

**Towards quality science education through quality assurance in  
Johannesburg South district: South Africa**

by

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## DECLARATION

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Exact wording of the title of the thesis as appearing on the copies submitted for examination:

**Towards quality science education through quality assurance in Johannesburg South district: South Africa**

I declare that the above is my work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Signature \_\_\_\_\_ Date \_\_\_\_\_

## **DEDICATION**

I dedicate this thesis to

my wife

**Winnet Hazvineyi Zisanhi**

for her continued understanding and moral support during my studies

and to my son

**Delane T Zisanhi**

for understanding and encouragement that enabled me to accomplish my studies

and my daughter

**Melissa C Zisanhi**

for closing my laptop on numerous occasions to get my attention. These were necessary breaks, thank you.

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## **ABSTRACT**

This study examined the nature of quality assurance frameworks in science education and the factors negatively affecting the quality of science education in the Johannesburg South district. The study explored the quality assurance practices, challenges that impede the attainment of quality science education in schools and the impact of quality assurance on the quality of science education. The Integrated Quality Management System, which encompasses whole-school evaluation, is the main policy used in secondary schools' quality assurance system.

A mixed methodology design was used in the research. The data collected was both qualitative and quantitative and was obtained from both primary and secondary sources. The qualitative data provided research opportunities which extended the type of information collected. It implied an interpretive or subjective approach with the focus being on how the respondents experienced and understood the quality assurance processes. Concurrent triangulation designs or convergent parallel design was used in order to develop a complete understanding of the research problem by obtaining different but complementary data for validation purposes and enhancing triangulation. Quantitative and qualitative data was collected at the same time and the findings were integrated in order to understand deeper the quality assurance mechanisms applied in science education. The use of multiple perspectives, theories and research methods resulted in rich information being gathered for analysis.

The study revealed that quality assurance practices, ranging from Integrated Quality Management System, Whole-school Evaluation and Assessment Quality Assurance among others, had a positive influence on the quality of science education. The results indicated that quality assurance policies and mechanisms present were followed by schools and the district support helped to improve the quality of science education. The presence of quality assurance policies and mechanisms had a positive bearing on the quality of science education. The lack of infrastructural resources, non-availability of laboratory technicians, science educator work overload, parents' non-involvement in academic support, poor learner subject selection criteria and non-rigorous quality assurance follow-up mechanisms were the main factors hindering the quality of science education.

**Keywords:** Quality assurance, quality science education, integrated quality management system, whole school evaluation

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## ACRONYMS AND INITIALISMS

CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
DOE	Department of Education
ECD	Early Childhood Development
ELRC	Education Labour Relations Council
ETQA	Education and Training Quality Assurance
FET	Further Education and Training
GDE	Gauteng Department of Education
GET	General Education and Training
IQMS	Integrated Quality Management System
LTSM	Learning and Teaching Support Materials
NSC	National Senior Certificate
REQV	Relative Education Qualification Value
SAT	School Assessment Team
SAQA	South African Qualifications Authority
SDT	School Development Team
SETA	Sector Education and Training Authority
SGB	School Governing Body
SIP	School Improvement Plan
SMT	School Management Team
SSE	Self School Evaluation
SSIP	Secondary School Improvement Programme
TIMSS	Trends in International Mathematics and Science Study
WSE	Whole-school Evaluation

# CHAPTER 1

## INTRODUCTION AND BACKGROUND: ORIENTATION TO THE STUDY

### 1.1 INTRODUCTION

This chapter covers the introduction, background, problem statement, limitations, delimitations, ethical considerations and chapter organisation. The significance of and the motivation for conducting the study are discussed. Mathematics and science competencies are very important for a nation since technological innovations are driving global competitiveness such that people with mathematical and scientific skills become extremely important for accelerating growth (Reddy, Visser, Winnaar, Arends, Juan & Prinsloo, 2016). The continued skills shortage, especially in the scientific and engineering fields, prompted the researcher to look at the supply industry for colleges and universities, namely the schools. There is an acute shortage of scientific-oriented professionals such as engineers, technologists, skilled artisans, technicians, doctors and chartered accountants in South Africa (South Africa, 2008:8-9). Research has shown that there is some degree of proportionality between failure in science at matriculation level and projections of the number of scientific professionals, thus affecting South Africa's development (Madibeng, 2006:1; South Africa, 2008:9). Underachievement in science at secondary school level is seen as a threat to South Africa's development (Muzah, 2011:2; Cameron, 2009:16). The current situation is that the quality of education for black children is still largely poor, which means that employment, earning potential and career mobility are reduced for these learners. This in itself limits the growth of the South African economy, hence there is pressure on the factor to turn around the situation (DBE, 2015:28).

The high failure rate in science and mathematics and the current slight improvements in quantity and not necessarily in quality as in the 2013 Grade 12 science results, especially in the Gauteng province in South Africa, all stimulated the researcher's interest in this topic. A high failure rate in science in Grade 12 has resulted in the subject being an unpopular choice, with fewer learners choosing to take the subject at FET (South Africa, 2008:8-9). The Department of Basic Education (DBE) agrees that

its internal assessments and the international benchmarking assessments confirm that progress was made in access, equity and redress but not necessarily in quality, therefore their emphasis will be on attaining quality (DBE APP, 2015 16:6). Since current practices are not helping the Department in its attempt to gain public confidence there is a need for guidelines for the school-based quality assurance of assessment (Maile, 2013:26). The importance of mathematics and science in social and economic development requires the country to measure and monitor its learners in these key subject areas, thus helping to assess the quality of the education system (Reddy et al., 2016). It is necessary to do further research to show that the improvements in South Africa's science results are both in quantity and quality. This study also attempted to establish whether these passes were directly linked to quality assurance and control/monitoring mechanisms that were introduced by the DBE.

The Minister of Basic Education, Angie Motshekga (2011), pointed out that the ANA results clearly demonstrated that educators needed an effective monitoring and evaluation system through which the quality of education can be continuously enhanced. The Minister thus admitted that the quality of education in South Africa is a cause for concern. According to Maile (2013):

“The disillusionment with the quality of certificates necessitates an investigation on the quality assurance mechanisms of the South African education system.”

Restoring confidence in the public education system requires that quality assurance systems operating at school level be consolidated (Maile, 2013:16).

The most commonly used term when considering the quality of education is “quality assurance”. Spaul (2013:6) defines quality assurance as the planned and systematic action necessary to ensure that the education provided by schools meets the expectations of the stakeholders and is relevant to the needs of a country. The quality assurance framework, according to Jansen (2011), provides indicators of good practice against which schools can measure their performance. Indicators are statements of the results, goals and behaviours which a school must demonstrate for excellent delivery. They can be measured both qualitatively and quantitatively. The

curriculum management model from the Department of Education (DOE) asserts that the functionality of schools is determined by their academic performance (CMM, 2016:2). Schools must have effective measures to manage, monitor and support the curriculum in all grades in the school. CMM (2016:4) further states that the effective management of the curriculum is directly linked to the performance of the learners and the results of the school.

According to the DBE (2011) technical report, teacher development support structures and functions must be improved and better coordinated among the national, provincial, district and school levels, and should also involve higher education institutions (DBE, 2011:14). There are no support mechanisms in place or, if present, they may not be properly followed or monitored, as revealed by the technical report. Furthermore, there is an urgent need to improve the ability of department officials to support educators by filling vacant posts and ensuring that the numbers of trained support staff are adequate to the number of schools, and should also take into account district size (DBE, 2011:14). This must be accompanied by clarifying and standardising staff locations, functions and responsibilities within and across provinces, eliminating overlapping and duplicated functions, providing better training and support for subject advisors and other district staff, and building relationships between and among schools and district officials (DBE, 2011:14). District quality assurance processes therefore have a huge role in helping schools to achieve quality science results.

The quality of the national results in Physical Sciences is a cause for concern. An analysis of the 2015 results in Physical Sciences of one district is shown in Table 1.1 below. Motivation for the selection of this district and the selected schools as well as the sample is given in Chapter 4, section 4.5.

**Table 1.1 Summary of district Physical Sciences results 2015**

	Number attained								Subject average	Cluster pass percentage	
	0-29.99	30-39.99	40-49.99	50-59.99	60-69.99	70-79.99	80-89.99	90-100			
Cluster 1	95	81	70	60	46	26	9	3	<b>44.5</b>	<b>75.6</b>	
Cluster 2	186	147	94	83	71	50	24	11	<b>44.1</b>	<b>72.2</b>	
Cluster 3	69	80	62	47	42	32	21	8	<b>48</b>	<b>80.6</b>	
Cluster 4	107	67	51	31	24	15	7	3	<b>33.1</b>	<b>64.9</b>	
TOTAL	457	375	277	221	183	123	61	22	<b>42.4</b>	<b>73.4</b>	
	1 109			610					<b>1 719</b>		
<b>DISTRICT SUBJECT AVERAGE: 40.1</b>					<b>DISTRICT PASS PERCENTAGE: 73.4</b>						

Table 1.1 shows that a total of 1 719 learners sat for the examinations. Only 610 learners obtained quality results (50% and above), representing 35,5% of the learners. Of those who had 50% and above the highest percentage (38%) came from cluster 2; cluster 4 obtained the lowest (13%); cluster 3 provided 25%, which was almost equal to cluster 1 with 24% of the learners with quality results. There is a need to investigate why the majority of learners obtained poor results (below 50%) as this is a better representation of the status of science in the country. Cluster 1 and 2 are composed of schools that service average to poor communities (quintile 1, 2, 3 and 4), cluster 3 serves medium to affluent communities (quintile 4 and 5), while cluster 4 serves city centre communities and consists of private colleges and independent schools, which are not classified under quintiles. Most schools in cluster 3 are former Model C schools, which have good infrastructure and are well-resourced. Cluster 2 has mixed schools, although the majority can be referred to as serving medium to poor communities based on quintile classification (where there is a sliding scale from quintile 1 schools, serving the poorest communities, and quintile 5, serving affluent communities).

Despite its poor results cluster 2, which serves relatively poor communities, produced the largest number of learners with quality results (above 50%). The majority of the schools in cluster 2 are public schools, which do not have adequate resources and infrastructure compared to former Model C (well-resourced) schools. From the

researcher's experience in this district some quality assurance mechanisms had been put in place that assisted this cluster in producing quality results. The challenges that prevented the attainment of quality results also need to be investigated. These challenges are the focus of this study.

