2014 and 2015 teacher development science equipment training workshops is 250. Participants from all these schools attended workshops at a central point in Rustenburg, North West province.

### **3.4.3 POPULATION AND SAMPLING**

Bless, Higson-Smith and Sithole (2013:139) describe population as a target group or group of interest to the researcher. To be part of the population, a set of elements that one desires to

apply the findings of the study is considered. Elements are the total number of either objects or human beings among which the study is conducted at a particular point in time (Denzin & Lincoln, 2011). The total number of high schools in the North-West province at the time of this research is about 300. Each school had one Physical Science teacher selected for training giving the number for teachers to be also 300. The Department of Education, North-West province, did the selection of the participants. The criterion for selection was based on the performance of learners (pass rate) in the Physical Science Matric examination for 2012 and 2013.

Sampling is the process of selecting units from a population of interest so that by studying the sample it is possible to fairly generalise results back to the population from which they were chosen (Tromchim, 2006). For this study, as mentioned earlier, 250 teachers (one teacher from each school) were selected. The participating teachers were selected from underperforming and Dinaledi schools. Of the 250 participants, 199 were from underperforming schools and 51 were from Dinaledi schools. Underperforming schools are those schools that achieve an average pass rate of less than 50% in the National Senior Certificate, specifically Physical Sciences in this research (Gauteng Department of Education, 2010). The Dinaledi schools fall under the Dinaledi programme which supports selected schools with a view to significantly increasing the participation and performance of learners, especially African and girl learners, in Mathematics and Science subjects (The Department of Basic Education and Higher Education and Training, 2011). Since its inception in 2002, the Dinaledi programme expanded from 102 to 500 schools across all nine provinces (Gauteng Department of Education, 2010). Dinaledi schools receive additional learning resources and teachers who are equipped with appropriate pedagogical and content skills, and languages of instruction. For inclusion in the Dinaledi programme, secondary schools were selected on the basis of having achieved at least 35% Senior Certificate Mathematics pass rate by black learners. Some former Model C schools that met these criteria were also included in the Dinaledi project (Gauteng Department of Education, 2010). Former Model C schools are schools which used to have the best resources and teachers and some of these schools currently still enjoy these characteristics.

The technique that was used for the study is the stratified random sampling technique. The strata or groupings in this case were in four North West Province districts. A total sample of 60 Physical Science educators was selected. First, the researcher assigned percentages from

each district and multiplied by the sample needed to get the exact number of teachers from each district and then drew the sample so that each district was represented. For example, 40% of the sample was obtained from the 1<sup>st</sup> district - Ngaka Modiri Molema, 30% from the 2<sup>nd</sup> district - Dr. Kenneth Kaunda, 20% from the 3<sup>rd</sup> district - Dr. Ruth Segomotso Momphati and 10% from the 4<sup>th</sup> district - Bojanala. The researcher worked in the district from which more teachers were sampled and as the distance got more and more from the researcher's district fewer and fewer teachers were sampled. This was the logic behind using stratified random sampling technique. Having determined the numbers from each district, the researcher went on to adopt the systematic random sampling by using a table of random numbers to choose the participants from each district. From the first district, 24 schools were selected, 18 from the second district, 12 from the third district and 6 from the fourth district. This led to a total of 60 schools that were ultimately selected. From each of the selected schools in each district, only one Physical Science teacher teaching at Grade 12 level at Further Education and Training (FET) phase was purposively selected. This resulted in 60 Physical Science teachers being sampled.

### **3.5 THE QUALITATIVE PHASE**

The second part of the study was the qualitative approach. According to Creswell (2007:36), qualitative researchers study phenomena in their natural settings, attempting to make sense of, or interpret phenomena in terms of the meanings people bring to them. McMillian and Schumacher (1997: 371) refer to qualitative research as a naturalistic inquiry, the use of non-interfering data collection strategies to discover the natural flow of events and processes and how participants interpret the data. Furthermore, Wimmer and Dominick (1997: 84) describe qualitative method as a source of in-depth data. It is the depth of the data rather than breadth that matters in qualitative studies and researcher plays an active role in the data collection. Thus, qualitative researchers are often more concerned about uncovering knowledge about how people think and feel about the circumstances in which they find themselves than they are in making judgements about whether those thoughts and feelings are valid. The qualitative research design used in this study employed open-ended questionnaire and semi-structured interviews. This phase of the research involved selecting educators to discuss and the impact of teacher development science equipment training workshops in the North West province.

### **3.5.1 Participant Selection**

The researcher purposively selected eight teachers from the 60 teachers who had completed the questionnaire. The eight were selected for classroom observation first before being interviewed. After ascertaining that their questionnaire data was information rich, further probing was needed to clarify some aspects. Each of the four districts had two teachers selected from their respective sampled numbers giving a total of 8 teachers. The criteria in the selection of 8 participant teachers for classroom observation was based on the responses from the questionnaire which the teachers had completed initially. The responses of these teachers were interesting relating to the way they were teaching before attending science equipment training workshops. Hence there was need to have a follow-up and confirm if the teachers were really purporting what they were saying in the questionnaire. Of interest to their responses were open-ended questions. The teachers selected were from schools that had performed below 60% in the National examination at Matriculation level and had attended the equipment training workshop for two years (2014 and 2015).

## **3.6 DATA COLLECTION INSTRUMENTS**

### **3.6.1 QUESTIONNAIRE**

Babbie (2011) defines a questionnaire as an assemblage of questions intended to elicit information relating to a particular research problem. Such information is solicited from targeted research participants. A self-constructed questionnaire comprising employed comprised of both closed-ended and open-ended questions was used in this study (see Appendix A). Closed-ended questions provided data for the quantitative phase and open-ended questions provided data for the open-ended phase. Closed-ended questions consisted of 3 and 4 point Likert type questions. The purpose of the questions was to get insight from the teachers on the impact of Teacher development science equipment training workshops as well as to check if the teachers are empowered by the workshops. The questions addressing the research problem were sought from literature but phrased by the researcher hence this required piloting of the instrument to determine its validity and reliability. The questionnaire was piloted using 10 teachers from one district that attended training workshops but were not part of the final sample for the main study.

The questionnaire consisted of four sections. Section A sought biographical details which were closed-ended questions. Questions solicited information pertaining to gender, teaching experience, grades taught and qualifications held. Section B was based on the Evaluation of Teacher Training Workshop. Questions in this section were 3 point Likert-type items. Participants were asked to rate each item in this section from “poor” to “excellent”. Examples of items include: Planning of workshops before the current curriculum and the workshops met the purpose; the content of the workshop enhanced my understanding of the content that I am teaching; presentations and hand-outs were appropriate and relevant to the purpose of the workshop. Section C was based on the Department of Education’s follow-up activities. Questions in this section were 4 point Likert-type items. Participants were required to rate each item from “Strongly Disagree” to “Strongly Agree.” Examples of items include: Does the teacher who attended the training give feedback to other educators who were not there at the workshop teaching the same subject? Is there a measuring instrument that has been provided by the department to check if the educators use the information? Does the Department make effort to check if information and materials received at schools are used or implemented? Is there an improvement in science subject results which can be linked to educators accomplishing the goals of the training workshops? Does the Department give feedback to educators after assessing them from workshops?

### **3.6.2 CLASSROOM OBSERVATIONS**

The observations done in the classroom were on account of teachers operating in their natural setting which is an important feature of case study (Yin, 2009). Each teacher was observed for two lessons covering at least a prescribed practical activity, a recommended experiment or both. Two observations of each teacher in different classes were conducted. These assisted the researcher to get a holistic picture of the teachers' practice in relation to science equipment use from their classrooms. An observation schedule helps the researcher to be systematic and capture the social setting in which people work. The practicals took a double period for each teacher, which was an average of 80 minutes. The lessons were spread over two terms. The lesson observations were non-participant observations (Opie 2004). For each of the observed lessons, the researcher sat at the back of the laboratory and took field notes. The field notes aimed to capture as much detail as possible about the lesson proceedings. The semi-structured lesson observations were guided by a deliberate effort to characterize teacher use of science equipment in their classrooms to facilitate teaching and learning (Suleiman,

2013). The following issues (Yang & Heh, 2007) were given special attention: (1) developing analytical, critical observation and problem solving abilities (2) creativity of individuals (3) science process skills such as observing qualities, measuring quantities, sorting, classifying, inferring, predicting, experimenting and communicating using available apparatus and materials. An observation schedule supported the researcher to record the events taking place in the classroom during the teaching and learning sessions. The schedule helped the researcher to concentrate on the teachers' practice. As alluded to by Maxwell (2005), an observation schedule helps the researcher to be systematic and capture the whole social setting in which people work. The teachers were observed conducting lessons as indicated in Topics of the lessons in which teachers were observed as indicated in Table 3.1. The names used in this study are pseudonyms.

**Table 3.1: Topics where teachers were observed conducting lessons**

<b>District</b>	<b>Teacher code</b>	<b>Topic</b>
Ngaka Modiri Molema	Ms. Tshiamo	<i>Session 1:</i> Heating and cooling curve of water. <i>Session 2:</i> Electric circuits with resistors in series and parallel - measuring potential difference and current.
Ngaka Modiri Molema	Ms. Lerato	<i>Session 1:</i> Heating and cooling curve of water <i>Session 2:</i> Electric circuits with resistors in series and parallel - measuring potential difference and current.
Dr. Kenneth Kaunda	Mr. Kagiso	<i>Session 1:</i> Heating and cooling curve of water <i>Session 2:</i> Electric circuits with resistors in series and parallel - measuring potential difference and current.
Dr. Kenneth Kaunda	Mr. Mothibedi	<i>Session 1:</i> Heating and cooling curve of water <i>Session 2:</i> Electric circuits with resistors in series and parallel - measuring potential difference and current.
Dr. Ruth Segomotso Momphati	Mr. Jessica	<i>Session 1:</i> Preparation of esters <i>Session 2:</i> Determine the critical angle of a rectangular glass (clear) block
Dr. Ruth Segomotso Momphati	Ms. Segoe	<i>Session 1:</i> Preparation of esters <i>Session 2:</i> Determine the critical angle of a rectangular glass (clear) block
Bojanala	Mr. Gontse	<i>Session 1:</i> Preparation of esters <i>Session 2:</i> Determine the critical angle of a rectangular glass (clear) block
Bojanala	Ms. Julia	<i>Session 1:</i> Preparation of esters <i>Session 2:</i> Determine the critical angle of a rectangular glass (clear) block

### **3.6.3 INTERVIEWS**

Kvale (1996) defines interviews as a face-to-face verbal communication between the interviewer and the person being interviewed (interviewee). In this study, semi-structured interviews were utilised. A semi-structured interview is a tool where an interviewer works from the interview schedule in which questions are asked in a predetermined order depending on the responses (Leedy & Ormrod, 2013). Semi-structured interviews require the participant to answer a set of predetermined questions and allow for probing and clarification of answers (Maree 2010:87). An interview schedule (See Appendix B) was used. Examples of questions on the interview schedule include: Which criteria was used by the Department of Education to select the teachers for training? How were those materials used in the training compared to the recent supply of materials in the schools? How confident were you at school when approaching the concepts dealt with in training? What specific ideas from the training did you apply in the classroom? The questions were designed to corroborate responses from the questionnaire. The interview schedule was piloted with six of the ten teachers who had completed the questionnaire during the pilot phase. The six teachers were conveniently sampled from the ten. As mentioned earlier, they were part of the training workshops but were not selected to participate in the main study.

### **3.6.4 VALIDITY AND RELIABILITY**

Two types of validity were ascertained before using the instruments. These are face and content validity. Face validity is the extent to which the researcher believes the instrument measures what it is supposed to measure (Leedy & Ormrod, 2010:92). Face validity is not a statistical measure but a subjective impression of how well the test represents what it purports to represent. The items of the questionnaire were designed in such a manner that they measure the attributes that they are intended to measure. Questionnaires were constructed and given to a panel of six University lecturers who sit in the Faculty's Higher Degree Committee and 5 teachers from Ngaka Modiri Molema district who were not part of the study for face validation of the instrument. The teachers were conveniently selected.

According to Leedy and Ormrod (2010:92), content validity is the extent to which a measurement instrument is a representative sample of the content area being measured. Content validity refers to the extent to which a test or instrument measures a representative

sample of subject-matter content, for example the coverage of the content of a syllabus (Cohen, Manion, & Morrison, 2000). In other words, content validity is essentially about checking the operationalization against the relevant content domain for the construct. It is usually established by consensus among content experts. Miller (2009) is of the opinion that development of a content valid instrument is typically achieved by a rational analysis of the instrument by raters (ideally 3 to 5) familiar with the construct of interest. Specifically, raters review all of the items for readability, clarity and comprehensiveness and come to some level of agreement as to which items should be included in the final instrument. The same team of experts who performed face validity of the instruments working in the same university and some teachers in schools were used for validating the instruments used in this study.