Schools and districts are graded as achieving, not achieving or underperforming based on the results of the National Senior Certificate (Grade 12) examinations (Muzah, 2011:2), therefore most schools and districts may concentrate only on Grade 12 to the detriment of the other grades, as pointed out below:

“The learner performance is increasing each year in Grade 12 and fluctuating in Grade 10 and 11. The downfall of the Grade 10 and 11 results could be as result of a greater focus which was given to the Grade 12 class of 2015” (Johannesburg South Subject Strategy, 2016:6).

The assumptions of this study are that, if there are quality assurance policies and mechanisms at every stage, level and grade, there will be no possibility of neglect of any grade or level. The study further assumes that if schools and institutions implement quality assurance processes and quality standards in science, the outcomes will be quality science education. This study therefore focuses on the policies, processes and mechanisms put in place by schools to move towards quality, as well as the actual practices and challenges impeding the attainment of quality science education.

## **1.2 THE AIM OF THE RESEARCH**

The purpose of this study was to map out the role of quality assurance in science education and the factors impeding the quality of science education using one South African district in Gauteng. This thesis examines the nature of quality assurance in science education frameworks and the factors that negatively affect the quality of science education in South Africa. The thesis also explores the impact of the current quality assurance system on science education in cluster 2 of Johannesburg South. The aim was achieved through the following objectives:

- to explore how quality assurance influences the quality of science education in secondary schools in the Johannesburg South district
- to identify the factors that negatively affect the quality of science education in secondary schools
- to examine what mechanisms have been introduced in the South African education system to promote quality science education
- to understand how secondary schools manage quality assurance in science education
- to propose a quality assurance framework that ensures quality science education achievement in South Africa.

### **1.3 MOTIVATION FOR THE RESEARCH**

International benchmark studies, which include SACMEQ (South African Consortium for Monitoring Education Quality), TIMSS (Trends in International Mathematics and science Study) and PIRLS (Progress in Reading Literacy Study), have all revealed major gaps in the quality of the South African schooling system. One quotation from TIMSS clearly shows that despite improvements South Africa is still experiencing low performance in mathematics and science:

“South African mathematics and science achievement scores have improved from a ‘very low’ (1995, 1999, 2003) to a ‘low’ (2011, 2015) national average. South Africa is still one of the lower performing countries in mathematics and science in comparison to other participating countries” (Reddy et al., 2016:15).

Research shows that quality assurance in education mainly focuses on public higher education, like universities and colleges, locally and internationally. Limited research is available on the actual experience of the public secondary education and even less in specific areas like science education. Most of the literature focuses on the experience from the quality assurer’s perspective (Baumgardt, 2013). This study seeks to present education stakeholders and quality assurance bodies with a picture of the

experience of the implementers of quality assurance science education, thus providing some input into future specific policy development.

For many years the South African education system has had only one credible objective measure of learner performance: the National Senior Certificate (generally known as matric) examination at the end of Grade 12 (DBE, 2011:20). This emphasis on quantity has brought a trade-off between quality and quantity. Quality education in terms of skills, literacy and numeric levels of competency continues to decline. The increase in the number of learners who pass Grade 12 amid poor quality offers no solution to the needs of our country. Some authors launched criticism on the matric pass rate, saying that it is deceptive, consigning thousands to a life that promises neither further education nor employment, and they stressed that quality counted (Ramphela, 2012:1; Bernard, 2000).

Due to pressure exerted by political leaders in haste to realise the success of their policies, the schooling system has not been able to focus on improving quality education rather quantity. Furthermore, the 30% pass in most learning areas has been labelled as degrading education standards and is used for political purposes (Ramphela, 2012:1).

#### **1.4 RESEARCH QUESTIONS**

The main research question of this study was:

- How does quality assurance influence the quality of science education in Johannesburg South secondary schools?

The following sub-questions were therefore considered essential to evaluate the role of quality assurances in determining the quality of science teaching and learning in the selected schools:

- What are the factors impeding the quality of science education in secondary schools?

- What mechanisms have been put in place in the South African education system to instil quality science education?
- How do secondary schools manage quality assurance in science education?

## **1.5 THE SIGNIFICANCE OF THE STUDY**

In recent years, public confidence in the quality of public secondary education has decreased significantly due to an increasing number of public secondary schools in the country producing poor Grade 12 results coupled with pass rates being calculated at a base of 30 or 40 percent (Jansen, 2014). There is an absence of a comprehensive quality assurance system in the South African education system. Furthermore, there is a paucity of research on quality assurance in the basic education of South Africa (Jansen, 2011). There is a need to restore confidence in the public education system through consolidation of quality assurance systems operating at school level (Maile, 2013:29).

This study clearly showed the status of quality assurance systems in secondary schools, the extent to which the policies were being implemented, the type of standards used to assure the quality of science education and the role of quality assurance in improving education in secondary education institutions. The study analysed the policies on quality assurance being used by the DBE. The current policy strives for equality and equity, however, it is failing to aggressively address the inequalities of the past (DBE APP, 2015-2016). Maile (2013) argues that the introduction of outcomes-based education (OBE), the national curriculum statement (NCS) and now curriculum and assessment policy statement (CAPS) should have been accompanied by the corresponding tools of implementation and quality assurance. These changes in the curriculum erode the knowledge that educators have, thus reducing their confidence and morale. While educators attempt to master the new changes before confidently implementing what the curriculum requires, a new set of changes are effected (Maile, 2013:26).

Understanding the curriculum demands should have informed educators to reconsider their teaching styles, hence the first beneficiary of this study will be the educational

providers, educators and quality assurers. Maile (2013) further states that the intricate problems of curriculum changes imply that schools operate without the necessary knowledge and this does not help to have a good curriculum when those at the implementation level are not trained. The significance of this study lies in its attempt to alert the DBE to the loopholes affecting the possibility of providing quality science education to all South Africans regardless of their race, colour or background. This is intended to influence the Department to appropriate specific directed quality assurance programmes in education. The researcher believes that the study can provide information to the public about the status of the quality assurance system of public secondary institutions and enable them to take remedial action to improve the system. Ultimately the study proposes a quality assurance framework that can ensure the achievement of quality science education in South Africa.

## **1.6 LITERATURE REVIEW**

### **1.6.1 Definition of quality in education**

“Quality assurance” is a term that is new in education, but that has rapidly become very important (Allais, 2009). In nearly all countries governments have some responsibility for education. This has led to the introduction of quality assurance as an important part of the organisation of education systems (Allais, 2009). Quality has become one of the most popular words of the early twenty-first century. The concept of quality in education is multifaceted in nature (UNESCO, 2000). “Quality” can be a relative concept. It is not an end in itself but is a means by which the end product is judged to be up to the standards. Quality consists of meeting learners’ needs, requirements and standards. Its definition depends on the perception and varies from situation to situation. Despite the immense and intense call for quality in various educational programmes all over the world, there is little agreement on what quality itself means and what indicators are to be used to measure it.

The literature on education does not clearly define what educational quality is, although there is a general understanding that education systems worldwide are always structured around a common vision of quality or standards (Leu & Price-Brom, 2005). The terms efficiency, effectiveness, equity and quality have been used synonymously

where quality instruction builds from existing mental frameworks (Adams, 1998). UNICEF (2002b) defines quality education using five key dimensions, namely what learners bring, environments, content, processes and outcomes. UNICEF (2002b) also emphasises that the definition encompasses education for human security, community development and national progress. Quality cannot be determined by the test scores or the learners' results only. Serbessa (2006:5) notes that the concept of educational quality is complex and multidimensional.

### **1.6.2 The concept of quality assurance and its definition**

Quality assurance refers to the mechanisms, set of activities and procedures adopted by a provider to assure a given quality or a continued improvement quality (Robinson, 1995:123). It involves planning, defining, encouraging, assessing and improving practice. It encompasses concepts such as standards, excellence, value for money, fitness for purpose and meeting stakeholders' needs. It is the process through which a provider assures itself and its stakeholders that it consistently reaches the highest standards possible in all aspects of activities. In the context of accountability, quality assurance is used as a mechanism to monitor performance. High standards are demanded from providers by learners, graduates, employers and the public at large. Quality assurance is a key tool in the educational process of providers ensuring that they fulfil the demands and needs of the society (IIPE, 2010; Madden, 2008; NAAC, 2007).

### **1.6.3 Debates in quality assurance**

Allais (2009) presents some of the debates in quality assurance illustrated below. One of the criticisms of total quality management systems is that they lead to an organisation putting all its energy into compliance, in order to obtain accreditation with one of the total quality management systems, instead of thinking creatively and consciously about quality. Linked to this is the criticism that many of the available total quality management systems are very time-consuming and complex.

The second criticism according to Allais (2009) goes as follows:

“We don’t trust institutions to judge themselves, so we want someone to check up on them. But how do we know we can trust those doing the checking up? Do we have auditing bodies to audit auditing bodies? Can there be inspectors of inspectors? Where does it stop? Who decides if a total quality management organisation is appropriately using its own total quality management system, or if it is making correct judgments about other organizations’ use of total quality management systems?”

Since quality assurance in education is relatively new, very little research has been done on its effectiveness. Those in favour of quality assurance sometimes assume that it will improve quality because that is what it is designed to do. However, good intentions do not always lead to the desired objective, and sometimes good intentions have undesired consequences. One of the criticisms of quality assurance systems is that they are complicated and costly for educational institutions to implement. For example, total quality management systems involve subscription costs (to the auditing body that manages the system), and often involve very time-consuming activities in order to comply with the audit criteria. Government organisations or other regulatory organisations that accredit educational institutions often want very specific information presented in a very specific way, and it can take a great deal of time for educational institutions to provide this. Similarly, educational institutions can find themselves forced to spend a large amount of time and energy preparing for audits by quality assurance organisations (Allais, 2009).

#### **1.6.4 Internal and external quality assurance**

According to Martin and Stella (2007:41), different quality assurance agencies use the term “external quality assurance” to denote different practices to serve various purposes, and they exercise the responsibility of carrying out quality assurance in various ways. There are two types of quality assurance systems, namely internal and external. Internal quality assurance ensures that an institution or programme has policies and mechanisms to make the attainment of its own objectives and standards possible. External quality assurance is performed by an organisation or quality assurance agency from outside the institution. The organisation assesses the

operation of the institution or its programmes in order to determine whether they meet the agreed upon or predetermined standards (CHE, 2008:8; Sanyal & Martin, 2007:5).