According to Ary, Jacobs and Razavieh (1996), reliability procedures are designed to find out whether the items in the test measure the same thing. These are internal consistency measures for assessing the inter-item consistency or homogeneity (items measure one trait or attribute) of Likert-type instruments such as the ones used in this study. The Cronbach alpha is widely used. Cronbach Alphas was calculated on the questionnaire that used the Likert scale. A good rule of the thumb is that reliability should be 0.7 and above to be acceptable (De Vos, Strydom, Fouche, & Delpont, 2006). In this study, Cronbach alpha was established at 0.76 for the questionnaire. The questionnaire was taken to statisticians at the North West University Mafikeng campus for this analysis to be done. This signals that the questionnaire was reliable in the data it solicited.

### **3.7 PILOT STUDY**

The basic purpose of the pilot study was to determine how the design of the study could be improved and to identify the flaws in the measuring instruments. According to Leedy and Ormrod (2010:110), a brief pilot study is an excellent way to determine the feasibility of the research. As mentioned earlier, the questionnaire was pilot tested with ten (10) teachers from Ngaka Modiri Molema district. The interview schedule was pilot tested with six of the ten teachers. The six teachers were conveniently sampled. The instruments were pilot tested among other reasons to see if:

- (i) questions were easy to follow;
- (ii) questions were relevant to what the research aimed to accomplish;
- (iii) there was coherence of questions in the various sections of the questionnaire; and

(iv) the time needed to answer the questionnaire was sufficient.

The pilot results were positive and resulted in some minor changes. Questions on section B and section C on the questionnaire had to be rephrased from questions into statement. This was seen as the appropriate thing to do as suggested by teachers who took part in the pilot study interviews.

### **3.8 RESEARCH METHODS**

The questionnaire was administered to the sampled 60 teachers in four North West Province districts as mentioned earlier; and 24 from Ngaka Modiri Molema; 18 from Dr. Ruth Segomotso Momphati, 12 from Dr. Kenneth Kaunda, and 6 from Bojanala district. The questionnaires were self-administered by the researcher and each participant took approximately 30 mins to complete the questionnaire. Questionnaires were analysed. After analysis of questionnaires, eight teachers (two from each district) were purposively sampled as mentioned earlier. The teachers were first observed teaching in their classrooms and the request that was made during ethics clearance period was that classroom observations would be either on prescribed practical activities or recommended practical activities or even both. The teachers had to be observed using equipment from the science training workshops. Each teacher was observed twice over two terms. Interviews were conducted with the teachers individually after classroom observations. Individual interviews were conducted in order to verify and elaborate on the responses of the questionnaire and some practices observed during classroom observation. Each interview took approximately 30 minutes. All interviews were audiotaped and transcribed verbatim.

### **3.9 DATA ANALYSIS**

Both quantitative and qualitative approaches were used to analyse the data. This was done to generate the most rigorous description of the participant's views on Science teacher training workshops. Quantitative data analysis was performed using both descriptive and inferential statistics. For qualitative data, inductive analysis was utilized (McMillan & Schumacher, 2006).

### **3.9.1 Quantitative Data Analysis**

Both descriptive and inferential statistics were used to analyse quantitative data so as to answer the research questions. Two Computer Software packages were used for analysis. These are: (1) Microsoft Excel Programme 2013 Version for constructing graphs or charts and carrying out calculations, (2) Minitab for performing the following tests of hypothesis: (a) t-test for paired samples and (b) Wilcoxon Signed Rank Test for paired samples. Statistical analysis entailed descriptive statistics (frequency tables and charts) mainly utilised in the analysis and reporting of findings as well as inferential statistics (t-test for paired samples and Wilcoxon Signed Rank Test for paired samples) for determining if the differences were statistically significant. Relevant basic assumptions were considered in performing the statistical analyses (McMillan & Wergin, 2010:88). For example, Pallant (2005:210) says with a sample size of 30+, violation of the additional assumption that the difference between the two scores obtained for each subject should be normally distributed was seen as unlikely to cause any serious problems hence the t-test for paired samples. However, caution was taken by also running an equivalent non-parametric test- the Wilcoxon Signed Rank Test for paired samples.

### **3.9.2 Qualitative Data analysis**

All responses from the interviews, field notes from observations and open-ended responses from the questionnaire was analysed using inductive analysis. Through this process, particular pieces of evidence lead to meaningful wholes. Inductive analysis involved coding and categorization of data, observing patterns and themes, and making reasoned conclusions. Coding began with reading the data in each data set and identification of frames of analysis (Hatch, 2002). Frames of analysis are levels of specificity within which the data was examined.

#### **3.9.2.1 Trustworthiness**

Trustworthiness was sought through the strategies of credibility, applicability, transferability, and conformability. *Credibility* refers to the confidence one can have in the truth of the findings and can be established by various methods (Golafshani, 2003). *Confirmability* refers to the quality of the results, in other words, the degree to which qualitative data and their interpretations can be authenticated. The techniques used for establishing credibility such as

data triangulation, investigator triangulation, and member-checking are important for building trust. According to Denzin & Lincoln (1994) *dependability* refers to the stability of the findings over time and *confirmability* refers to the internal coherence of the data in relation to the findings, interpretations, and recommendations. Padgett (1998) further states that an audit trail can be used to confirm dependability and conformability simultaneously. The audit trail for this study included detailed notes regarding data collection, data analysis, and any modifications made thereof. *Transferability* or applicability means, in essence, that other researchers can apply the findings of the study to their own investigations, taking into consideration the contextual uniqueness of this study.

### **3.10 RESEARCHER'S ROLE**

In qualitative studies, the role of researchers is quite different from that of the researcher in quantitative studies. Denzin & Lincoln (1998) describe that the researcher is considered an instrument of data collection in qualitative studies. This means that data is mediated through this human instrument, rather than through inventories, questionnaires or machines. The researcher administered questionnaires since this study is mixed method research. Then the researcher coded the questionnaires for analysis and analysed data to derive meaning from what the participants actually voiced. The researcher also interviewed respondents and transcribed recorded interviews before analysis of the qualitative data.

### **3.11 ETHICAL CONSIDERATIONS**

Ethical considerations were practiced in the study as they are an important part of a scientific study. To Jackson (2008), ethical considerations are significant because they are intended to protect researchers and research participants. As argued by Bless *et al.* (2013), researchers conform to ethics in research assists so as to avoid abuse of human rights or any behaviour that may jeopardise the study. The following was done to ensure that ethical considerations were adhered to: approval of the research proposal was sought from NWU ethics committee as well as relevant authorities in the provincial and district levels of the Department of Education. Written requests for permission and access were sent to these authorities (see Appendix G). Respondents were fully informed about the research, including but not limited to its purpose as well as how the results would be distributed. Written and signed consent was sought from research participants. Anonymity was assured to all research participants. The

identity of the research participants and the information that they gave was kept confidential. Participation was voluntary and participants were told they could withdraw from the study at any time. The researcher informed participants about the purpose of the research and assured them that they were not coerced to participate.

### **3.12 CHAPTER SUMMARY**

This chapter described the methods used in the study. Mixed method research was used. A description of the research instruments was given. Issues of validity and reliability were considered as well as trustworthiness of qualitative data. Data analysis methods utilised were explained and the rationale was amplified. The researcher's role and ethical considerations were also explained. The pilot study was reported as this was conducted before distribution of questionnaires and interviews so that the validity of the instruments could be assured. The next chapter presents the data collected, and the data analysis and interpretation are presented.

## **CHAPTER 4**

### **PRESENTATION AND DISCUSSION OF RESULTS**

#### **4.1 INTRODUCTION**

This chapter presents results of the empirical investigation conducted to investigate the impact of teacher development science equipment training workshops in the North West Province. Both quantitative and qualitative data gathered through the investigation are summarized, presented and discussed in this chapter. Descriptive and inferential statistics were used to present quantitative data. Tables, pie charts and bar graphs are utilised to present this data. Qualitative data collected from interviews, open-ended questionnaire and field notes from classroom observations are presented in form of themes. The results serve to address the following research objectives, set to:

- (i) establish the nature of the current workshops;
- (ii) determine the influence of Teacher development science equipment training workshops; and
- (iii) determine if teachers are empowered by the workshops.

#### **4.2 DESCRIPTION OF THE SAMPLE**

The analysis and interpretation of data was based on the responses of the Physical science teachers in four educational districts of the North West Province of South Africa. The total number of the respondents was sixty (60). The responses on the questionnaire were coded and analysed. Eight (8) teachers, two from each of the four districts, were purposively sampled. Classroom observations were conducted with the eight teachers after which they were interviewed. All interviews were audio-recorded and transcribed verbatim. Results from the questionnaire, classroom observations and interviews are given below.

#### **4.3 QUESTIONNAIRE RESULTS AND INTERPRETATION**

A total of sixty (60) respondents were identified. All of the respondents completed the questionnaire. The questionnaire therefore had a 100% return rate because it was administered in person by the researcher. The questionnaire sought to elicit knowledge on the

impact of teacher development science equipment training workshops in the North West Province. The purpose was to establish the influence of these Teachers development science equipment training workshops run by the Department of Education’s MSTs, North-West province and determine if teachers are empowered by the workshops.

#### 4.3.1 QUANTITATIVE DATA

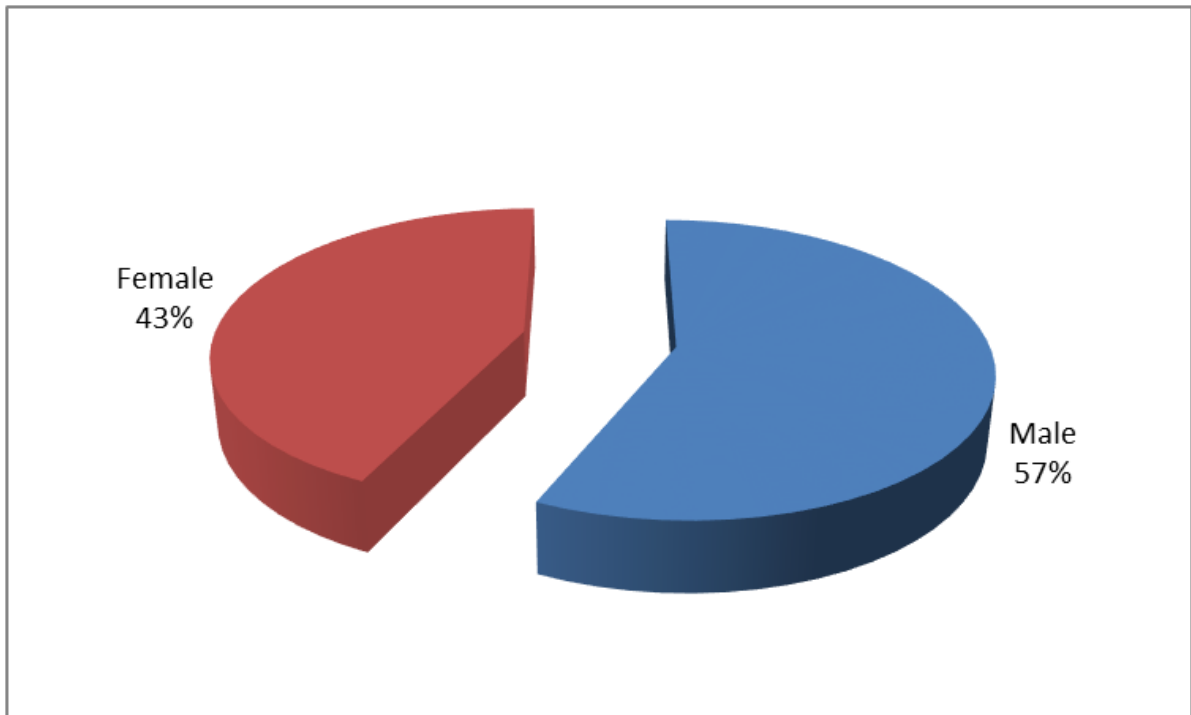
First to be presented is the biographical data and the first variable is age. The questionnaire sought to determine the age of the research and Table 4.1 summarises the findings therefrom.