## **1.7 THE RESEARCH METHOD**

The study followed a descriptive survey design to investigate the research problem. The exploration and description of a case take place through detailed, in-depth data collection methods, involving multiple sources of information that are rich in context (De Vos et al., 2005:272). Furthermore, De Vos et al. explain that a case being studied may refer to a process, activity, event, programme or individual or multiple individuals, and might even refer to a period of time rather than a particular group of people (De Vos et al., 2005:272). The detailed in-depth data collection methods used in this study include interviews, document analysis and questionnaires (De Vos et al., 2005:272). De Vos et al. (2005:272) note that there are three types of case study, namely intrinsic, instrumental and collective case studies. The intrinsic case study is solely focused on the aim of gaining a better understanding of the individual case. The instrumental case study is used to elaborate on a theory or to gain a better understanding of a social issue. The collective case study furthers the understanding of the researcher about a social issue or population being studied. A case study follows the logic of the experiment rather than the logic of the survey, therefore it is not necessary to repeat a case study (Yin, 2008).

Yin (2008) recognises that when a case study is being conducted, the collection procedures are not routinised, therefore case study choice of design is ideal if the setting being observed is a specific environment with the unique event. In this study, a case study refers to a process, activity, event or programme whereby the researcher gains a better understanding of an issue or the population being studied within a specific time and setting.

A mixed methodology design was used. The research data collected during the research was both qualitative and quantitative. This type of data is suitable because qualitative methods provide research opportunities which extend the type of information that can be collected. It implies an interpretive or subjective approach with the focus being on how the respondents experience and understand the particular

situation. Quantitative data was gathered to support the quantifiable data for analysis of the quality assurance mechanisms in science education. The use of multiple perspectives, theories and research methods has been seen to be a strength in educational research and the combination of quantitative and qualitative research methods as complementary (Johnson & Christenson, 2008:51). There is, however, a need to consider the fundamental principles of research, which implies that it is wise to collect multiple sets of data using different research methods and approaches in such a way that the resulting mixture or combination has complementary strengths and no overlapping weaknesses (Johnson & Christenson, 2008).

Quantitative research is associated with social survey techniques such as structured interviewing questionnaires, self-administered questionnaires, experiments, content analysis and the analysis of official statistics. Qualitative research, on the other hand, is typically associated with participant observation, semi- and unstructured interviewing and discourse analysis.

### **1.7.1 Interviews**

Interviews are defined as methods of data collection that involve seeking open-ended answers related to a number of questions, topic areas or themes (O'Leary, 2005:113). Interviews help the researcher to go out and actually talk to real people, asking them what they think and obtaining first-hand information on how they genuinely feel. When researchers conduct interviews, they are able to put themselves in a position to see, hear and get a sense of their participants. Interviews provide the relatively systematic collection of data and, at the same time, ensure that important data are not forgotten (O'Leary, 2005:114).

Interviews were conducted with quality assurance, IQMS, science officials and deputy principals involved in science quality planning, monitoring and implementation. More information was gathered through questionnaires from school management teams (SMTs), i.e. science heads of department (HODs), deputy principals, school governing body (SGB) representatives, school integrated quality management system (IQMS) and school assessment team (SAT) coordinators at the purposefully chosen schools in Johannesburg South cluster 2. Informal interviews and/or questionnaires were given

to science educators and SGB members in secondary schools in the Johannesburg South district.

### **1.7.2 Questionnaires**

A questionnaire is a set of questions on a form to be completed by the respondent in respect of a research project. It will probably contain as many statements as questions, especially if the researcher is interested in determining the extent to which respondents hold a particular attitude or perspective (De Vos et al., 2005:166). A questionnaire aims at obtaining facts and opinions about a phenomenon from people who are informed on the particular issue (De Vos et al., 2005:166). Questionnaires were designed and given to science HODs, deputy principals, SMT members, science educators and SGB members.

### **1.7.3 Documents**

Official documents like results, quality assurance documents and results analysis were used to check for the quality of the results since the inception of science quality assurance programmes in the Johannesburg South District. Artefacts of present day groups and educational institutions may take three forms: personal documents, official documents and objects (McMillan & Schumacher, 2010:361). A personal document is any first person narrative that describes individual action, experiences and beliefs. Personal documents include diaries, personal letters and anecdotal records. Anecdotal records include logs, journals and notes on lesson plans or the parent's development record of a child. Official documents include memos, minutes of meetings, working papers and drafts of proposals. They describe functions and values and how various people define the organisation (McMillan & Schumacher, 2010:361).

## **1.8 THE LIMITATIONS OF THE STUDY AND KEY ASSUMPTIONS**

The study was limited to the role of quality assurance in secondary schools of South Africa. The study covered only a single district of the Gauteng Department of Education in terms of the quality assurance practices and specifically in the science learning areas. It is beyond the scope of this study to cover quality assurance in other learning

areas and at primary or higher education institutions. The assumption of quality science education was based on an input and output theory. There was, however, a need to ascertain the impact of quality assurance on science education. The study was also limited to performance criteria and indicators mainly from the monitors and implementers of the quality assurance policies and not the perspectives of the policy formulators.

## **1.9 ETHICAL CONSIDERATIONS**

Since the research was both qualitative and quantitative in nature there was the anticipation of personal intrusion, thus ethical considerations were prioritised. Policies regarding informed consent, deception, confidentiality, anonymity, privacy and caring were adopted. The research design not only involved selecting participants but adhering to research ethics.

### **1.9.1 Informed consent**

To gain permission participants signed the protocol for informed consent. They chose the time and place of the interviews to establish trusting relationships and handle the dialogue. The time required for participation was non-interfering, while the interviews were conducted in the natural setting (McMillan & Schumacher, 2010).

### **1.9.2 Confidentiality and anonymity**

The settings and participants were disguised so as to appear similar to several possible places. People and places given code names where anonymity was required. There was a dual responsibility to protect the individual's confidences from other persons in the setting and to protect the respondents from the general reading public. In the survey research there was a dissociation of names from responses during the coding and recording process (Creswell, 2013).

### **1.9.3 Privacy and empowerment**

There were negotiations with participants so that they might understand the power that they had in the research process. The power of mutual problem solving was used. Participants were informed that these results would not be an exchange for their privacy if they participated in the study (Lincoln, 1990). All participants were also informed about their choice in terms of withdrawal from participation at any time.

### **1.9.4 Caring and fairness**

Open discussion and negotiations were carried out to promote fairness to participants and to the research enquiry. A sense of caring and fairness was part of the researcher's thinking, actions and personal morality in the research (McMillan & Schumacher, 2010). Detailed information on the research design and methods used to collect and analyse data for this study is given in Chapter 4.

## **1.10 DEFINITION OF TERMS**

A number of terms used in this thesis need to be explained.

### **1.10.1 Quality science education**

Quality science education according to Xanthoudaki (2010:38-39) means providing effective contexts and policy frameworks, taking into account learner and educator influence and perceptions about science and finally encouraging, developing and fostering cooperation between formal and informal learning environments. Quality science education is accompanied by quality science learning, teaching and pedagogy in this study.

### **1.10.2 Quality assurance**

Quality assurance (QA) is a proactive approach which attempts to identify problems and deal with them immediately, or prevent them from happening at all. It is a second phase of quality control (QC), a reactive approach which identifies a weakness or non-

compliance and endeavours to correct it, ensuring it will not happen again in the area that the damage has been done (Doherty, 2012:75). Quality assurance in this thesis is a generic term used as shorthand for all forms of internal and external quality monitoring, evaluation or reviews and is defined as a process of establishing stakeholder confidence whose provision (inputs, processes and outcomes) fulfils expectations or measures up to the minimum requirements. At the institutional level, quality assurance is generally defined as that aspect of the overall management function that determines and implements the quality policy (Martin & Stella, 2007:34).

### **1.10.3 Science**

“Science” in this study refers to the following three subjects namely Life Sciences, Physical Sciences and Natural Sciences. In South African secondary schools Life Sciences and Physical Sciences are done at the Further Education and Training (FET) level, Grade 10 to 12. Physical Sciences comprise Physics and Chemistry, and focus on investigating physical and chemical phenomena through scientific enquiry by applying scientific models, theories and laws so as to predict events in the physical environment. Life Sciences involve the study of life processes and living things, also known as Biology. Natural Sciences in South Africa is a subject done at primary and lower secondary General Education and Training (GET) level and comprises general physics, chemistry, biology and geography. This study, however, focused only on Physical Sciences and Life Sciences in ordinary public schools in South Africa.

### **1.10.4 The science learner**

A science learner generally refers to Grade 8 and 9 Natural Sciences learners and Grade 10, 11 and 12 learners who are studying Physical Sciences and/or Life Sciences as the subject of choice in South African public high schools. This study focused only on Physical Sciences and Life Sciences learners who are in the Further Education and Training (FET) band, from Grade 10 to Grade 12 in South Africa.

### **1.10.5 Quality performance**

In the context of this study, quality performance in schools encompasses the full range of activities that would characterise a school as achieving certain internal and external set standards. In addition to academic performance, it also includes well-motivated and committed educators, learner satisfaction and involvement, parental involvement, a clean and orderly school environment, and strong principal and school management team (SMT) leadership. The definition encompasses a wider range of activities than merely academic performance in terms of pass rates and success in national examinations. The term “poor quality” is, however, relative, but in this study emphasis was on the output or exit level matric results in science (Life Sciences and Physical Sciences). This is the measurable outcome mainly used by the DOE and institutions when selecting students for university, college intakes and job markets. Quality results in this study refers to the 50% mark and above and low/poor quality refers to marks of 49% and below.

### **1.10.6 Annual National Assessment (ANA) and Trends in International Mathematics and science Study (TIMMS)**

ANA and TIMMS refer to a standardised assessment programme used to assess competency levels in numeracy and literacy in Grades 3, 6 and 9. TIMSS was developed by the International Association for the Evaluation of Educational Achievement (IEA) to allow participating nations to compare learner educational achievement in mathematics and science across borders. In this study ANA, TIMMS and matric results are used as a measure to determine the quality of education that learners in South Africa receive.

## **1.11 SUMMARY OF CHAPTERS**

The chapters in the thesis are organised as set out below.

### **Chapter 1: Orientation to the study**

This chapter deals with the introduction, background, problem statement, limitations, delimitations, ethical considerations and definition of terms. The significance of and the motivation for conducting the study are discussed.

## **Chapter 2: Literature review (1)**

This chapter concentrates on the reflections of authors and scholars regarding the role of quality assurance in education. It starts by conceptualising and explaining the meanings of the key terms in the study, quality assurance and quality science education. The second aspect is to discuss the theoretical underpinnings that guided the study. TQMS theories and the Systems theory are explained and linked to science quality education and quality assurance. The chapter also looks at the nature of quality assurance policies, and their implementation and shortcomings.