**Table 4.1: Age**

<b>Age (years)</b>	<b>Frequency</b>	<b>%</b>
30yrs and below	4	6.7
31 – 34	5	8.3
35 – 39	7	11.7
40 – 44	26	43.3
45 – 49	15	25.0
50yrs and above	3	5.0
<b>Total</b>	<b>60</b>	<b>100</b>

Table 4.1 shows that very few teachers (only 4) which translate to 6.7 % of the sample are in the 30 years and below age category. Also, a very small number (only 3) which converts to 5% of the sample are in the 50 years and above category. The majority of respondents (26 teachers) which translates to 43.3% of the sample are in the age category 40 and 44years followed by the age category 45 and 49years with 15 teachers which converts to 25% of the sample. The remaining age groups of 31 to 34years and 35 to 39 years have 5 and 7 teachers which translate to 8.3% and 11.7 % respectively. The biographic data reveals that most of the Physical Sciences teachers (41) are in the 40 to 49 years of age category. The analysis shows that there are more teachers who are 40 years and above than those who are 39years and below teaching Physical Science in the North West province.

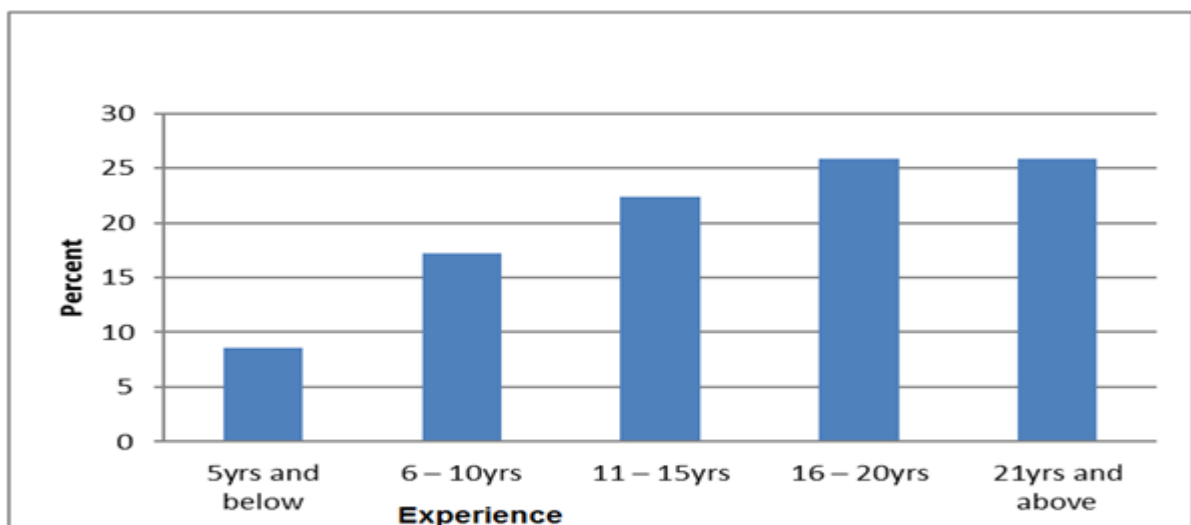
The second variable is the gender composition of the participants is. The gender profile of the participants is described in Figure 4.1.



**Figure 4.1: Gender**

As shown in Table Figure 4.1, the majority of participants were male teachers constituting 57% of the sample who attended equipment training workshops for the past two (2) years. Female teachers constituted 43% of the sample. This shows that more male teachers attended equipment training workshops for the past two (2) years as opposed to their female counterparts.

Teaching experience is the third variable whose results are presented in Figure 4.2.



**Figure 4.2: Teacher Experience**

As shown in Figure 4.2, the majority of the teachers taught for years ranging from 16yrs – 20years (16 which constitute 26.7 % of the sample) and 21years and above (16 which constitute 26.7 % of the sample). The two were followed by those teachers with the teaching experience in the range of 11-15years which was 21.7% category. From Figure 4.2, few teachers were in two categories (10 which converts to 16, 6% of the sample were in the 6-10 years category 5 (which converts to 8.3% of the sample) were in the 5 years and below category. The interpretation of Figure 4.3 shows that most Physical Sciences who attended this attended equipment training workshops were experienced. The overall analysis reveals 45 out of the 60 teachers had 10 years or more years in the field of teaching Physical sciences at Further Education and training level and only 15 had less than 10 years.

The fourth variable is educational qualifications of the respondents is presented in Table 4.2.

**Table 4.2: Educational Qualification**

<b>Qualification</b>	<b>Frequency</b>	<b>%</b>
Standard 10 plus 3-year diploma	2	3.3
Degree	25	41.7
Honours Degree	33	55.0
Master's Degree	0	0
Other	0	0
<b>Total</b>	<b>60</b>	<b>100</b>

A look at Table 4.2 shows the educational qualifications of the respondents, most of them with frequency of 33 (55% of the sample) have an Honours Degree. This is followed by 25 respondents who hold at least a degree. The expectations are that the teachers hold relevant educational and/or professional qualifications needed to perform the work they are employed for. As shown on Table 4.2, the highest educational qualifications the respondent hold is an Honours degree. There is no respondent with a Master's or other higher qualifications. Only two respondents have a Standard 10 plus a three-year Diploma.

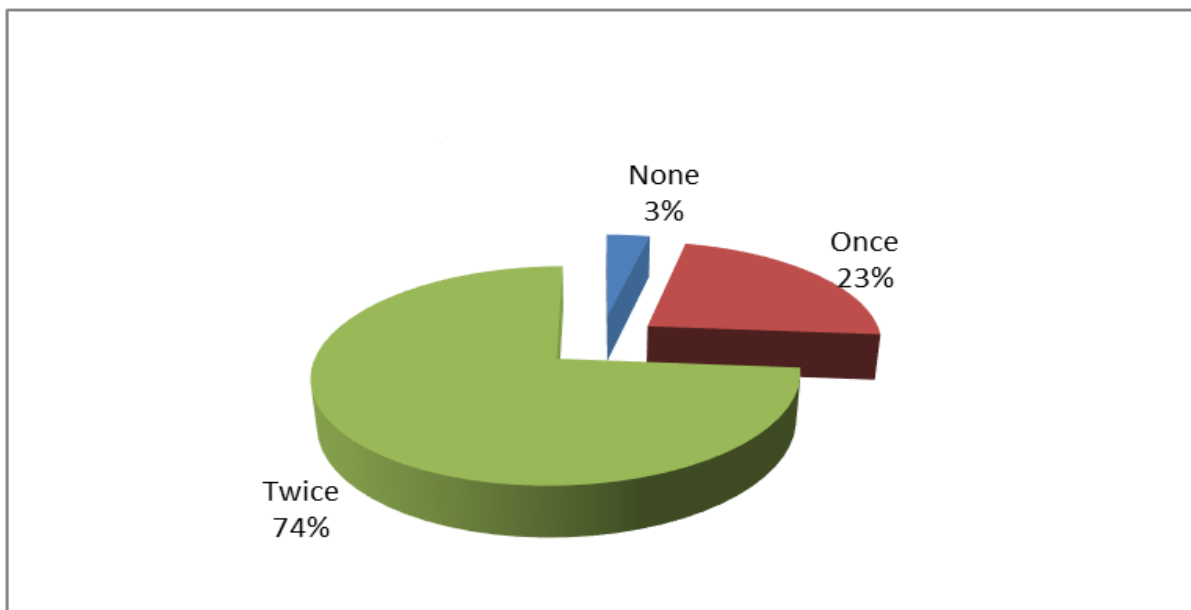
Another aspect of interest on the questionnaire was that of the grade levels the teachers were teaching. This information is provided in Table 4.3.

**Table 4.3: Grade levels taught by respondents**

<b>Grade</b>	<b>Frequency</b>	<b>%</b>
G10,11,12	47	78.3
G11, 12	5	8.3
G10, 11	3	5.0
G11	1	1.7
G10,12	1	1.7
G12	1	1.7
G10	2	3.3
<b>Total</b>	<b>60</b>	<b>100</b>

Table 4.3 shows that a larger proportion (47 out of 60 which translates to 78.3% of the sample) are teachers who taught all three grade levels at FET level which are Grades 10,11 and 12 classes. Only respondents taught Grades 10 and 11 classes which convert to with 8.3% of the sample. The remaining eight teachers either taught Grade 11 only (1), Grades 10 and 12 only (1) Grade 12 only (1) and Grade 10 only (2).

The other aspect which the questionnaire sought was the frequency the respondents had attended the equipment training workshops. Figure 4.3 displays this information.



**Figure 4.3: Frequency the respondents had attended the equipment training workshops**

As indicated on Figure 4.3, the larger proportion (74% of the sample) of the respondents had attended equipment training workshops twice. This is followed by respondents who attended workshop once constituting 23% of the sample. The category with lower percentage was that

of respondents who were attending for the first time which constituted of 3% of the sample. More teachers had attended the workshops before as compared to those who had not.

Besides the bibliographical data section on the questionnaire, the other section focused on the evaluation of the teacher training workshops. Statements sought information regarding the organization of workshops, checking whether workshops met their purpose, assessing the content related to training, checking whether workshops enhanced understanding of the content directed towards enhancing the participants' teaching, establishing appropriateness of materials handed out during workshops and achievement of workshop objectives. Participants rated the statements from poor through average to excellent. Results from this evaluation are presented in Table 4.4.

**Table 4.4: Teacher Training Workshop Evaluation**

Rate each item from "Poor" to "Excellent"			
Statements relating to current workshops (n = 60)	Poor (%)	Average (%)	Excellent (%)
1. Organization of workshops	1.7	76.3	22
2. Meeting the purpose	0	76.3	22.7
3. Training content	3.5	74.1	22.4
4. Enhancement of understanding of the content towards your teaching	0	81	19
5. Addressing participants' questions during workshops	3.4	71.2	25.4
6. Appropriateness of hand-outs given in respect of presentations	0	74.6	25.4
7. Achievement of workshop objectives	0	74.6	25.4
<b>OVERALL (AVERAGE) RATING (%)</b>	<b>1.2</b>	<b>75.5</b>	<b>23.3</b>

Scale: 1 = Poor    2 = Average    3 = Excellent

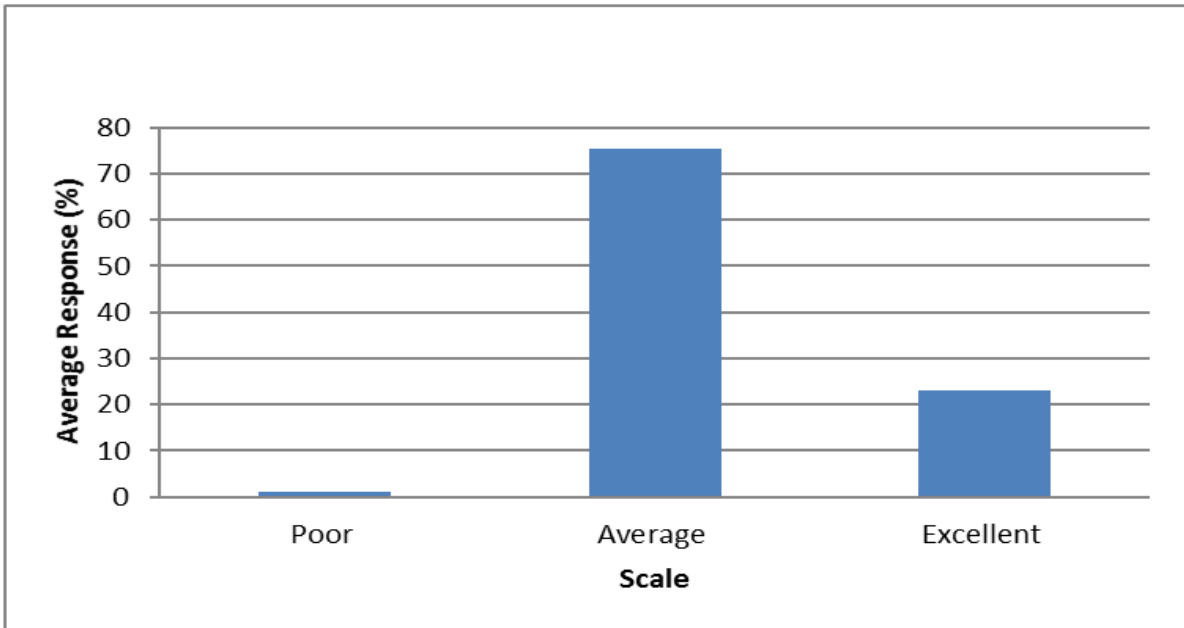
Responses to the statement relating to *organization of workshops* reveal that larger proportion (76.3% of the sample) of respondents rated the workshops as average. This was followed by those respondents who rated the workshops as excellent who constituted 22% of the sample. A very small proportion of the respondents rated the workshops as poor and this constituted 1.7% of the sample.

The second statement sought to establish if the workshops *met the purpose* they were intended to fulfil and over three-quarters of the respondents (76.3% of the sample) rated the workshops as average. Slightly under a quarter of the respondents (22.7% of the sample) rated the workshops as excellent. None of the participants rated workshop as poor.

The third statement solicited information on the *training content* of the workshops. The results indicated that most of the respondents (74.1% of the sample) rated the workshops as average. Just slightly lower than a quarter of the respondents (22.4 % of the sample) rated training workshops as excellent and a very small percentage of the sample (3.4 %) rated workshops as poor. Regarding the fourth statement which sought to establish if the workshops *enhanced respondents' understanding of the content towards their teaching*, the majority of the respondents (81% of the sample) rated the workshops as average. The remaining 19% of the sample rated the workshops as excellent and none of the respondents rated the workshops as poor.

The fifth statement was sought to see if participants' *questions raised during workshops were addressed*. Analysis reveals that the majority of respondents (71.2% of the sample) rated the workshops as average whereas 25.4% of the sample rated the workshops as excellent. On the contrary, only a small proportion of the sample (3.4%) rated the statement as poor. The penultimate statement on this section solicited information regarding the *appropriateness of hand-outs given in respect of presentations* and again a higher proportion of the respondents (74.6% of the sample) rated the workshops as average just like they did on other statements. The remaining 24% of sample rated the workshops as excellent and none of the respondents rated the workshops as poor.

The last statement checked *if workshop objectives were achieved*. Analysis revealed that most of the respondents (74.6% of the sample) rated the workshops as average on this subject. The remaining 25.4% of the sample rated the workshops as excellent and none of the respondents rated the workshops as poor. Figure 4.4 is a depiction of the average overall ratings on a scale: 1 = Poor, 2 = Average and 3 = Excellent.



**Figure 4.4: Depiction of an average overall rating of statements by respondents**

The average overall rating evaluation of the science equipment teacher training workshops by respondents reveals that most of them (75.5% of the sample) rated the workshop as average, 23.3% of the sample rated the workshops as excellent and a meagre 1.2% of the sample rated the workshops as poor in their ultimate evaluation.

The third section on the questionnaire sought to elicit information relating to workshop follow-up by the Department of Education on teachers who attended the workshops. The probes were framed in the form of statements as indicated in Table 4.5.

**Table 4.5: Evaluation relating to Workshop follow-up by the Department of Education**

Item ( n = 60)	SD (%)	D (%)	A (%)	SA (%)
1 As a teacher who attended the training, I give feedback to other educators who were not there at the workshop teaching the same subject as requested by the Department	7.3	10.9	78.2	3.6
2 There is a measuring instrument that has been provided by the Department used to check if as teachers we use the information received from training	5.5	23.6	65.4	5.5
3 I use the instrument provided by the Department to check if information and materials received at schools are being used or implemented by teachers and learners	5.5	18.2	70.9	5.5
4 There is an improvement of knowledge and skills which can be linked to us teachers achieving the goal of the training workshops	1.8	12.7	76.4	9.1
5 The Department gives us feedback as teachers after having assesses us about the workshops	7.3	20	69.1	3.6
6 I benefit from the DoE's follow-up evaluation on equipment training I received	0	10.9	80	9.1
<b>OVERALL (AVERAGE) RATING (%)</b>	<b>4.6</b>	<b>16.1</b>	<b>73.2</b>	<b>6.1</b>

Key/Scale: SD = Strongly Disagree (1), D = Disagree (2), A = Agree (3), SA = Strongly Agree (4)

As shown in Table 4.5, the first statement solicited information to determine if teachers who attended the training give feedback to other educators who were not part of the training but are teaching at the same school. Most of the respondents (78.2% of the sample) agreed with the statement and 3.6% of the sample strongly agreed. This shows that over 81.8% of the sample agreed with the statement. A small proportion of the sample (10.9%) disagreed and 7.3% of the sample strongly disagreed with the statement.

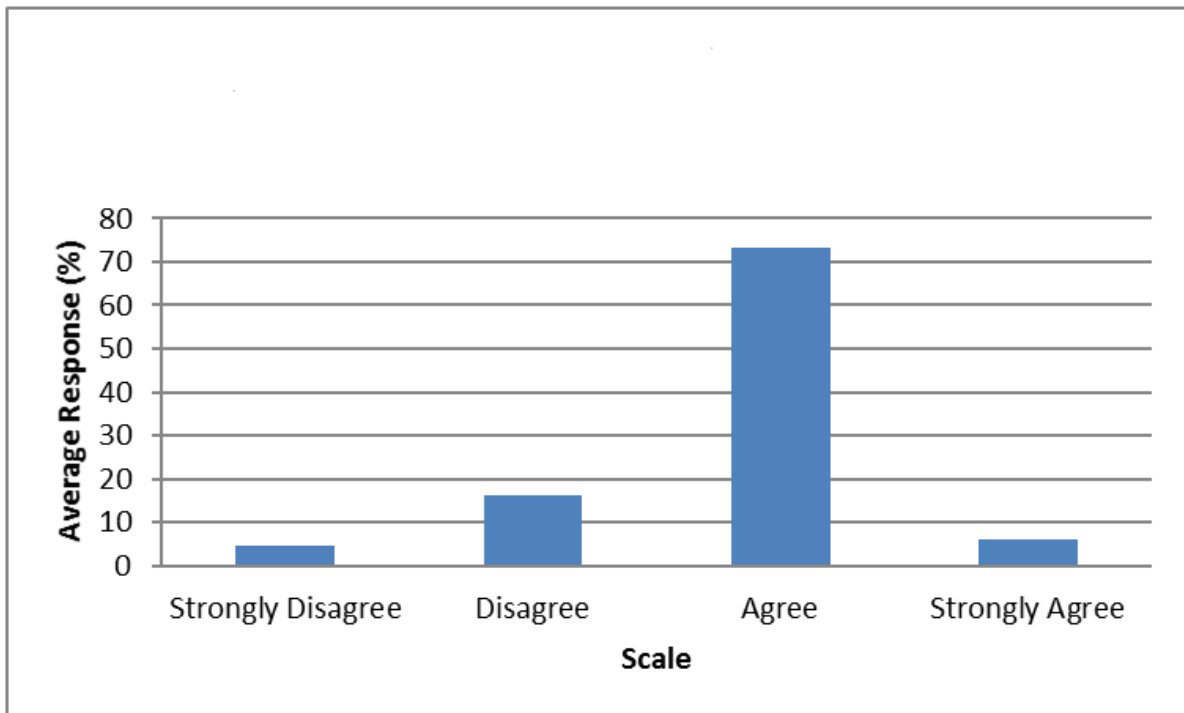
The second statement talked to the idea of establishing if there is a measuring instrument that has been provided by the Department of Education to check if teachers use the information received from training. The analysis reveals that majority of the respondents (65.4 % of the sample) agreed and 5.5% of the sample strongly agreed with the statement. A total of 70.9% of the sample agreed with the statement whereas 29.1% of the sample disagreed with the sample. Of those who disagreed, 23.6% disagreed while 5.5% strongly disagreed.

The assumption was that the Department of Education would not buy apparatus and equipment for teachers in the schools who do not use it. Therefore, the third statement wanted to find out the extent to which teachers in the schools used the instrument provided by the

Department of Education to check if information and materials received at schools are used or implemented. The analysis of the completed questionnaires reveals that a larger proportion of the respondents (70.9% of the sample) agreed that they use the instrument from the Department. A small percentage of the sample (5.5%) strongly agreed to the idea of using the instrument. In contrast, 18.2% of the sample acknowledged not using the instrument by disagreeing with the statement and 5.5% of the sample strongly disagreed with the statement.

The statement which followed wanted to establish if the teachers who attended the workshops felt that there is an improvement of knowledge and skills linked to achieving one of the goals of the training workshops. The majority of the respondents (76.9% of the sample) agreed that there was improvement of knowledge and skills gained from the workshops. In addition to this high number of respondents, a further 9.1% of the sample strongly agreed. To the contrary, a small number of respondents did not feel their knowledge and skills had improved as a result of the workshops: 12.7% of the sample disagreed and a meagre 1.8% strongly disagreed.

The fifth statement solicited data about the Department giving feedback to teachers after assessing them about workshops. Analysis shows that most of the respondents (69.1% of the sample) were in agreement with the statement and a small proportion of the sample, strongly agreed. On the contrary, 20% of the sample disagreed and 7.3% of the sample disagreed with the statement. The last statement established if teachers benefit from the DoE's follow-up evaluation on equipment training they received. A look at Table 4.7 shows that most of the respondents (80% of the sample) agreed that they benefited from the evaluations conducted by the DoE and 9.1% of the sample strongly agreed. The opposing view saw 10.9% of the sample disagreeing and none of the respondents strongly disagreed with the statement. Figure 4.5 is a representation of the average overall ratings where on a scale: 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Agree (A), 4 = Strongly Agree (SA)



**Figure 4.5: Depiction of an average overall rating of statements by respondents relating to Workshop follow-up evaluations by the Department of Education**

The average overall rating relating to Workshop follow-up evaluations by the Department of Education reveals that the majority of the respondents (73.2% of the sample) agreed to the statements, 6.1% of the sample strongly agreed, 16.1% of the sample disagreed and 4.6% of the sample strongly disagreed with the statements.

There was also a section on the questionnaire which sought to evaluate previous teacher training workshops which the teachers had attended previously on the old curriculum, the National Curriculum Statement (NCS). This provided baseline data for comparison. The same statements in Table 4.6 were duplicated. The responses were analysed and treated the same as done with those in Table 4.6. Means for the two evaluations were calculated and presented in Table 4.8 for Mean Deviation. For the rest of the table see Appendix C, since Table 4.6 only shows means and analysis for respondents 46 to 60. The rest of the results are shown in Appendix C.

**Table 4.6: Mean deviation [Current (A) and previous (B) workshop evaluations]**

<b>Respondent</b>	<b>Previous (B)</b>	<b>Current (A)</b>	<b>Difference (A – B)</b>
46	2.00	3.00	1.00
47	2.00	3.00	1.00
48	2.00	3.00	1.00
49	2.00	2.67	0.67
50	2.00	2.67	0.67
51	2.00	2.33	0.33
52	2.29	3.00	0.71
53	2.43	3.00	0.57
54	2.14	3.00	0.86
55	1.71	2.67	0.95
56	1.86	2.67	0.81
57	2.00	3.00	1.00
58	2.00	3.00	1.00
59	1.71	2.67	0.95
60	2.00	2.67	0.67

Table 4.6 shows results for the mean deviation. The Mean Deviation is a measure of dispersion which shows the amount of spread from the mean. It indicates how mean scores differ at a certain point which is the arithmetic mean. Overall mean scores were determined for each respondent for both previous (B) and current (A) workshops. The difference between the two means was calculated (A-B). This difference could only range from 0 to 2. However, in order to ascertain if the difference was significant or not, the study resorted to inferential statistics. As explained in the methodology chapter, a t-test for paired samples was computed using Minitab (see, Appendix E for Minitab Output for t-Test for paired samples). The results from this test are summarised as follows:

A paired-samples t-test was conducted to evaluate if the respondents perceived a difference in the nature of the previous and current workshops. The difference was found to be statistically significant [ $t(59) = 8.97, p < .00005$ ] given that the p-value (i.e. the probability value) is less than 5% (i.e. 0.05) level of significance.

In addition, a Wilcoxon Signed Rank Test for paired samples (see, Appendix F for Minitab Output) was derived. The results from this test are summarised as follows: A Wilcoxon Signed Rank Test was conducted to evaluate if the respondents perceived a difference in the nature of the previous and current workshops. The difference was found to be statistically

significant [Wilcoxon Statistic = 1360.0,  $p < .00005$ ] given that the p-value (i.e. the probability value) is less than 5% (i.e. 0.05) level of significance.

#### **4.4 QUALITATIVE DATA**

This section presents data from classroom observations and interview results. The data from the two instruments of data collection is presented simultaneously for meaningful reporting.

The data is presented under seven themes:

- (1) criteria for selection,
- (2) nature of equipment and materials,
- (3) confidence in using the equipment and materials,
- (4) application of learned techniques during teaching,
- (5) suggestions for future workshops from the teachers, and
- (6) specific skills.