## **Chapter 3: Literature review (2)**

This chapter further reviews the literature specifically on the challenges faced by science education in a South African context. The steps taken to achieve quality science education are examined. Particular attention is paid to science education and the reasons for the poor results in science in South Africa. Quality assurance in science education is also critically examined.

## **Chapter 4: Research design and methodology**

Chapter 4 deals with the research design and methodology employed in the study. The motivation for conducting the study is also explained. Population, sampling, sampling techniques, data collection instruments, data analysis and reliability and validity modalities are also discussed. Three approaches were employed in collecting data, namely interviews, questionnaires and viewing of documents.

## **Chapter 5: Presentation and interpretation of the findings**

Chapter 5 focuses on the presentation, analysis and interpretation of the findings. A brief description of the setting and the participants is provided. Participants' responses to interview questions, the questionnaires and their views on the role of

quality assurance in quality of science education are presented, analysed and interpreted. Chapter 5 is devoted to the interpretation of the data and findings from the surveys. The interpretation of the research findings is discussed in accordance with the specific objectives and theoretical framework.

## **Chapter 6: Summary, recommendations and conclusions**

Chapter 6 presents the summary of the findings as supported by empirical evidence and the literature review. The conclusions regarding the benefits of educational quality assurance in science and the factors leading to poor quality science education in South Africa are discussed.

## **Chapter 7: Proposed quality assurance framework for the attainment of quality science education**

Chapter 7 proposes a quality assurance framework that would ensure the attainment of quality science education. The proposed framework was formulated from the literature search and the empirical evidence gathered.

### **1.12 CONCLUSION**

Chapter 1 provided the background information for the research, the introduction and the research problem. The emerging trends and current status in education quality assurance in South African education and worldwide were highlighted, as well as the challenges. The concept of quality assurance in education, as depicted in the literature, was outlined. The terms used in the study were also defined in this chapter. A description of the research problem, the justification of the study, the purpose statement, research objectives and research questions were also stated. A brief description of the research methodology and design was provided. The scope and limitations, key assumptions and ethical considerations were also outlined. Finally, an outline of the chapters in the thesis was given.

## CHAPTER 2

### LITERATURE REVIEW (1): QUALITY ASSURANCE IN EDUCATION

#### 2.1 INTRODUCTION

This chapter concentrates on the reflections of authors and scholars regarding the development and role of quality assurance in education. The chapter begins by laying out the theoretical underpinnings that guided the study. This is followed by conceptualising and explaining the meanings of the terms central to the study, namely quality assurance, integrated quality management system and quality science education. The chapter also looks at the current quality assurance practices and policies, and their implementation by the Department of Basic Education (DBE) in South Africa, as well as their shortcomings

The questions the author had when starting this research were influenced by Allais (2009:9), where the following questions were posed: “What exactly is quality assurance? Why do we need it? Does it really improve quality? Is quality assurance in education something different from quality assurance in general?” Quality assurance is a multidimensional concept for which many definitions are given. Research suggests that it is widely accepted that quality assurance is the means by which an institution confirms to itself and to others that conditions are in place so that it may achieve the standards set for it internally or externally.

In the South African context Bischoff et al. (2007:40) remark that the Department of Education’s quality assurance initiative of the Integrated Quality Management System (IQMS) clearly shows that there is a need to develop unique quality assurance systems within the schools where implementers are involved in order to improve quality.

“Any system of evaluation is only as good as the people who design and implement it.”

Bischoff et al. (2007) assert that teacher evaluation systems should be designed and implemented in the schools where learning occurs. Since IQMS was designed beyond the realm of each school there are high chances of dissonance as it is evaluated from outside the school.

“The role of the principal in the implementation of IQMS is not as straight forward as it is spelt out in the policy documents. Principals need to study both the design and implementation criteria of teacher evaluation systems critically. They also need to take cognisance of the role that parents and the district have to play during quality assurance initiatives in schools” (Bischoff et al., 2007:40).

## **2.2 THE THEORETICAL FRAMEWORK UNDERPINNING THE STUDY**

In this study the total quality management (TQM) theory and systems theory were used as the guiding theoretical frameworks. A number of scholars contributed to the TQM theory. The most notable are Philip Crosby, Joseph Juran and Edwards Deming. Crosby's theory emphasises the need for the continuous improvement of the quality of products and services where it is worthwhile to spend money on quality. Joseph Juran's theory gave birth to the quality trilogy, which emphasises quality planning, quality improvement and quality control, and that there should be careful planning and controlling (Powell, 1995). Finally Deming's theory views TQM as a model for the continuous improvement of the quality of the production of goods and services, originally used in manufacturing companies.

### **2.2.1 Deming's theory on total quality management**

Deming's theories are based on the concept that continuous improvement can help increase quality while at the same time decrease costs. Total quality management theory is mainly used in the business world, where it focuses on the satisfaction of the customer. In education, quality is assigned to learner achievement, of which the learner is the customer. Deming proposed fourteen points of TQM, which he argued can be applied to small and large organisations, service and manufacturing industries, or even divisions within a company (Deming, 1986:23). This approach can therefore be applied

to education, where TQM can improve the quality of education in a number of areas like physical resources, curriculum, staff development and learner performance (Hayward, 1999:i-ii; Cotton, 2001:13). Quality is related to the continuous improvement of processes and the product or service to keep pace with changing customer demands (Deming, 1986:31).

### **2.2.1.1 Deming's fourteen points on TQM**

According to Deming (1986) TQM consists of the following fourteen points.

#### **i) Create constancy of purpose for improving products and services**

Every educational institution should strive towards excellence through reflecting on its purpose, then strive to improve the areas of weakness; consequently products and services will also improve. The quality of education offered should be constantly quality-assured to ensure that learners as products of the education system enter meaningful positions in society.

#### **ii) Adopt the new philosophy**

The role of management in implementing quality is of the utmost importance. In the context of this study the school management should approach all stakeholders in a manner that would help them to embrace any new philosophies that strive for quality.

#### **iii) Cease dependence on inspection to achieve quality**

Inspection is taken as fault-finding missions which in many cases is not embraced by workers. In science strict adherence to certain practices with no option of flexibility would negatively affect quality.

- iv) End the practice of awarding business on the basis of price tag alone. Instead, minimise total costs by working with a single supplier**

The practice of publicising and emphasising examination results as a measure of quality must be shifted to the rear. The focus should be on all other skills gained by learners throughout their years of learning. Lasting relationships between schools and learners should be factored in as part of quality results.

- v) Improve constantly and forever every process for planning, production and service**

At every stage, level or phase there should be monitoring and checking of quality so as to improve the processes taking place. Quality assurance should therefore take precedence in education circles. The pursuit of quality should be a continuous effort undertaken by all stakeholders in the organisation.

- vi) Institute training on the job**

Quality assurance mechanisms should be able to identify the training needs of educators. In many countries finding highly qualified science educators is a huge challenge, therefore if poorly qualified educators are already in the system the priorities should be on training them while on the job.

- vii) Adopt and institute leadership**

Institutions require proper leadership that drives all relevant quality policies into action. Principals and SMTs in schools should work in unison with the Department's vision and appeal to all stakeholders to work together towards a certain goal.

- viii) Drive out fear**

Learners may have a fear of failure. The tension that goes with the examinations may drive learners away from school, leading to an undesirable waste of resources and failure by the school in creating the best quality learners.

Since quality does not necessarily imply high cost, schools can still realise quality from the available resources. All that is needed is that staff be trained to be resourceful and creative and make the best out of their environment.

**ix) Break down barriers between staff areas**

School authorities should work hard to develop a conducive, open climate that will instil a sense of security among both learners and staff.

**x) Eliminate slogans, exhortations and targets for the workforce**

Exhortations create conflict and, at any rate, a larger proportion of problems is attributable to faulty systems rather than individuals.

**xi) Eliminate numerical quotas for the workforce and numerical goals for management**

**xii) Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system**

Multiple ways of recognising quality attainment by both learners and educators should be available in schools. The criteria of pass rates and without looking at some values inculcated into learners and the skills they have gained would definitely rob them of pride of workmanship in schools.

**xiii) Institute a vigorous programme of education and self-development for everyone**

Educators need to develop themselves to match the changes in the global trends. New information and technological advancements should be embraced by all.

**xiv) Take action for everybody in the company to work accomplishing the transformation**

Transformation towards realising quality in any organisation is not an easy task. There is a need to put mechanisms in place that will help everyone to accomplish this transformation.

The use of the TQM model in education to improve quality is supported by Hayward and Steyn (2001), who argue that this would give a distinct identity to those who want to improve quality in the educational sector (Hayward & Steyn, 2001:104). The above TQM, however, has been developed into present-day quality management systems with some eight principles, according to Westcott (2013:291-292).

**2.2.1.2 Principles of quality management systems**

**i) Customer focused**

According to Westcott (2013) the customer determines the level of quality. No matter what processes and efforts are put in place, the customer still determines whether the efforts were worthwhile (Westcott, 2013). Customers can be classified as internal or external customers, where internal customers in the organisation receive the output of others' work to help them create products for the ultimate customer through exchanging information, documents and instruction (Gatiss, 1996:17). In this case educators receive inputs from the department policymakers, management and planners in order to plan and deliver instruction. If they are satisfied, it is likely that they will in turn satisfy learners and parents as the ultimate customers. Gatiss (1996:17) points out that external customers are those people who consume the product or service concerned. Learners are referred to as user-only customers as they receive tuition, but parents pay for it. In this study learners are referred to in three ways: external customers when buying knowledge from the education system; internal customers when they participate in the delivery of their own learning; and products of the education system when they are prepared with skills for life, universities or workplaces.

## **ii) Total employee involvement**

All employees would participate and work towards a common goal only when fear has been eliminated from the workplace. This can be achieved by empowering employees through self-managed work teams, with management providing the proper environment.

## **iii) Process centred**

A fundamental part of TQM is a focus on process thinking, where a series of steps that take inputs from suppliers transform them into outputs that are delivered to customers. These steps that are required to carry out the processes are defined and performance measures are continuously monitored in order to detect unexpected variations (Westcott, 2013:291).

## **iv) Integrated system**

TQM focuses on horizontal processes interconnecting different functional specialties. Micro-processes add up to larger processes. Everyone must understand the vision, mission and guiding principles as well as the quality policies, objectives and critical processes of the organisation. There is a need to continuously monitor and communicate quality performance. An integrated system therefore connects business improvements elements in order to improve or even exceed customer, employee or stakeholder expectations (Westcott, 2013).

## **v) Strategic and systematic approach**

This part includes the formulation of strategic plans that integrate quality as a core component.

## **vi) Continual improvement**

Continual improvement drives organisations to become more competitive, thus more effective in meeting stakeholder expectations.

### **vii) Fact-based decision-making**

Data on performance measurements is required for an organisation to know whether it is doing well or not. The collection and analysis of data will therefore help organisations to predict outcomes based on past experience.

### **viii) Communication**

Effective communication, where strategies, methods and timelines are given, helps in maintaining the morale and motivation of employees at all levels within an organisation.

## **2.2.2 Systems theory**

Systems theory is a theory that unifies the natural and human constructed world and is able to support science education reforms (Chen & Stroup, 1993:447). The 1960s saw the first efforts to realise the potential of systems thinking at the level of school curricula. The Science Curriculum Improvement Study (SCIS) of the mid-1960s developed curriculum units that introduced the concepts of systems, interactions, subsystems and variables to elementary schoolchildren. General systems theory is about engaging the richness and dynamism of the world around us. Science education reforms of the last 30 years have emphasised giving learners' access to hands-on learning environments. This marks a significant improvement in science education. In its own right systems theory has five major strengths in science education, namely towards integration; engaging complexity; understanding change; relating macro and micro levels; and functioning in a human-made world.

### **2.2.2.1 Towards integration**

There is a notion that a system is an assembly of interacting parts which exhibits behaviour not localised in its constituent parts (Chen & Stroup, 1993). Quality assurance in science education involves different components being examined, which include quality assuring inputs, processes and outputs.

### **2.2.2.2 Engaging complexity**

Chen and Stroup (1993) point out that traditional science education curricula avoided complexity by relying on educator knowledge. Systems theory, however, provides tools for actively engaging complexity. Quality assurance as a process is complex in the sense that criteria or standards have to be set and consequently there is a need to have evaluation tools so as to gauge performance.

### **2.2.2.3 Understanding change**

Systems theory, according to Chen and Stroup (1993), provides the intellectual tools for learners to build understanding based on dynamics. At the same time quality assurance processes are dynamic due to the changing phases and needs of society. The quality of things changes based on the value attached to it or on the customer needs.

### **2.2.2.4 Relates macro to micro levels**

General systems theory offers the possibility of making explicit the complementary relation between macro and micro levels of analysis. Quality assurance mechanisms at both macro and micro level were critically engaged in this study.

### **2.2.2.5 Functioning in a human-made world**

Systems theory tries to merge the different thought patterns between the human world and the natural world. In order to understand the goal and design of natural systems discussions should centre on human understanding of the world brought by experiences (Chen & Stroup, 1993). This study focused on quality assurance systems as human made in an effort to match the natural world system balances.

## **2.3 KEY DEFINITIONS**

The ancient Greek philosopher Aristotle defines quality as fitness to purpose from his famous quote:

“Any kind of excellence renders that of what it is the excellence good and makes it perform its function well” (Aristotle c. 380 BC).

In this case quality is realistic and can be measured, so Aristotle might be regarded as the father of modern quality systems (Doherty, 2012). However, fitness to purpose has been contested by a number of authors like Pirsig (1976), who questions below:

“Quality is, how do you know what it is, or how do you know it even exists? If no one knows what it is, then for all practical purposes it doesn’t exist at all. But for all practical purposes it does exist.”

Fitness to purpose is a much more useful concept in education especially if “purpose” can be defined as “satisfying the stakeholders with a notion of continuous improvement” (Doherty, 2012:80).

Quality assurance is a term that is relatively new in education, but that has rapidly become very important. This chapter therefore aims to provide an introduction to quality assurance in education and briefly describes the organisations in South Africa responsible for quality assurance. In order to explain this concept fully, it is important to clearly define the terms used in this thesis.

### **2.3.1 Quality assurance**

Baumgardt (2013:190) notes that there is an urgent need for a common definition of quality assurance together with a standard procedure for how it should operate. She further states that until and unless this happens, it is likely that a system flawed by inconsistent interpretation and application will simply continue into the future. The South African Qualifications Authority (SAQA) (2001:6) defines quality assurance as the sum of activities that assure the quality of products and services at the time of

production or delivery. This definition was borrowed from industrial business quality assurance procedures, where the activities and products are directly associated with the goods and services provided to external customers.

According to Doherty (1994) quality assurance is a prevention-based approach focused on products' working reliability, dependability and consistency. There is a great focus on the aims, content, resourcing and projected outcomes of programmes (Doherty, 1994:11).

In this thesis the "goods, products and services" are used with reference to education and in particular science education. Quality assurance is used as a generic term for all forms of internal and external quality monitoring, evaluation or reviews and encompasses quality control, audit and assessment. Quality assurance is referred to as a process of establishing stakeholder confidence whose provision (inputs, processes and outcomes) fulfils expectations or measures up to the minimum requirements. At the institutional level, quality assurance is generally defined as that aspect of the overall management function that determines and implements the quality policy (Martin & Stella, 2007:34).

### **2.3.2 Integrated Quality Management System (IQMS)**

The responsibility for monitoring the quality of schools currently rests with the Department of Education. Schools have the mandate to enhance the quality and academic performance of the learners. This is possible only with the implementation of the quality assurance measures, assessment policies and systems to monitor the success of learners (DOE, 2001). The Department, in conjunction with the Education Labour Relations Council (ELRC), has attempted to develop alternative methods of evaluating schools and educator performance. The system currently being implemented is called the Integrated Quality Management System (IQMS). It attempts to incorporate the evaluation of schools, the monitoring of teacher performance and a system for supporting educators in their work. The IQMS consists of three programmes, namely developmental appraisal, performance measurement and whole-school evaluation. Developmental appraisal (DA) appraises individual educators in a transparent manner with a view to determining areas of strengths and weaknesses,

and to draw up programmes for individual development. Performance measurement (PM) evaluates individual educators for salary progression, grade progression, affirmation of appointments and rewards or incentives. Whole-school evaluation (WSE) evaluates the overall effectiveness of a school as well as the quality of teaching and learning. This quality assurance initiative measures the work of individual educators (ELRC, 2003:3).

### **2.3.3 Quality science education**

Quality science education, according to Xanthoudaki (2010:38-39), means providing effective contexts and policy frameworks, taking into account learner and educator influence and perceptions about science and also encouraging, developing and fostering cooperation between formal and informal learning environments. Quality science education is accompanied by quality science learning, teaching and pedagogy. The quality of science is reflected by the outcomes at the exit levels, like matric results. The term “poor quality” is, however, relative but in this study emphasis is on the output or exit level matric results in science (Life Sciences and Physical Sciences). This is the measurable outcome mainly used by the Department and institutions when selecting students for university, college intakes and job markets. Quality results in this study refer to the 50% mark and above and low or poor quality to marks of 49% and below.

### **2.3.4 Science**

“Science” in this study refers to the following three subjects: Life Sciences, Physical Sciences and Natural Sciences. In South African secondary schools FET level, Physical Sciences comprise both physics and chemistry, and thus focus on investigating physical and chemical phenomena through scientific enquiry by applying scientific models, theories and laws to predict events in the physical environment. Natural Sciences in South Africa is a subject done at primary and lower secondary GET level and comprises general physics, chemistry, biology and geography. Only Physical Sciences and Life Sciences are meant when referring to “science” in this study.

### **2.3.5 Annual National Assessment (ANA) and Trends in International Mathematics and Science Study (TIMSS)**

The Department of Education also organises systemic evaluations (tests of samples of students) at the lower levels of the school system, to establish how much children in primary schools are learning. These tests look at numeracy and literacy levels. This refers to a standardised assessment programme to assess competency levels in numeracy and literacy in Grades 3, 6 and 9. TIMSS, on the other hand, is a cross-national assessment of the mathematics and science knowledge of Grade 4 and Grade 8 learners. TIMSS was developed by the International Association for the Evaluation of Educational Achievement (IEA) to allow participating nations to compare learner educational achievement across borders. TIMSS was first administered in South Africa in 1995, and continued to be administered in 1999, 2003, 2011 and 2015 (Reddy et al., 2016). For this study, both ANA and TIMSS results in conjunction with matric results are used as a tool to determine the quality of education that learners in South Africa can demonstrate.

### **2.3.6 Districts**

Districts consist of personnel who are experts in school management, leadership, governance, curriculum, staff development, human resources, procurement and financial planning. They are referred to as the district support teams as they are mainly responsible for monitoring and supporting schools in order to improve quality (RSA, 2001:20). District support services rely on school self-evaluations (SSE), school improvement plans (SIP) and external whole-school evaluation reports from supervisory teams. These reports then guide the district support services to implement quality assurance processes in schools to enhance quality performance. District management improvement is one of the critical focal points, especially in terms of support offered to schools, and there is need to strengthen monitoring of the curriculum at school level to turn around learner performance (DBE, 2015).

Of the many functions the district should execute in order to support schools, a few are given below:

Implementation of performance management systems and whole-school evaluation policies; improving schools' capacity in terms of curriculum monitoring, oversight roles of principals and school management teams, and making sure that all principals are competent in their management functions; facilitating participation of the community through school governing bodies (SGBs) and parents; supporting work plans by educators and school management teams; and offering management and leadership training to enhance skills that enable managers to be competent in performing their core duties (DBE, 2015).

### **2.3.7 Umalusi**

Umalusi is a statutory organisation that was established by the South African Parliament to monitor and improve the quality of general and further education (Allais, 2009:22). Umalusi has a mandate to monitor and moderate the achievements of learners' primarily through external examinations and certification of the learners. Umalusi also evaluates whether providers of education and training have the capacity to deliver and assess qualifications and learning programmes, and are doing so to maintain quality standards. To achieve this, a process of accreditation was introduced, where educational institutions must meet all criteria stipulated by Umalusi. According to Allais (2009:23), Umalusi does not only evaluate state schools but also private schools, colleges and adult education institutions. Umalusi also accredits assessment bodies which set the external examinations that are used to evaluate learners. Umalusi also evaluates the quality of qualifications through a process of quality assuring the curricula that belong to different qualifications. Umalusi then sets rules on the number of subjects to be passed.

## **2.4 QUALITY ASSURANCE IN EDUCATION**

### **2.4.1 A brief history**

Since the 1970s, governments throughout the world have been influenced by business models in the private sectors. Most governments believed that business models were more efficient than the traditional bureaucratic models of governments (Allais, 2009). Governments tried to privatise certain areas of operation, or to privatise some aspects

of areas which used to be regarded as government responsibility. These factors contributed to governments being increasingly concerned with the regulation of different areas of work. As a result, governments started to adopt ideas such as quality assurance from business. In nearly all countries, governments have some responsibility for education. This has led to the introduction of quality assurance as an important part of the organisation of education systems (Allais, 2009).