##### **4.4.1 Criteria for selection**

During interviews, a question was asked to establish if the purposively sampled eight teachers knew the basis for their selection in the Science Equipment teacher development training workshops. As mentioned in the methodology chapter, teachers were given pseudonyms. When asked why he was chosen to participate in the workshop(s), Mr. Gontse a teacher from one school in Bojanala district said,

the Department of Education was targeting Dinaledi schools or monitoring teachers who were teaching at Dinaledi schools and since I am teaching at a Dinaledi school, that is the reason why the Department of Education picked me for these workshops.

Ms. Tshiamo from a school in Ngaka Modiri Molema district said,

As you can see this is a village school, my understanding is that the Department has seen that this school is poor and does not have laboratory equipment and materials so they selected me to participate so that this village school will benefit.

Another participant, Mr. Kagiso from one secondary school in Dr. Kenneth Kaunda district said,

I understand the criterion the DoE uses is that of the previous year's Matric Examination performance to select schools for the workshops. Those schools that obtained a 70% or more in the previous Matric Examination are selected to be trained for the science equipment's and those that obtained less than 70% were selected to cover content gaps.

Mrs. Jessica, from one of the high schools in Dr. Ruth Momphati district, was not sure about the selection criteria, however, she pointed out that she heard that the DoE was only selecting teachers from the Dinaledi Schools. Ms. Lerato from one secondary school in Ngaka Modiri Molema district believed that the DoE was targeting to improve the pass rate in science subjects in the province. She said,

My school was chosen because it is a science-oriented school and they are training us to master use of laboratory equipment so that we manage to overcome the challenges posed by use of the equipment in the prescribed practical activities.

Mr. Mothibedi from a high school in Dr. Kenneth Kaunda district suggested that all schools offering Physical sciences eventually needed to undergo science equipment training hence it just happened that they were among the first to be considered. The other three teachers' responses resonated around the same reasons mentioned earlier. The analysis reveals that teachers did not have the same reasons for participating in the workshop(s). The rationale they gave for being selected to participate was diverse. Though some of reasons given are in tandem with DoE's criteria some are not. The next theme focuses on the nature of equipment and materials.

#### **4.4.2 Nature of equipment and materials**

During classroom observations and interviews, focus was on the nature of apparatus and materials used in the schools. Of interest was how the apparatus and materials were comparable to those used during training workshops and the ones existing in the schools prior to the training workshops. One participant, Ms. Lerato, when completing the open-ended section of the questionnaire was of the opinion that the equipment used in the workshops are modern. When interviewed, she had this to say,

It is good that they supplied to our schools exactly the same equipment and materials we used during training. The ones we had in our schools were old and outdated, and it was becoming difficult for us to conduct practical activities in the schools as some of

the apparatus and equipment was old and malfunctioning. Look at the old ammeters, they are difficult to use...

During the second classroom observation, Ms. Lerato was observed teaching electrical circuits and she had both old ammeters and voltmeters and the new digital multi-meters. It was good to see that learners were using old and new apparatus.

The second participant, Mr. Segoe from one of secondary school Dr. Ruth Momphati district wrote,

As a Physical science teacher I am pleased to attend the training workshop because my school finally has some apparatus and chemicals to use. The school had no equipment at all. So far I can say the equipment is durable too.

During classroom observation sessions, Mr. Segoe was observed doing the prescribed practical activity on Esterification and determining the critical angle of a rectangular clear glass. The learners were all hands-on and on task. The learners were observed doing the practical activities on their own. In the course of the interview, Mr. Segoe further explained,

In this school we did not have any equipment and had to rely on their nearby schools especially when we were doing prescribed practical activities. We would encounter problems for example when we wanted chemicals because we were told we could buy our own as they are replenishables...

Mrs. Jessica from the same district as Mr. Segoe was observed teaching the same topics with those of Mr. Segoe. She was thankful, just like her colleague, because her school did not have any apparatus and chemicals. Of interest was her response during interviews, when she said *“as much as I appreciate both the training and the equipment, I wish they can give us more equipment. I have a lot of learners in my classes.”* The same plea was raised by Mr. Mothibedi who said,

Remember the day you observed me doing the Heating and cooling curves of water? I could not do that simple activity before just imagine because we did not have laboratory thermometers and beakers or test-tubes. Half a loaf is better than nothing; I just wish they can give us more equipment.

The rest of the teachers echoed the same sentiments which have been mentioned earlier. The responses resonate around the equipment not being enough (quantity) but the teachers appreciate that it is modern and durable.

#### 4.4.3 Confidence in using the equipment and materials

Confidence in using the equipment and materials became a theme which emerged from the data. Ms. Julia a teacher from a high school in Bojanala district displayed confidence in both sessions she was observed teaching. During the interview session, she said,

I am developing confidence as I continuously use the equipment. Before the training, we did not have some equipment here at the school. Some of the equipment, I had not used it before during my training in tertiary institutions. For example, titration was not in my training syllabus. However, the training workshop helped me a lot in taking readings from the burette. Now I know how to take accurate readings. I feel very confident, the workshop helped him a lot ...

Another participant Mr Kagiso gave praise to the confidence he had gained in using the photogates. He alluded to the fact that he had not used them before. Ms. Tshiamo also made mention of the confidence she had gained in using the photogates just like Mr. Kagiso. This is what she had to say,

Physical sciences is not an easy subject to teach in the sense that a teacher has to demonstrate confidence during the teaching and learning process. I had problems using photogates. However, after the training I gained so much confidence that I help colleagues who have not attended the training workshop on science equipment training.

As mentioned in the methodology section, all the eight teachers were observed teaching twice and the observed sessions had to include use of the equipment received after the training. Basically the teachers were observed teaching more or less the same topics given that the observations were done during the same period and the teachers were following the same schedules. The teachers were at ease and exuded confidence with heating and cooling curves of water, electric circuits, preparation of esters and determining the critical angle of a rectangular glass block. Instructions were clear during the lessons. Even where there were more learners in a class, the groups were made bigger but learners did the practical activities on their own. Overall, the teachers displayed confidence in the execution of prescribed and recommended practical activities.

#### 4.4.4 Application of learned techniques during teaching

In addition to determining the extent of confidence the teachers displayed in using the equipment and materials from the training, the other theme was application of learned techniques during teaching. The assumption in asking a question around this issue was that in the workshops, facilitators provide the participants with a variety of ways in which the apparatus could be used in teaching several concepts. Ms. Jessica acknowledged that part of their training was to ensure that they (teachers) use the equipment and materials in several ways. During the interview she said,

We were taught to effectively use of the equipment. Besides doing the prescribed experiments only, we were also taught for example to convert an experiment into a practical investigation or vice-versa. Now that the equipment is here at the school, I can do that and allow the learners to perform the activities. This is an addition to putting learners into small groups for them to effectively do the practical activities.

For the two sessions on esterification and determining the critical angle of a glass block, Ms. Jessica was observed teaching, learners were put into groups of 4 and each learner was assigned a role as they performed the experiments.

The other participant Mr. Gontse hinted that a lot could be done using the equipment for example, practical demonstrations, practical investigations, experiments or projects. During the interview Mr. Gontse said,

I use the equipment for a lot of activities. At times I just do a simple demonstration for learners to understand. I also ensure that my groups are not too big. A maximum of four learners per group is fine. I told the learners if they have projects on certain topics, they can come and ask for the equipment to try their ideas. There is a lot we are using the equipment for...

As with Ms. Jessica, classroom observation sessions showed Mr. Gontse pairing the learners into groups and performing prescribed experiments. The rest of the teachers talked about putting learners into small groups for them to manipulate the apparatus and set it up in order to collect results. Group work during practical activities was the common practice in each teacher participant. Lesson observations also confirmed this. Learners were put in small groups to conduct the relevant prescribed experiments. Not much of the other techniques were seen. Given that only two lessons were observed for each teacher, there was not much room to display other learned techniques.

#### 4.4.5 Suggestions for future workshops

The theme suggestions for future workshops was derived from a question seeking to establish what the teachers were proposing could be done differently if the workshops were to be offered again. The first suggestion was the duration for the training workshops. The teachers spend five days at each training workshop and the teachers stated that this was limited. The participants advocated for more days to be allocated for the training. During interviews, Ms. Tshiamo had this to say,

“We spent five days only at the training workshops. My suggestion is that the time should be increased by three days or more. The facilitators are more knowledgeable in using the equipment. I also suggest that the Department incorporates specialists from industries and technicians because those professionals they use that equipment day and day out.

Another participant, Ms. Lerato lamented that all the prescribed practical activities were not performed and the few which were performed were congested. She suggested,

More time should be dedicated to all the prescribed experiments in the CAPS document. Every teacher should have full understanding of how the equipment works and have confidence in using the equipment and materials.

Mrs. Jessica’s suggestions were similar to those of the other two participants regarding the extension of the duration of the training workshops. She said, “*We had a short stay at the workshop though the practicals to be done were many. We need a lot of more quality time to do these practicals.*”

Another interesting suggestion was given by Ms. Julia who recommended that,

the organisers of the training should ensure that all, I repeat, all practicals including formal and informal ones should be done during the training. Besides that facilitators should also ensure that each and every teacher knows how to perform the activities with learners during the lessons.

The remaining teachers’ recommendations concur with those of other participants presented in the preceding paragraph. The results show that the suggestions are mainly related to: more time for training workshops, all practicals to be covered during training, both formal and informal and specialists from where the equipment is assembled to be part of the team of facilitators.

#### 4.4.6 Specific skills empowered with from the workshop

The last theme sought to establish specific skills which participants felt had empowered them from the workshop. To this effect, Mr. Gontse said,

Three important skills I have learnt from the topic are (1) setting up the equipment correctly, (2) operate the equipment correctly, and (3) calibrating equipment if it is not calibrated. Equipment operation is very key in doing experiments. I had problems with the photogate, Boyle's apparatus and ticker timers but now I am fine. The workshop really empowered me.

In the same vein, Mr Kagiso said,

I learnt that one must have the background theory to the practical activity he/she wants to perform. Secondly, it is the calibration of equipment if there is need to calibrate it. The third skill I got from the workshop is setting up the equipment.

Ms. Jessica said,

The training helped me to deal with the concept of zeroing the thermometer. I use this this skill when dealing with heating and cooling curves for water. The other two skills were setting up the apparatus and calibrating whenever need arose. Also preparing the required concentration of a reagent from its stock solution

The other participants' suggestions are similar to the ones raised above. Basically the skills learned can be summarised as setting up apparatus like the tick timer, operating equipment like photogates and Boyle's apparatus, operating apparatus which has been set up, zeroing the thermometer and calibrating some equipment.

Other issues which have not been touched on in the presentation of data in the preceding paragraphs regarding classroom observations are given here. To a moderate extent, learners' analytical, critical and observation skills were developed given the way the teachers went through the teaching and learning process of the prescribed practical activities. Problem solving and creativity of individuals are areas where all eight participants need to improve on. The approaches the teachers used did not promote these abilities. Regarding science process skills, all eight teachers' performance was satisfactory. Learners were able to infer, predict, experiment and communicate findings using the available apparatus. The learners were engaged throughout. It was impressive to see all learners in the observed classes being on point. The purpose of observations was to assist the researcher in getting a holistic picture of the teachers' practice in relation to science equipment use from their classrooms. To this end,

the effort to characterize teacher use of science equipment in their classrooms to facilitating teaching and learning was realized.

#### **4.5 DISCUSSION**

The biographical data shows an interesting pattern regarding age and experience. The majority of the teachers (44) were over the age 40years and 45 out of the 60 teachers had teaching experience of over 10 years teaching at Further Education and Training (FET) level. Most of the teachers teach across all grade levels, that is, 10 to 12. Interestingly, except only two teachers, the rest had at least a degree with a good proportion of the degreed teachers having a postgraduate qualification. A possible explanation for this might be that school principals opt for teachers with experience to teach Physical Sciences at FET. This result may be explained by the fact that school principals believe experience is critical hence expected quality results might be achieved if experienced teachers are allocated higher grade levels such as Grades 10, 11 and 12. The findings of the current study are consistent with those of Makgato and Mji (2006) who found teaching experience is a factor associated with high school learners' poor performance in their study on factors affecting learners' poor performance- a spotlight on mathematics and physical science. Shifting focus to age, the number of female teachers was slightly less than that of males but almost comparable which is good. This shows there are as many female teachers who are being involved in teaching Physical sciences at FET level.