Internationally quality is a notion that has accompanied basic education in various places. The focus on quality assurance has recently accelerated particularly in the United Kingdom (UK), Australia, New Zealand and the USA. In recent years the quality discourse has moved from one promoting and encouraging quality to institutional bench marking and audits by external bodies. Most recently a number of countries have established national agencies, such as the Quality Assurance Agency In Education in the UK (QAA), the Tertiary Education Quality and Standards Agency (TEQSA), the New Zealand University Academic Audit Unit (AAU) and the South African Qualifications Authority (SAQA). An international umbrella organisation for these agencies, the International Network for Quality Assurance Agencies in Higher Education, has also been established. Through the work of these agencies universities shape their activities and report on them in order to demonstrate that they have quality assurance processes (Mekasha, 2008).

#### **2.4.2 Checks and balances in education**

According to Allais (2009), education systems have always had some kind of checks and balances that were put in place to keep track of quality or standards in educational institutions and systems, and to try to improve them. Only recently these have been referred to as “quality assurance”. Quality assurance in education has been developed from the traditional checks and balances in the systems. It is therefore something rather different and is new to education (Allais, 2009:15). The checks and balances in education traditionally included external examinations, systemic evaluations and inspection. In South Africa the inspection system during the apartheid era was largely based on intimidation, resistance, fear, negativism and punitive actions. Many black educators were suspicious of these inspectors and resisted through mobilising trade

union support and banning the inspectors and the school management from entering their classrooms (Reddy, 2005:2-3).

### **2.4.3 Measuring quality education**

In this study measuring quality involved examining educational inputs, processes and outputs using the relevant tools. In order to measure the quality of science education there are some useful indices that can be used, according to Bamisaiye (1983). The indices can reveal the productivity of the educational system based on inputs, processes and outputs analysis. Education was viewed as requiring human and nonhuman inputs which undergo a number of processes to produce output. The output indicators for measuring quality science education included learner achievements, qualifications, levels of competence, and knowledge and skills acquired. Input to output ratio can then be used to measure the productivity of an educational system. Bamisaiye (1983) identifies quantifiable and nonquantifiable indices, where school climate, discipline, morale, attitudes and so on are nonquantifiable. The quantifiable indices included the quantity and quality of inputs to education, the relevant curriculum, appropriate teaching methods and the quality of teaching aids, adequate and suitable infrastructural facilities, learner to educator ratios, learner to classroom ratios, administration and the efficiency of inspection and supervision, contact time, textbooks, laboratory and library resources, educator qualifications, assessment of learning activities and experiences, reliability of examinations in use, and the quality of learning that is achieved (Bamisaiye, 1983:11).

Quality assurance is employed to ensure that there is a consistent provision and utilisation of high standard resources to foster effective teaching and learning at every stage and aspect of the educational system with emphasis on the improvement of overall school performance and set academic targets (Fasasi, 2006). Babalola (2004) argued that quality assurance should ensure that inputs have a positive impact on the teaching and learning process. The aim of quality assurance is to promote high quality learners, educators, infrastructural resources, subject curriculum and effective implementation of policies on education. Quality assurance also helps policymakers with decision making tools in education functions, goals and key characteristics (Babalola, 2004).

## **2.5 QUALITY ASSURANCE ESTABLISHMENT IN SOUTH AFRICAN SCHOOLS**

Quality assurance serves several purposes, including control accountability and quality improvement (UNESCO, 2002:23). The schools as institutions have huge roles in improving and assuring the quality of teaching and learning. Educator interaction with learners is influenced and shaped by the way schools function, the leadership, relations with parents, support received and the overall climate of the school (UNESCO, 2002:24). Consequently a number of countries, including South Africa, have since developed tools to assess the quality and performance of the schools as institutional units. In order to evaluate schools a number of tools can be used. In this study three main tools are examined, namely:

- External inspection or supervision (Whole-school Evaluations, DBE)
- Internal school self-evaluation (Self School Evaluations, IQMS)
- Examinations and tests (assessment of quality assurance, evaluations at school and national level).

### **2.5.1 Basic education quality assurance**

Quality assurance in many countries is exercised with the intention of ensuring that the minimum standards indicated in the quality of inputs, processes and outcomes are achieved. However, there are no universally agreed upon standards of quality since different institutions are observed using different measures to check the quality of their programmes. In basic education in South Africa, the policy framework for FET within the national quality assurance process is that the outcome of secondary education is scrutinised once every five years through an external process. The Department of Basic Education develops and reviews its own internal process that is checked by an external agency every five years (HERQA, 2006). The Minister of Basic Education has acknowledged that there is still a lot to be done to achieve quality education:

“Our own internal assessments and international benchmarking assessments confirm that while progress has been made on access, equity

and redress, the emphasis for this administration will be on attaining quality. We will endeavour to increase the number of Grade 12 learners who can gain entrance to university, moving incrementally from 172 000 in 2013 to 250 000 in 2019, and work to improve the quality and quantity of passes” (Motshekga, 2015a).

Attaining quality results in this case is to make sure that more learners gain access to universities. The attainment of quality education therefore requires all stakeholders to work together, at the same time ensuring that the quality assurance processes in place are improved or adhered to.

### **2.5.2 Policy framework**

Policies can be defined as guidelines for action within an organisation and help it to achieve its purpose. Where policies do exist, they are often only words on paper produced for the sake of compliance, but the actual implementation of the policy is questionable. Providers are also expected to abide by policies that have been developed externally such as the policies drafted by the regulatory authorities regarding quality assurance or accreditation (Baumgardt, 2013:44). Policies often differ in form depending on the company size, industry and years in business. Policy documents generally contain certain standard components, such as a purpose statement, definitions of key terms, the background to and the reasons for the policy, start, end and review dates, and specific guidelines as to processes and procedures in order to be effective. A policy should be informative, direct, clear, concise, current and easy to understand (Meador, 2012; Baumgardt, 2013).

The main elements of the policy frameworks are the following: strategic planning that will enable the institution to describe its objectives and outcomes; a code of practice to judge the institution’s standards and criteria of quality; processes that will help clarify the dimensions of criteria accepted in subjects and programmes through regular self-assessment; and external assessment mechanisms that can evaluate institutional outcomes and processes for quality assurance (HERQA, 2006). At national level HERQA is responsible for conducting national quality audits, revealing public reports on the outcomes of the audits and reporting on the criteria of processes audited (DOE,

2001a). HERQA functions as an independent, non-profit agency. It conducts quality audits of individual countries on site every five years, and also appoints the audit panels (HERQA, 2006).

Soon after South Africa's independence from the apartheid regime in 1994, there was a transition period that was characterised by the race towards policy making (Kraak, 1999). The success of policies in change management is determined by the stability of policies that have been introduced. In the South African education system, however, the policies were introduced with such speed that it brought instability (Cameron & Green, 2004). Adding to this instability was the issue of education districts that were introduced only in 1994 and acted as conveyer belts of policies to the schools. Their operation was mainly an emphasis on policy compliance as part of their administrative mandate (McKinney, 2010, cited in Maile, 2013). Maile (2013:25) points out that district support remains a work in progress of which more work is yet to be made to improve the quality of support that they are supposed to give to schools. In order to improve the quality of learning and teaching a lot still needs to be done, especially by districts to implement policy in a systematic and integrated manner (Govender, 2003).

## **2.6 MODELS OF QUALITY ASSURANCE**

### **2.6.1 Examination models**

Examination models are associated with learners obtaining examination marks for university entrance, where the emphasis is on maintaining a national and international standard for all who obtain a particular qualification. The primary assumption of the model is that ensuring quality is linked to providing evidence that learners acquired the appropriate subject or disciplinary knowledge. The aim of the model is to award a value that is independent of the candidate's institution. However, in practice the model only fulfils this aim on its own when the institutions involved are highly selective and have roughly similar resources for preparing learners for examinations. The examination model has worked relatively well in cases such as the French baccalaureates, A-levels in the UK and Scottish Highers and to some extent the old South African senior certificate (Umalusi, 2012). In France the status of the baccalaureate is ensured by the fact that successful candidates are guaranteed a university place by law; the quality of

the baccalaureates is managed by the state. In the UK, the status of A-levels reflects the resources and public confidence in the institutions primarily associated with the programmes. As the model spread to a greater diversity of institutions, examination results became more related to the intake of the school or college than to the quality of teaching (Umalusi, 2012).

### **2.6.2 Accreditation models**

According to Umalusi accreditation models are midway between centralised examination models and the kind of delegated assessment model being developed by many of the SETA ETQAs in South Africa. They are more associated with vocational qualifications, allowing institutions to relate to quality and standards based on local needs as well as to national criteria. It is the model adopted by vocational awarding bodies in the UK. These bodies accredit institutions as colleges and schools and monitor their assessment procedures; they do not necessarily examine individual learners but a sample basis. Unlike the examination model, individual institutions carry out the assessment of learners, a process that is overseen by external examiners. The syllabuses differ from those based on examination models – they are in between the prescribed syllabuses and outcomes models, which have no formal syllabus. They emphasise outcomes and processes more than focusing on content, and encourage written and non-written assignments and continuous assessment rather than just an unseen examination (Umalusi, 2012).

### **2.6.3 Inspection models**

Umalusi (2012) identifies inspection models as more holistic in their approach to institutions than the previous two models, and have developed quite separately. They focus on the activities of the institution as a whole and its achievements and the observation of individual learners. This model focuses less on individual syllabuses and examinations and less on the provision of programmes and their assessment. Inspection models are unlike examination models, which focus entirely on student outcomes at one or more times in the year, and unlike accreditation models, which imply an ongoing relationship between the accrediting body and the institution. They

involve one-off visits and the presentation of inspection reports to both the national government for evaluation purposes and the individual institution for support and improvement. In the UK inspection has been developed independently of the accreditation and examination models and by a separate organisation called OFSTED. It is treated as complementary. The outcomes that are the product of examination and accreditation become part of the data for inspection. As they become accepted, schools and colleges increasingly come to regard them as supportive of their goals and not punitive (Umalusi, 2012).

#### **2.6.4 Systemic evaluation model**

The systemic evaluation model is not very popular and is not well developed in most countries. It involves institutional visits, testing of individual learners and the reporting of institutional practices and outcomes. The model is not designed to assess individual learners or to evaluate or assess individual institutions. The main aim of systemic models is to obtain information on how a system or sector performs, using sampling techniques (Umalusi, 2012). This model focuses on the system rather than on the individual or institutional level of measurement. England adopted a variant of systemic evaluation which is based on examination and test results in the form of national league tables. Examination and test results of schools and colleges for different age groups are used to position them on the league tables, thus reflecting in part the social composition of its intake and its location. The league tables have also been linked with a market-based system of parent choice and have led to some schools concentrating on improving their league table score. Consequently there is less concentration on universal educational goals (Umalusi, 2012).