The Teacher Training Workshop evaluation results are discussed by employing components of Stufflebeam's (2003) Context, Input, Process and Product (CIPP) evaluation model. The first two components, context and input, become relevant when results relating to the organisation of workshops, meeting the purpose, training content and appropriateness of hand-outs given in respect of presentations. The results show that teachers rated the organisation of the workshops highly. The purposes of the workshops were well delineated meaning the teachers knew what needed to be done in addressing the question posed by Stufflebeam and Shinkfield (2007) under context evaluation. To the teachers the workshops met their purpose of enabling them to be conversant in science equipment usage. According to Zhang et al. (2011), the needs of the workshops were assessed and opportunities for addressing the needs were identified. Teachers were in agreement on the appropriateness of

the handouts given in respect of presentations as well as training content befitting procedural designs and educational strategies that was most likely to achieve the desired results. This falls under input evaluation addressing the question how should it be done. These teachers benefitted from the training given the way they rated the above-mentioned aspects of the evaluation of the workshops. These results support the findings of a great deal of the previous work in this field of evaluating education projects such as the Bob Randall of the South West Regional Educational Research laboratory (Stufflebeam, 2003).

The other three evaluation statements namely; enhanced respondents' understanding of the content towards their teaching, questions raised during workshops were addressed and workshop objectives were achieved are discussed within the context of the other two components, process and product, of the Stufflebeam's (2003) CIPP model. The evaluation here will be asking two major questions which are checking implementation process of the workshop(s) and assessing workshop(s) outcomes (Zhang et al., 2011). The results of this study show that the teachers rated all the three statements highly. The training workshop enhanced teachers' understanding of the content towards their teaching, and the teachers acknowledged that all the questions which they had were addressed during workshop. To the teachers, the workshop objectives were well achieved. It is interesting to note that in all seven statements of relating to the evaluation of this study were well rated by the teachers. It seems possible that these results are due to worth and significance of the skills the teachers gained from the workshops. The present findings seem to be consistent with other research (Stufflebeam, 2003) which found if well planned and implemented, training workshops achieve their outcomes at the end.

Regarding the section on checking the evaluation relating to workshop follow-up by the Department of Education, all six statements were rated above average by most of the teachers. The DoE encourages teachers who will have participated in the workshops to share information with those who will not have attended. It also became apparent that after attending workshops, teachers are not supported or assessed; the DoE sends its staff, for example, subject advisors to monitor how teachers conduct experiments. Subject advisors even require prescribed practical activities for moderation. This is a way of checking if the teachers are indeed performing practical activities. In contrast to earlier findings by Muwanga-Zake, (2001), where teachers were found not to be using laboratory equipment

purchased for the schools, there is evidence in this study that teachers were making use of science equipment supplied to their schools. Concerning the statement checking if there is an improvement of knowledge and skills which can be linked to achieving goals of the training workshops, there was again overwhelming evidence to the affirmative. Linked to this statement is another statement which wanted to establish if teachers benefit from the evaluations conducted by the DoE, again the majority of the teachers confirmed to the affirmative. These findings are rather encouraging as they attest to the achievement of some of the workshop objectives. These findings are a positive response to the recommendation posed by Makgato and Mji's (2006) study.

The calculated mean deviations show that there is a difference in the way the teachers rated the evaluation of the current workshop(s) compared to the previous workshop(s). Two inferential statistics, a paired sample t-test and a Wilcoxon Signed Rank Test for paired samples were conducted and showed that the ratings which teachers did were statistically significant. These findings further support the idea of the training workshops having empowered the teachers and positively influenced the way teachers conduct practical activities. Regarding the current workshops, teachers get the same equipment in their schools which the schools will have received whilst the teachers are undergoing training. The equipment and apparatus is relevant to the current curriculum as it [equipment and apparatus] is tailor-made for prescribed and recommended experiments. Unlike in the previous workshops, teachers would attend the training but no equipment would be delivered to the schools. Some schools did not have science equipment and apparatus at all. This relates to the importance of the significant difference in the perception of teacher towards the two workshops.

Shifting focus to results from interviews, the theme for the rationale teachers gave for being selected to participate in the workshop(s) was diverse. Though some of reasons given are in tandem with DoE's criteria some are not. A possible explanation for this might be the inconsistency with one component of Bell and Gilbert's (1996) Science teacher development model which is personal development. According to Bell and Gilbert, personal development is when the teacher is aware that there is a need for professional development and acknowledges the desire to acquire new ideas or strategies. Once the teacher knows this, then

the teacher would initiate his or her training thereby knowing reasons for attending workshops or professional development. Regarding the nature of equipment and materials, the results indicate that teachers agreed that some of the equipment was modern compared to what they had in their schools. The other result was that teachers received the same equipment in their schools as they had used during the training workshops. Some of the results are that some schools did not have equipment at all and it was good the teachers attended the workshops. Although, these results differ from some published studies (Thomas & Israel, 2012; Voogt, Tilya & Akker, 2009), they are consistent with those of Kadzera (2006). These findings corroborate the ideas of Bhukuvhani et al. (2010) for example, found that schools in Zimbabwe like many developing countries face challenges of limited resources for imparting effective and efficient science education.

The other results show that the teachers were confident in using the equipment and materials. Observations and interview results attest to this. This result may be explained by a number of different factors. One of the factors might be that the teachers grasped the concept in the training workshops very well since they knew they had to perform the practical activities with their learners in schools. Another explanation might be that the teachers tried the activities first before they had their lessons with learners. These results differ from those found by Dahar and Faize's (2011) study, but they are broadly consistent with earlier findings by Hakielimu (2010) in Tanzanian secondary schools. As can be inferred from interview results, the teachers are applying the learned techniques in the science classrooms. However, it would be more beneficial if the teachers were using the equipment for demonstrations or other teaching approaches. Demonstrations help learners to conceptualize the scientific concepts more effectively and learners are challenged to connect theories to actual practice (Kandjeo-Marenga, 2011). This study cannot conclusively take the teachers words as only two lessons per each teacher were observed.

Finally, the results relating to suggestions which teachers gave were mainly to do with a prolonged stay at the workshop site. The teachers want more time, five days is not enough for them to do the training. The teachers also recommended that all the prescribed experiments and the recommended experiments should be performed during training. This does not seem feasible. The teachers have learners to take care of back in the schools. Prolonged stay would mean the learners will have lost quite some contact time without their teachers. Maybe, that is the reason why the Department of Education had to send the teachers twice for training in

different years so that they can learn as much as they can. Time has never been enough, for example, learners are being deprived of the chance to conduct experiments in their science lessons because teachers say there simply is not time (Shepherd, 2010). Maybe this is the reason the DoE has prescribed experiments which have to be done by learners in Grades 10 to 12. Overall, the results indicate that the training workshops were a success. Teachers gained some specific skills. They alluded to the fact that they can now set up some experiments used equipment which they did not have but has been supplied to the schools. Teachers were therefore empowered by the workshops and the workshops had positive influence to the ways teachers are teaching to a moderate extent. These results are consistent with those of other studies (Dudu, 2014) and suggest that training workshops being run by the Department of Education's North West province are of great value to the teachers and empowering the teachers as they execute their work.

#### **4.6 CONCLUSION**

In this chapter, the descriptive and inferential statistics was presented in describing the nature of the current workshops. The results indicated that there is some statistically significant difference in the way the current workshops are run as compared to the previous ones. Observation and interview results were also presented in the chapter and showed that to a great extent, the Teacher development science equipment training workshops have positively influenced the teachers by giving them skills which they need in performing different practical activities. Overall, the teachers have been empowered by the workshops. However, some of the suggestions the teachers have recommended regarding the workshops are unrealistic.

## **CHAPTER FIVE**

### **SUMMARY, RECOMMENDATIONS AND CONCLUSION**

#### **5.1 INTRODUCTION**

This chapter present a brief summary of the study, the findings on the literature review and analysis of empirical data and lastly, it makes recommendations based on the participants' views about the impact of the Teacher Development science equipment training workshops. The implications for instructions as well as suggestions for future research are discussed.

#### **5.2 SUMMARY OF THE STUDY**

The overall aim of the study was to identify the impact of Teacher Development science equipment training workshops in the North West Province. The study then sought whether the use of the teacher development science equipment training workshops could serve as an mediation for teachers to perform prescribed and recommended practical activities in their schools as demanded by the CAPS curriculum. This could only be established after the teachers had been trained and received equipment and materials from DoE. This ensured that the researcher was able to address the research questions posed at the onset of this study. The following sub-research questions needed to be addressed:

- (i) What is the nature of the current workshops?
- (ii) What is the influence of Teacher development science equipment training workshops?  
and
- (iii) How are the teachers empowered by the science equipment training workshops?

Chapter 1 gives a brief outline of the statement of the problem and rationale behind this study. In trying to find ways of determining the nature of teachers' development science equipment training workshops, more concerted focus should be on the current workshops. Specifically on how the equipment and materials used in the training are comparable to the ones already existing in the schools and how the teachers are empowered by the science equipment training workshops. Chapter 2 reflects on the current and recent scope of the research studies on science education training workshops. The chapter further provides the review of professional development workshops. Attending equipment training workshops is

one of the vehicles designed to help teachers learn science concepts at the same time they are refining their science teaching abilities, skills and strategies (Battista & Foster, 1999). Chapter 3 focuses on the methods of research and the instruments used to gather data and the construction of the questionnaires, classroom observation schedule, interview schedules and their validation. Data analysis methods, researcher's role and issues of trustworthiness and ethical consideration are also discussed. Chapter 4 presents findings, offers an analysis and interpretation of data as well as giving broad discussions of the findings from the empirical investigation. The findings provide the basis for responses addressing the research questions. This chapter presents the summary, recommendations and conclusion of the whole study.

### **5.3 SUMMARY OF FINDINGS**

The findings of this research are discussed in conjunction with the purpose of the study in the Chapter 1. This section therefore, focuses on the discussion of each findings in conjunction with the research questions mentioned in chapter 1.

#### **5.3.1 Findings on Research Question 1: *What is the nature of the current workshops?***

The literature revealed that the nature and the scope of science equipment workshops consist of issues and challenges specifically with regard to when to use the equipment and for what reasons. The findings revealed that teachers are appreciating attending such workshops as they are gaining a lot. To the teachers the workshops are fairly well organised and the workshops are meeting their purposes. In other words, they are meeting their set objectives. The training is thorough as the teachers gain some content in pursuit of using the materials and equipment. As with any training, participants will always have questions and the teachers agreed that most if not all the questions which they raise during the training workshops are well addressed. Thus this enhances understanding of the content towards the teachers' teaching. The hand-outs given in respect of presentations during training workshops are appropriate and the teachers refer to them when they are on their own during the teaching and learning process of both prescribed and recommended practical activities.

Regarding evaluation relating to Workshop follow-up by the Department of Education, the study found out that teachers who attended the training are expected to give feedback to their colleagues who were not there at the workshop teaching the same subject at the same school.

The DoE official monitors this process by tasking subject advisors for each area office oversee this process. The subject advisors also monitor use of the equipment and apparatus in each and every school which would have received the equipment. Findings point to the fact that there is an improvement of knowledge and skills which can be linked to achievement of goals for the training workshops. To a greater extent, the teachers are benefitting from the DoE's follow-up evaluation on equipment training workshops.

### **5.3.2 Findings on research question 2: *What is the influence of Teacher development science equipment training workshops?***

The Science training workshops influenced the way teachers teach science. The interview results indicate that quite a number of schools did not have science apparatus and equipment in their schools. This implies that laboratory activities were not conducted yet we know that these are essential in teaching science as it stimulates learner's interest as well as developing their scientific skills (Dillion, 2008). Besides scientific skills, hands-on activities help to substantiate scientific knowledge and understanding (Dahar & Faize, 2011); hence it is hard to imagine what kind of science learning was happening in the schools without laboratory activities. The findings also point to the fact that teachers confidence in performing practical activities has increased. Teachers are no longer afraid of setting up equipment, calibrating apparatus which need to be calibrated and use some equipment which the teachers proclaimed they had not used, for example, photogates. This indicated positive influence of the workshops on the way the teachers are now going about doing their day to day operations.

The other interesting finding is that some teachers are going beyond prescribed practical activities. Teachers are also performing informal practical activities making use of approaches such as demonstrations during the teaching and learning process. Demonstrations help learners conceptualise the scientific concepts more effectively than chalk and talk where students are challenged to connect theories to actual practice (Kandjeo-Marenga, 2011). In a way the science equipment training workshops are indirectly positively influencing the way science classes are being conducted by the teachers who took part in the training. The other findings which became apparent is that the DoE consistently now monitors use of the apparatus and materials which were supplied to the schools, in a way, the material is now being use by the teachers. This is important because it implies meaningful teaching and learning of science is taking place. As noted by Hanuscin (2007), the availability of

laboratory equipment and chemicals is one among the factors that facilitates the teaching and learning of science.

### **5.3.3 Findings on research question 3: *How are the teachers empowered by the science equipment training workshops?***

Empowerment of teachers during and after attending workshops comes in a plethora of ways. The question to be asked is what aspects of the teaching and learning process did the teachers take with from the workshops? If skills, strategies or approaches, a question again is asked, are the teachers infusing these in their teaching? The findings show that the teachers in this study were empowered by the science equipment training workshops. Teachers attested to the fact that *they are now able to set up the equipment correctly, operate the equipment correctly, and calibrate equipment if it is not calibrated*. This is very important because equipment and apparatus including chemicals can be at a school but if teachers cannot perform the above skills then no practical activities are done. If a teacher for example, cannot prepare a solution of a required concentration, then no titration can be performed regardless of the fact that the chemicals are available. The workshops empowered the teachers in this regard.

The findings also show that teachers can now convert an experiment into a practical investigation or into a project or just a simple demonstration. This allows the teachers to use the appropriate teaching approaches when need arises. Teachers also know when to allow hand-on sessions and this indicates that teachers are making practical work an integral and essential part of learning science thereby not limiting experiments and practical work in science lessons. In their teaching, teachers now ensure that learners also develop process skills inferring, predicting, experimenting and communicating findings using the available apparatus. The workshops did a lot by empowering the teachers with such skills which they can now develop in learners in the process of teaching and learning science. As witnessed during classroom observations, teachers are also now able to divide their huge classes into meaningful small groups where all learners in a group are involved. As confirmed by interview results, the teachers got this from the training workshops. All in all, the workshops really empowered the teachers.

## **5.4 RECOMMENDATIONS**

This sections provides recommendations as suggestions for practical applications for the findings.

### **5.4.1 Recommendations 1**

#### *Criteria for selection*

The Department of Education should make it a point that when they do their sampling, reasons for selection are well-known and clear to the teachers. For example, in this study, reasons for selection was that the teacher is either form a Dinaledi school or a poor performing school. However, some teachers gave different reasons for selection when asked the basis for attending the workshops. In future, teachers should be informed of the criteria selection before they even attend the workshops so that they feel there is need for personal development (Bell & Gilbert, 1996). Personal development involves teachers coming to realise that some aspects of their practice are problematic. This could be a slow process, starting with an inarticulate awareness that requires time to take shape. It could also be sparked by a specific event that crystallises dissatisfaction. This realisation then becomes the spur for teachers to seek ways to address the problem. In this way, they will acknowledge the desire to acquire new ideas or strategies and become focused during training.

### **5.4.2 Recommendations 2**

#### *Nature of equipment and materials*

The results have indicated that most schools did not have laboratory resources at all. Attending the workshops was beneficial in that the teachers' schools also received equipment and materials. What these findings are presenting is quite disturbing. A number of schools in the North West province might not be having laboratory resources and the Department of Education need to move fast and ensure that the schools get laboratory resources and the teachers need to be trained. Laboratory resources have a positive impact in teaching and learning of science (Sunal, Wright & Sundberg, 2008), in that an opportunity is given to both teachers and learners to perform prescribed and recommended practical activities as recommended by the CAPS curriculum.

### **5.4.3 Recommendations 3**

#### *Application of learned techniques during teaching*

The results suggest that only a handful of teachers are able to convert on practical activity into the other, for example, converting a cook-book recipe type of experiment into a practical investigation, project or demonstration. It is good that the DoE officials specifically subject advisors are monitoring the teachers to see implementation of learned techniques. However, the same subject advisors may have cluster meeting with the teachers where they further discuss how implementation of learned techniques can be taken to a higher level rather than just monitor them on what was done during workshops. Subject advisors can build communities of practice to build on what was learnt during training workshops.

### **5.4.4 Recommendations 4**

#### *Suggestions for future workshops*

The teachers were suggesting that they need more time for the workshops instead of the five-days set for training. However, this might not be feasible. Instead of bring all the teachers over 120 teachers from the province at one particular instance, the Department of Education can organise the science training workshops to be conducted in districts or even area offices so that the training is for a small number of teachers at a particular instance. Several of these trainings can be done at regular intervals maybe covering specific formal and informal practical activities. In so doing, the request that all practical activities should be done during training can be met or achieved instead of trying it with over 120 teachers in one place. The other request of bringing people from industry to be part of the workshops can also be opted in and see if it is feasible.

### **5.4.5 Recommendations 5**

#### *Workshop follow-up by the Department of Education*

The DoE is doing a good job following up teachers in the schools to see if they are using the equipment. However, instead of letting the process be like a fault finding mission, the subject advisors can act as mentors for the teachers and if possible team teach and perform practical activities together. This will boost the confidence of the teachers in performing prescribed and recommended practical activities even more.

## **5.5 FURTHER STUDIES**

Future studies should be done to investigate if there is a relationship between science equipment training workshops and improvement of science results that is, determining if there is a relationship between science equipment training and achievement in science. Since the commencement of these trainings, the overall pass rate in Physical Sciences in the North West province has been improving and others want to associate the improvement without evidence, hence there is need for the research to be conducted.

## **5.6 LIMITATIONS OF THE STUDY**

Sixty teachers from four (4) district in the North West Province were selected to participate in this study. This was because of the budgetary constraints. This sample size was relatively small for inferential statistics, and therefore might not have been large enough to be representative of the entire population though procedures were followed for analysis.

## **5.7 CONCLUSION**

In this concluding chapter, the major findings, conclusions, and recommendations of the study were summarized. Limitations of the study were also highlighted. This mixed methodology study set out to determine the impact of teacher development science equipment training workshops in the North West Province. Impact was defined by first establishing the nature and then influence of Teacher development science equipment training workshops as well as finding out if teachers were empowered by the workshops. As the findings of the study show, sampled teachers had contradicting reasoning for being selected for the training. This study therefore has recommended that teachers have to be made cognisant when attending workshops reasons for their selection. The findings also showed that some schools did not have apparatus and equipment hence thanks to these workshops. However, more schools might be in the same situation of not having apparatus and equipment. The findings also show that teachers' confidence has been raised after attending the workshops and the teachers have gained some specific skills and teaching strategies. Findings also show that workshops are well organised and the Department of Education is running them in an improved manner compared to the previous workshops. Finally the DoE is monitoring use of supplied apparatus and equipment in a coordinated manner. Recommendations regarding

criteria for selection, nature of equipment and apparatus, applications of learned techniques during training and suggestions for future workshops have been proposed.

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## APPENDICES

## APPENDIX A

### Questionnaire

#### Section A: *Biographical data*

The questionnaire seeks to determine the impact of Teacher development science equipment training workshops you have attended and to that end check if as a teacher, the workshops are empowering you in the teaching of Physical Sciences. You are kindly asked to answer the questions as sincere as possible. DO NOT WRITE YOUR NAME.

NAME OF THE SCHOOL.....

Indicate your answer to the question in the section by putting a tick (x) in the box provided against each answer of your choice.

#### 1. AGE

1.1	30 Years and below	
1.2	31 – 34 Years	
1.3	35-39 Years	
1.4	40 – 44 Years	
1.5	45 – 49 Years	
1.6	50 Years and above	

#### 2. Gender

2.1	Male	
2.2	Female	

#### 3. Teacher Experience

3.1	5 Years and below	
3.2	6 – 10Years	
3.3	11– 15Years	
3.4	16– 20 Years	
3.5	21 Years and above	

#### 4. Qualification (Mark the applicable blocks)

5.1	Standard 10 plus 3 Years diploma	
5.2	Degree	
5.3	Honours Degree	
5.4	Master's Degree	
5.5	Other: Specify	

#### 5. Which class (es) are you teaching?

6.1	Grade 10	
6.2	Grade 11	
6.3	Grade 12	

6. How many times have you attended workshops on equipment training?

8.1	I have not attended any	
8.2	I have attended one only	
8.3	I have attended twice	

**Section: B**

***Teacher Training Workshop Evaluation***

**Before introduction of workshops**

<i>Please rate each item from "Poor" to "Excellent"</i>	Poor	Average	Excellent
1. Organization of workshops			
2. Meeting the purpose			
3. Training content			
4. Enhancement of understanding of the content towards your teaching			
5. Addressing participants' questions during workshops			
6. Appropriateness of hand-outs given in respect of presentations			
7. Achievement of workshop objectives			

Any other comments you have about the previous workshop (s)  
 .....  
 .....  
 .....

***Teacher Training Workshop Evaluation***

**After introduction of workshops**

<i>Please rate each item from "Poor" to "Excellent"</i>	Poor	Average	Excellent
1. Organization of workshops			
2. Meeting the purpose			
3. Training content			
4. Enhancement of understanding of the content towards your teaching			
5. Addressing participants' questions during workshops			
6. Appropriateness of hand-outs given in respect of presentations			
7. Achievement of workshop objectives			

Any other comments you have about the current workshop (s)

.....

.....

.....

.....

.....

**Section C**

***Workshop follow-up***

Please rate each item from “Strongly Disagree” to ‘Strongly Agree’	Strong Disagree	Disagree	Agree	Strongly Agree
1. As a teacher who attended the training, I give feedback to other educators who were not there at the workshop teaching the same subject as requested by the Department				
2. There is a measuring instrument that has been provided by the Department used to check if as teachers we use the information received from training				
3. I use the instrument provided by the Department to check if information and materials received at schools are being used or implemented by teachers and learners				
4. There is an improvement of knowledge and skills which can be linked to us teachers achieving the goal of the training workshops				
5. The Department gives us feedback as teachers after having assesses us about the workshops				
6. I benefit from the DoE’s follow-up evaluation on equipment training I received				

## **APPENDIX B**

### **Semi-structured Interview Schedule**

1. Which criteria were used by the Department of Education to select the teachers for training (if any)?
2. How are the apparatus and materials used in the training compared to the recent supply of apparatus and materials in the schools?
3. How confident were you at school when using equipment you dealt with in training?
4. What specific ideas from the training did you apply in your classroom?
5. What must be done differently if this training could be offered again?
6. Give any 3 specific elements from the workshop you apply in your classroom? Why?

## APPENDIX C

### Teaching and learning session's observation schedule

	<b>Issues given special attention</b>	<b>Highly Satisfactory</b>	<b>Satisfactory</b>	<b>Acceptable</b>	<b>Need Improvement</b>
a	developing analytical abilities				
b	developing critical abilities				
c	developing observation abilities				
d	developing problem-solving abilities				
e	creativity of individuals				
f	science process skill-measuring quantities				
g	science process skill-sorting/classifying				
h	science process skill-inferring				
i	science process skill-predicting				
j	science process skill-experimenting				
k	science process skill-communicating using available apparatus and materials				

## APPENDIX D

### Mean deviation [Current (A) and previous (B) workshop evaluations]

<b>Respondents</b>	<b>Previous (B)</b>	<b>Current (A)</b>	<b>Difference (A – B)</b>
1	2.57	3.00	0.43
2	2.00	2.83	0.83
3	2.00	3.00	1.00
4	2.86	2.67	-0.19
5	2.33	3.00	0.67
6	2.14	3.33	1.19
7	2.00	2.67	0.67
8	2.57	2.50	-0.07
9	3.00	3.50	0.50
10	2.57	3.00	0.43
11	2.29	3.17	0.88
12	2.43	3.00	0.57
13	2.00	3.00	1.00
14	2.00	3.00	1.00
15	2.00	3.00	1.00
16	3.00	3.00	0.00
17	2.14	2.83	0.69
18	2.00	2.33	0.33
19	1.86	1.83	-0.02
20	2.00	2.17	0.17
21	2.29	2.17	-0.12
22	2.29	1.83	-0.45
23	2.00	1.67	-0.33
24	2.00	1.83	-0.17
25	2.33	3.00	0.83
26	2.43	3.00	0.57
27	3.00	2.67	-0.33
28	2.00	2.33	0.33
29	1.86	2.67	0.81
30	2.00	2.17	0.17
31	2.00	2.67	0.67
32	2.00	3.00	1.00
33	2.00	3.00	1.00
34	2.57	2.67	0.10
35	2.29	3.00	0.71
36	2.00	3.00	1.00
37	2.71	3.00	0.29
38	2.00	2.50	0.50
39	3.00	2.83	-0.17

40	2.00	3.00	1.00
41	2.57	3.00	0.43
42	2.00	3.00	1.00
43	2.00	2.67	0.67
44	1.71	2.67	0.95
45	3.00	3.00	0.00
46	2.00	3.00	1.00
47	2.00	3.00	1.00
48	2.00	3.00	1.00
49	2.00	2.67	0.67
50	2.00	2.67	0.67
51	2.00	2.33	0.33
52	2.29	3.00	0.71
53	2.43	3.00	0.57
54	2.14	3.00	0.86
55	1.71	2.67	0.95
56	1.86	2.67	0.81
57	2.00	3.00	1.00
58	2.00	3.00	1.00
59	1.71	2.67	0.95
60	2.00	2.67	0.67

## APPENDIX E

### Minitab Output for t – test for paired samples

#### T-Test of the Mean

Test of  $\mu = 0.0000$  vs  $\mu \text{ not } = 0.0000$

Variable	N	Mean	StDev	SE Mean	T	P
Difference	60	0.5793	0.4792	0.0646	8.97	0.0000

## APPENDIX F

### Minitab Output for Wilcoxon Signed Rank Test for paired samples

#### Wilcoxon Signed Rank Test

Test of median = 0.000000 versus median not = 0.000000

	N	Number Missing	N for Test	Wilcoxon Statistic	P	Estimated Median
Difference	60	0	59	1360.0	0.000	0.5950

## **APPENDIX G**

### **LETTERS USED TO APPLY FOR CONSENT**



**Education and Sport Development**  
Department of Education and Sport Development  
Departement van Onderwys en Sport Ontwikkeling  
Lefapha la Thuto le Tlhabololo ya Metshameko  
**NORTH WEST PROVINCE**

10 Nelson Mandela Drive,  
Mafikeng  
Private Bag X10,  
Mmabatho 2735  
Tel.: (018) 388-1964 / 3383  
Fax: 086 513 9881 / (018) 381-8299  
e-mail: bmonale@nwpg.gov.za  
e-mail: omolete@nwpg.gov.za (Off. Man.)