## **2.7 SOUTH AFRICAN MODELS IN SECONDARY SCHOOLS**

South African secondary schools or high schools consist of the GET band (Grade 7-9) and the FET band (Grade 10-12). The main models that have been used and are currently being used are the examination model as elaborated on by Umalusi (2012) in section 2.7.1 and 2.7.2 below.

### **2.7.1 Further Education and Training (FET)**

The current model of quality assurance within most of the FET system is an examination model. The approach to quality assurance within this model is to ensure that the examinations meet the requirements of the syllabus, as well as to ensure that the examinations and marking are carried out fairly and appropriately, and that the marks are a true reflection of learners' achievements. Within this model, the quality assurance of curriculum and qualifications happens at the level of the systems and processes involved in developing syllabuses and assessment guidelines. There is no separate process of assessing "standards setting"; the "standards" to which learners are expected to conform are contained in the syllabus and the examinations. Taken together over a period of time, the syllabuses and examinations provide a relatively specific indication of how each syllabus should be interpreted. Therefore, the processes involved in monitoring and assessing the syllabuses as well as in the setting and marking of examinations are all-important. To reiterate what is prescribed in the syllabus (including content and skill statements), the types of questions set in examinations and the level of difficulty of examinations over a period of time, as well as the approach to marking, are the major determinants of what is formally taught and learnt (Umalusi, 2012).

### **2.7.2 Approaches in General Education and Training**

Historically, the main model of quality assurance in the GET band was an inspectorate model, run by the provincial departments, as there was no national examination or national system of inspection. This took place within the context of centrally prescribed syllabuses. In recent years there has been a move towards extending the examinations model to aspects of the GET system. The examinations written by adult learners are

now moderated by Umalusi, with similar procedures to those described above for the FET band. In theory, common assessment tasks set for Grade 9 learners are being phased in, and will also be moderated by Umalusi, although it is not clear to what extent and when this will happen on a meaningful basis throughout the system. However, what is not clear is the extent to which extending the examination approach is appropriate at this level. While official policy has been designed in such a way that learners can exit the system at the end of GET, in practice this is unlikely, and this area is therefore likely to remain as a fairly low stakes assessment, given that there is no systemic need for external examinations at GET level (Umalusi, 2012).

## **2.8 QUALITY ASSURANCE STRUCTURES AND THE MANAGEMENT OF ASSESSMENT**

Quality assurance structures were developed as well as the management of assessment as in Curriculum 2005 and Report 550. Districts, schools and learning sites in South African education were stipulated in circular 41/2001 (DBE, 2001). The assessment systems development unit in the Department of Education facilitated the implementation of the national assessment policy and allowed the assessment management structures to bring about proper quality assurance mechanisms. The Provincial Assessment Team (PAT), the District Assessment Team (DAT), the Cluster Assessment Team (CAT) and the School Assessment Team (SAT) form the quality assurance bodies for ensuring that assessment policy is implemented, properly managed and monitored at the various levels.

### **2.8.1 Functions of the assessment quality assurance structures**

#### **2.8.1.1 Provincial assessment team (PAT)**

The provincial assessment team (PAT) is a professional assessment forum which coordinates developments regarding the implementation of national and provincial assessment policy and consultation regarding implementation. The team is composed of assessment specialists from all districts (one representative from GET and one from FET), Head Office representatives from the Assessment Systems Development Unit

(ASDU), Examinations, Policy and Logistics Unit (EXPLU), Assessment Materials Unit (AMU), Adult Basic Education and Training (ABET), Learning Programmes and Framework Development and Support (LPFDS) and Teacher Unions. This provincial assessment team meets at least six times a year. Its functions are to coordinate and mediate developments regarding the implementation of national and provincial assessment policy and assessment systems, procedures and materials. The team ensures the implementation of policy and regulations to counter the abuse of assessment as a means of exclusion. It also ensures that assessment is based on outcomes-based education principles (including CASS). The implementation of assessment policy and guidelines facilitates multi-level and multi-functional assessment practices and a sound assessment practice that is fair, valid and reliable at provincial level. The team promotes the implementation of policy based on a bias-free assessment system, facilitates the professional development of educators to become assessors, improves progression in grades and formally reports to senior managers, units, district assessment teams or unions. According to circular 44/2001 the district representatives on the provincial assessment team have a role to draw up detailed management plans for assessment activities in the district as stipulated by policies, regulations and circulars. They also ensure that all assessment projects initiated by the district office deal with aspects of learner assessment, for example common examinations, secondary school intervention programmes and district improvement programmes. These activities are monitored and coordinated by the district assessment team in accordance with the district management plan. They also coordinate, monitor and evaluate all activities related to assessment in the district. Finally, they would facilitate parent and/or learner appeals against assessment decisions if not settled by the district assessment team (DBE, 2001:3).

#### **2.8.1.2 District assessment team (DAT)**

The district assessment team (DAT) ensures the implementation of assessment policy at district, cluster and school level. It also ensures the management and monitoring of assessment processes in the district and liaise with the cluster and school assessment teams. The DAT consists of different representatives from curriculum and professional development and support (CPDS) for each phase. These representatives include

assessment specialists, e.g. ECD/Foundation, Intersen and FET/ABET. The chairperson should be a PAT member, while other members are learning area representatives, e.g. Physical Sciences, Life Sciences and Mathematics. The DAT ensures that every school is part of a cluster assessment team. It also coordinates, monitors, evaluates and ensures the functionality of cluster assessment teams. The implementation of the national and provincial assessment policies are monitored through conducting and performing moderation processes. Moderation should cover cluster-based continuous assessment records and school-based continuous assessment records. Finally, DAT ensures that every school has established a school assessment team (DBE, 2001).

### **2.8.1.3 Cluster assessment team (CAT)**

The cluster assessment team (CAT) ensures the implementation of assessment policy at school cluster level and ensures the management and monitoring of assessment processes in the clusters. In the Johannesburg South district the schools are divided into clusters of not more than ten schools. Educators of the different learning areas meet to discuss assessment issues and the district officials then assign a coordinator for every cluster to take responsibility for the coordination of the cluster and to chair cluster meetings. The composition of the FET and GET cluster assessment team should include representatives from schools in the different subjects. The main functions of the CAT is to draw up and implement a cluster assessment management and action plan. These plans facilitate the implementation of policy and guidelines that ensure multi-level and multi-functional assessment practices and to assist educators in the implementation of continuous assessment and the development and implementation of a variety of assessment methods, tools and techniques (DBE, 2001).

### **2.8.1.4 School assessment team (SAT)**

School management addresses assessment in the whole-school development planning. The function of the school assessment team (SAT) is to develop and maintain a school assessment policy that will be an integral part of whole-school policy planning. The school assessment policy is usually in line with the provincial and national

assessment policy. The SAT implements and monitors the implementation of the school, provincial and national assessment policy as well as evaluates the policy on an ongoing basis and, where necessary, make amendments. The composition of the SAT includes the principal and/or deputy principal, all heads of department and at least one elected staff member from each of the phases offered in the school. The Department of Basic Education strongly recommended that a parent representative from the school governing body (SGB) be granted observer status on SAT. Parent representation on SAT ensures that the parent body is constantly informed regarding the provincial and school assessment policies and assessment guidelines. SAT continuously identifies and addresses barriers to learning and development in a whole-school approach through continuous assessment and other assessment systems. SAT is also responsible for preparing progress reports once a term, including written evidence of challenges on the implementation of the management plan (DBE, 2001).

## **2.9 LEARNING AND TEACHING SUPPORT MATERIALS (LTSM) QUALITY ASSURANCE POLICY**

The learning and teaching support materials (LTSM) policy in South Africa was designed to ensure that learning and teaching support materials and curriculum resources are developed and made accessible to all institutions of learning (Ngobeni, 2011). The policy seeks to ensure that LTSM are available for each learner at a ratio of 1:1, are delivered to schools on time, are reviewed to determine their impact on learning and are procured for schools through the funding made available.

### **2.9.1 Learning and teaching support materials (LTSM)**

Learning and teaching support materials (LTSM) includes a variety of learning and teaching materials used in the classroom. These range from resources created by educators and learners to commercially produced classroom resources such as wall charts, workbooks, textbooks, e-books, readers, stationery, science kits, dictionaries, encyclopaedias etc. Electronic LTSM (E-LTSM) are the books converted to digital format for display on a computer screen or handheld device (DBE, 2011). Core LTSM refer to the category of LTSM that is central to teaching the entire curriculum of a subject for a grade. Generally, this would comprise a textbook/learner book, workbook

and teacher guide. For the Foundation and Intermediate Phases this includes graded readers and in the Intermediate Phase also a core reader for the teaching of literature. In the Senior Phase it includes a core reader and a novel for the teaching of literature, and for FET set works (DBE, 2011). Supplementary LTSM according to the DBE (2011) refer to LTSM in addition to the core LTSM, and are generally used to enhance a specific part of the curriculum. Examples include a Geography atlas, dictionaries, apparatus for Natural Sciences, Physical Sciences Technology, Mathematics, Life Sciences, and electronic and technical equipment (DBE, 2011). For the purposes of the LTSM policy it is used as contemplated in Section 21 of the South African Schools Act 1996 (No. 84 of 1996) to include stationery and supplies, learning material, teaching aids, and science, technology, mathematics and biology apparatus (DBE, 2011).

### **2.9.2 The policy**

The LTSM policy has been introduced to ensure that all the injustices and inequalities of the past, with regard to learner support, are addressed. The policy ensures the production and selection of quality LTSM, and makes them available to all learners in public schools. Every learner and teacher must have access to the minimum set of core material required to implement the National Curriculum Statement Grades R-12. The issue of textbook coverage has two dimensions, addressed in this LTSM policy, namely supply and retention. In addition to coverage, the other key elements of optimal LTSM usage for improved educational outcomes are ensuring the appropriate quality of the material (Ngobeni, 2011). The long-term vision for the provision of LTSM is to ensure the following: Learners and educators have access to quality learning and teaching materials to meet the requirements of the curriculum; educators receive the training they require to continuously improve their use of LTSM and to become confident in their profession; parents are informed about what happens in the school and are aware of their responsibilities in the LTSM usage and retention; and learners are aware of the importance of doing their school work, in school and at home, utilising LTSM appropriately (DBE, 2011).