---

**NGAKA MODIRI MOLEMA DISTRICT**

---

Enquiries S.O. Molete  
Telephone 018 - 388 - 3383

To : Area Managers  
Mahikeng Area Office  
Rekopantswe Area Office  
Ditsobotla Area Office  
Ramotshere Moiloa Area Office

**Attention : School Managers: Science Schools**

From : Mr B.E. Monale  
District Director

Date : 20 November 2015

**Subject : Permission to conduct a research in Secondary Schools**

Permission is hereby granted to Mrs S.S. Seqwe, Student No.: 16956705 a student at North West University who is studying towards a Masters Degree in Education, to conduct a research on **"The impact of teacher development science equipment training workshops in the North West Province – Ngaka Modiri Molema District"** targeting schools, which offer Physical Sciences

The Schools Managers and educators are requested to cooperate with her during this project, not forgetting to adhere to the non-negotiables of the State President.

It is also requested that prior arrangement is made to avoid disruption of marking and production of results

Your cooperation and support in this regard is highly appreciated

Yours in education

  
Mr B.E. Monale  
District Director



---

**"Towards Excellence in Education"**



Private Bag X2046, Mmabatho  
South Africa, 2735

Tel: 018 389-2111  
Fax: 018 392-5775  
Web: <http://www.nwu.ac.za>

The Area Manager  
Bojanala District

Education Leadership Development  
Tel: 018 3892500 (Secretary)  
Email: [gliza.senne@nwu.ac.za](mailto:gliza.senne@nwu.ac.za)

Date: 18/08/15

Dear Sir/Madam

#### REQUEST FOR PERMISSION TO CONDUCT RESEARCH

This is to confirm that Mrs. S.S.K. Segwe (16956702) is a Masters student registered at the North-West University, Mafikeng Campus. The title of the dissertation is: **The Impact of Teacher development Science Equipment Training Workshops in the North West Province in Bojanala District schools.**

Permission is hereby kindly requested to enter Bojanala District schools to collect data from teachers. Data collection will be by way of questionnaire and interviews.

Collection of data will occur outside school contact time so as not to interfere with teaching and assessment processes or office duties. The dates and times of the collections are to be agreed upon by the principal and all other participants.

Participants will participate voluntarily in the data collection. The identity of the participants and the school and Area Office will be kept confidential and anonymous. The information collected therefore cannot and will not be used to evaluate the Area Office/school in terms of its performance in comparison with others, because the information collected will not be about academic results or teachers' teaching performance in specific schools.

Should you enquire more information about the project, kindly contact the supervisor for this project: Dr. Washington T. Dudu (018 389 2833).

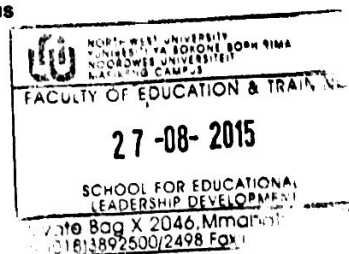
Herewith permission is kindly requested to perform this research in your Area Office. It would be appreciated if you would kindly grant **written** permission to this student. Any assistance given to the student to perform the research will be appreciated.

Yours sincerely

Prof P du Toit

Director: School for Education Leadership Development (School in which the Masters and PhD programme is registered)

Mafikeng Campus





Private Bag X2046, Mmabatho  
South Africa, 2735

Tel: 018 389-2111  
Fax: 018 392-5775  
Web: <http://www.nwu.ac.za>

The Area Manager  
Dr Kenneth Kaunda District

Education Leadership Development  
Tel: 018 3892500 (Secretary)  
Email: [eliza.senne@nwu.ac.za](mailto:eliza.senne@nwu.ac.za)

Date: 18/08/15

Dear Sir/Madam

**REQUEST FOR PERMISSION TO CONDUCT RESEARCH**

This is to confirm that Mrs. S.S.K Segwe (16956702) is a Masters student registered at the North-West University, Mafikeng Campus. The title of the dissertation is: **The Impact of Teacher development Science Equipment Training Workshops in the North West Province in Dr. Kenneth Kaunda District schools.**

Permission is hereby kindly requested to enter Dr. Kenneth Kaunda District schools to collect data from teachers. Data collection will be by way of questionnaire and interviews.

Collection of data will occur outside school contact time so as not to interfere with teaching and assessment processes or office duties. The dates and times of the collections are to be agreed upon by the principal and all other participants

Participants will participate voluntarily in the data collection. The identity of the participants and the school and Area Office will be kept confidential and anonymous. The information collected therefore cannot and will not be used to evaluate the Area Office/school in terms of its performance in comparison with others, because the information collected will not be about academic results or teachers' teaching performance in specific schools

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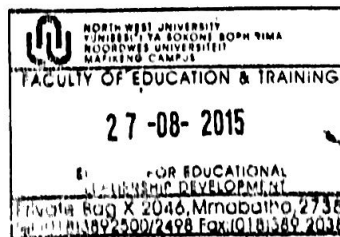
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Mafikeng Campus





Private Bag X2046, Mmabatho  
South Africa, 2735

Tel: 018 389-2111  
Fax: 018 392-5775  
Web: <http://www.nwu.ac.za>

The Area Manager  
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Tel: 018 3892500 (Secretary)  
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Date: 18/08/15

Dear Sir/Madam

**REQUEST FOR PERMISSION TO CONDUCT RESEARCH**

This is to confirm that Mrs. S.S.K. Segwe (16956702) is a Masters student registered at the North-West University, Mafikeng Campus. The title of the dissertation is: **The Impact of Teacher development Science Equipment Training Workshops in the North West Province in Ngaka Modiri Molema schools.**

Permission is hereby kindly requested to enter Ngaka Modiri Molema schools to collect data from teachers. Data collection will be by way of questionnaire and interviews.

Collection of data will occur outside school contact time so as not to interfere with teaching and assessment processes or office duties. The dates and times of the collections are to be agreed upon by the principal and all other participants.

Participants will participate voluntarily in the data collection. The identity of the participants and the school and Area Office will be kept confidential and anonymous. The information collected therefore cannot and will not be used to evaluate the Area Office/school in terms of its performance in comparison with others, because the information collected will not be about academic results or teachers' teaching performance in specific schools.

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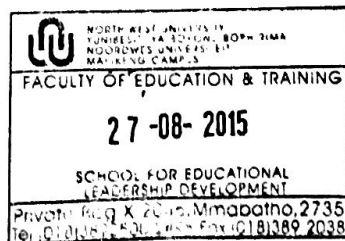
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Yours sincerely

Prof P du Toit

Director: School for Educational Leadership Development (School in which the Masters and PhD programme is registered)

Mafikeng Campus





NORTH-WEST UNIVERSITY  
YUNIBESITHI YA BOKONE-BOPHIRIMA  
NOORDWES-UNIVERSITEIT  
MAFIKENG CAMPUS

Private Bag X2046, Mmabatho  
South Africa, 2735

Tel: 018 389-2111  
Fax: 018 392-5775  
Web: <http://www.nwu.ac.za>

The Area Manager  
Dr. Ruth Segomotso Momphati District

Education Leadership Development  
Tel: 018 3892500 (Secretary)  
Email: [eliza.senne@nwu.ac.za](mailto:eliza.senne@nwu.ac.za)

Date: 18/08/15

Dear Sir/Madam

#### REQUEST FOR PERMISSION TO CONDUCT RESEARCH

This is to confirm that Mrs. S.S.K. Segwe (16956702) is a Masters student registered at the North-West University, Mafikeng Campus. The title of the dissertation is: **The Impact of Teacher development Science Equipment Training Workshops in the North West Province in Dr. Ruth Segomotso Momphati schools.**

Permission is hereby kindly requested to enter Dr. Ruth Segomotso Momphati schools to collect data from teachers. Data collection will be by way of questionnaire and interviews.

Collection of data will occur outside school contact time so as not to interfere with teaching and assessment processes or office duties. The dates and times of the collections are to be agreed upon by the principal and all other participants.

Participants will participate voluntarily in the data collection. The identity of the participants and the school and Area Office will be kept confidential and anonymous. The information collected therefore cannot and will not be used to evaluate the Area Office/school in terms of its performance in comparison with others, because the information collected will not be about academic results or teachers' teaching performance in specific schools.

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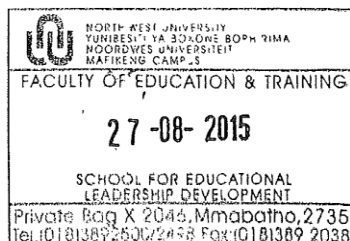
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Yours sincerely

Prof P du Toit

Director: School for Education Leadership Development (School in which the Masters and PhD programme is registered)

Mafikeng Campus



**APPENDIX H**

**CERTIFICATE OF LANGUAGE EDITING**



NORTH-WEST UNIVERSITY  
YUNIBESITHI YA BOKONE-BOPHIRIMA  
NOORDWES-UNIVERSITEIT  
MAFIKENG CAMPUS

Private Bag X2046, Mmabatho  
South Africa, 2735

Tel: +2718 389-2111  
Fax: +2718 392-5775  
Web: <http://www.nwu.ac.za>

School of Teacher Education and Training  
Tel: +2718 389 2451  
Fax: +27  
Email: 22055215@nwu.ac.za

18 August 2015

TO WHOM IT MAY CONCERN

## CERTIFICATE OF EDITING

I, **Muchativugwa Liberty Hove**, confirm and certify that I have read and edited the entire dissertation ***THE IMPACT OF TEACHER DEVELOPMENT SCIENCE EQUIPMENT TRAINING WORKSHOPS IN THE NORTH WEST PROVINCE***

By **SEGWE SUZAN SELINA KELEBOGILE, STUDENT NO. 16956702**

submitted in fulfilment of the requirements for the degree **Master of Education (Mathematics and Science Education)** at the North-West University (Mafikeng Campus).

**Segwe Suzan** was supervised by **Washington T. Dudu** of North-West University.

I hold a PhD in English Language and Literature in English and am qualified to edit academic work of such nature for cohesion and coherence.

The views and research procedures detailed and expressed in the thesis remain those of the authors.

Yours sincerely

**Dr M.L.Hove**

Original details: Dr M.L.Hove(22055215) C:\Users\22055215\Desktop\CERTIFICATE OF EDITING.docm  
18 August 2016

File reference: Dr M.L.Hove

**APPENDIX I**

**TURNITIN REPORT**



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THE IMPACT OF TEACHER DEVELOPMENT IN TERMS OF EQUIPMENT  
TRAINING WORKSHOPS IN THE NORTH WEST PROVINCE

AGUMU MURAN KOLINA SULEBENKHA

STUDENT NO J08070

A DISSERTATION SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF MASTER OF EDUCATION IN SCIENCE AND  
MATHEMATICS EDUCATION AT THE NORTH WEST UNIVERSITY,  
MADIBOLE

APPROVED BY DR. WASHINGTON T. DUDU

AUGUST 2016

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