### **2.9.3 Quality assurance of LTSM**

The Department of Basic Education proposed that in all instances of core and supplementary LTSM supplied material will be independently assessed prior to use in schools. All core LTSM will be subject to approval by the DBE for use in South African schools. All supplementary LTSM will be subject to approval by the provincial education department for use in schools for curriculum delivery enhancement and independent assessment will be done where the producer or commissioning agent will not exert any undue influence on the assessment process. The assessment should be performed by experts not involved in the development process according to established screening criteria (DBE, 2011).

## **2.10 TOTAL QUALITY MANAGEMENT PHILOSOPHY**

### **2.10.1 International practices**

In various countries a total quality management philosophy has been used to design tools to quality-assure schools, for example the Malcolm Baldrige Education for Performance Excellence in the USA, the Integrated Quality Management Systems (IQMS) in South Africa and the British Standards for Quality Systems (BS5750). All these management systems centre on quality assurance, quality control, quality audit and quality assessment (Doherty, 1994:11).

According to CDE (2015:3):

“Research has identified effective educators as the most critical factor in determining student achievement. Given the importance of high-quality teaching, countries around the world have focused on teacher evaluation as a process that can be used to both measure and improve teacher effectiveness, through strengthening accountability and supporting the professional development of educators.”

In this regard South Africa introduced the Integrated Quality Management System (IQMS) as a way to evaluate, measure and improve teacher effectiveness (ELRC, 2003).

### **2.10.2 IQMS in South Africa**

A number of research studies have been conducted in South Africa on the nature, effectiveness, professional development and implementation of IQMS (Mahlaela, 2012; Mji, 2011; Nkambule, 2010; Sambumbu, 2010; Bisschoff et al., 2007). In these quality assurance initiatives there is a great focus on the measurement of the work performance of the individual educator (ELRC, 2003:3). IQMS in South Africa came into being when an agreement was reached in the ELRC (Resolution 8 of 2003) to integrate the existing programmes on quality management in education. The programmes at that time were the Developmental Appraisal System (DAS), which was introduced in on 28 July 1998 (Resolution 4 of 1998), the Performance Measurement System, which was agreed to on 10 April 2003 (Resolution 1 of 2003) and Whole-school Evaluation (WSE). The IQMS is informed by Schedule I of the Employment of Educators Act, No. 76 of 1998, where the Minister is required to determine performance standards for educators in terms of which their performance is to be evaluated (ELRC, 2003).

CDE's analysis (2015) reveals that the current policy is deeply flawed, resulting in very limited implementation in those public schools interviewed (CDE, 2015). The findings by CDE's international research raised questions about the new performance-based teacher appraisal policy (IQMS). One of the questions raised was, "Are they good enough to significantly improve teacher effectiveness and learning achievement?"

The main purposes of IQMS were listed in the agreement as follows: to identify specific needs of educators, schools and district offices for support and development; to provide support for continued growth; to promote accountability and monitor an institution's overall effectiveness; and to evaluate educators' performance. The guiding principles were borrowed from private sectors and these included the following: the need to ensure fairness, for example there can be no sanction against an educator in respect of his/her performance before providing meaningful opportunities for

development, the need to minimise subjectivity through transparency and open discussion, as well as the need to use the instrument professionally, uniformly and consistently.

The IQMS is an integrated quality management system consisting of three programmes which are aimed at enhancing and monitoring the performance of the education system. The three programmes are developmental appraisal, performance measurement and whole-school evaluation. The purpose of developmental appraisal (DA) is to appraise individual educators in a transparent manner with a view to determining areas of strength and weakness, and to draw up programmes for individual development. The purpose of performance measurement (PM) is to evaluate individual educators for salary progression, grade progression, affirmation of appointments and rewards and incentives. The purpose of whole-school evaluation (WSE) is to evaluate the overall effectiveness of a school as well as the quality of teaching and learning. These three programmes are implemented in an integrated way in order to ensure the optimal effectiveness and coordination of the various programmes.

The Department of Basic Education, however, says that the IQMS and WSE system provide opportunities for the identification of teacher development needs but this needs strengthening (DBE APP, 2015-2016:10).

“The IQMS, in particular, is considered to be time-consuming, bureaucratic and involving too much paperwork – features exacerbated by the fact that neither educators nor district officials have the capacity or are adequately trained to use and thus benefit from it. In addition, too many continuing professional development programmes lack relevance and practicality and are sometimes simply of poor quality” (DBE, 2011:13).

Quality attainment is achieved when current practices are improved. The Department of Basic Education needs to revisit IQMS and improve on areas of weaknesses.

### **2.10.3 Future considerations on IQMS**

The Department of Basic Education indicated a great need to strengthen accountability at school level by enhancing the monitoring of performance management systems. There is a need to strengthen the integrated quality management system for school-based educators (IQMS) and the performance management and development scheme (PMDS) for office-based educators, and to use the tools to identify the specific developmental needs of educators (DBE APP, 2015-16). The Department also acknowledges that there is an underutilisation of the skills development budget in the provinces. There is therefore a need to prioritise the monitoring of the utilisation of the skills development budget so that educators are the primary beneficiaries of training and support.

“The implementation of the Whole School Evaluation (WSE) processes should be closely monitored so that evaluated schools that have been identified as ‘high risk’ schools and in need of urgent intervention are provided with the required support. The intervention should be targeted at the ‘risks’ in order to improve basic functionality and management in schools as well as effective teaching and learning in the classroom. Following the promulgation of the South African Standards for Principalship, the Department will complete standards for every level of school management, i.e. standards for both Heads of Departments and Deputy Principals” (DBE APP, 2015-16).

Effective quality assurance mechanisms require the setting of standards not only externally but internally in the schools. The Department of Basic Education should therefore try to shift from prescribing standards and also do wide consultations with schools to come up with unique standards that suit the school’s contextual factors (Bischoff et al., 2007:40). According to DBE the standards will inform the development of appointment criteria for the two levels of school managers and the development of competency assessment tests to ensure that only competent educators are appointed at management level. DBE will strengthen the physical and regulatory environment within which districts operate for improved education service delivery to schools under

their care. The accountability of officials will be under scrutiny for improved delivery of identified key sector priorities (DBE APP, 2015-16).

This thesis will be useful for the Department to propose improved quality assurance practices informed by research.

#### **2.10.4 IQMS evaluation process in South Africa**

The Integrated Quality Management System (IQMS) consists of three main areas of evaluation, namely performance measurement (PM); developmental appraisal (DA) and whole-school evaluation (WSE). The first section used when evaluating has four performance standards used when observing educators teaching. The second section is made up of eight performance standards which relate to aspects for evaluation outside of the classroom.

The first section is intended for developmental appraisal, performance measurement and whole-school evaluation. The performance standards are as follows: the creation of a positive learning environment; knowledge of curriculum and learning programmes; lesson planning, preparation and presentation; and learner assessment.

The second section consists of eight performance standards, namely professional development in field of work/career and participation in professional bodies; human relations and contribution to school development; extracurricular and co-curricular participation; administration of resources and records; personnel; decision making and accountability; leadership, communication and servicing the governing body; and strategic planning, financial planning and EMD. The information obtained here is used to score educators for salary/grade progression, advise educators on areas that need improvement, compile a school improvement plan (SIP) incorporated in the school self-evaluation (SSE) report of the whole-school evaluation (WSE).

## 2.11 WHOLE-SCHOOL EVALUATION (WSE)

Whole-school evaluation is defined as a system of evaluating the performance of schools as a whole, where the contributions of all nine focus areas to improving performance are measured rather than simply the performance of an individual member of staff (DOE, 2001a:iii). WSE is viewed as the cornerstone of the quality assurance system in South African schools. Most schools in also use other quality assurance mechanisms, according to Sambumbu (2010:103), to improve the quality of education. These include whole-school evaluations (WSE), systematic evaluation, internal supervision and a workplace skills plan. Sambumbu (2010) indicates that the following mechanisms were in operation during the research period: WSE (all schools), systematic evaluations (89% of schools), internal supervision (67% of schools) and a workplace skills plan (56% of schools). The research showed that none of these systems were integrated in any of the schools as they were all being implemented as separate entities in a compartmentalised manner. This study investigated how the IQMS processes were being run in schools in order to improve the quality of science education.

To prevent bias in quality assurance evaluators or supervisors indicators should be designed. A veritable measurement tool was developed by some scholars in education which measures educational effectiveness, efficiency and performance in different contexts and is referred to as quality assurance indicators (QAIs) (Chalmers, 2008). Indicators that need to be considered, according to UNESCO (2002), include the following: what learners gain; quality learning environments; quality content; processes that support quality; and outcomes from the learning environment (UNESCO, 2002).

According to Ayeni (2012) there are six indicators that can be used to quality-assure schools, namely learning resource inputs; instructional process; educators' capacities development; effective management; monitoring and evaluation; and quality learning outcome. Chalmers proposes that policymakers should use outcome indicators to measure complex processes qualitatively, thus helping supervisors to be objective (Chalmers, 2008). Quality assurance has been classified as input, process and output, which also tend to measure quantitative variables like learner results, infrastructure and instructional resources (Akhuemonkhan & Raimi, 2013).

Nine areas to be quality-assured or evaluated have been identified by the Department of Basic Education to be carried out (DBE, 2001:13). They are the basic functionality of the school; leadership, management and communication; governance and relationships; quality of teaching and learning, and educator development; curriculum provision and resources; learner achievement; school safety, security and discipline; school infrastructure; parents and community. The scale in Table 2.1 is applied when giving judgements or rating the schools on all of the nine focus areas.

**Table 2.1 Whole-school Evaluation Tool Rating Scale**

<b>Rating</b>	<b>Performance level</b>	<b>Interpretation</b>
1	Needs urgent support	<p>It also means, “Does it exist? Is it done? Does it occur?”</p> <p>To answer this question the evaluator must look at documentary evidence or evidence gathered through interviews, lesson and other observations, etc. and may also refer to a particular practice or occurrence that is happening at the school.</p> <p>Noncompliance, not appropriate, not available, not adhered to, not implemented. There are major weaknesses that require immediate remedial intervention and action. Province/District needs to intervene urgently.</p>
2	Needs improvement	<p>Everything that happens at a school or that is documented should be tested against all relevant legislation applicable to education, e.g. Constitution of SA., SA Schools Act and its Amendments, Public Servants Act, Educator Employment Act, Public Finance Management Act, Child Act, Occupational Health Services Act, Department of Basic Education and Provincial Education Department policies and regulations.</p> <p>Non-compliance with a significant number of minimum requirements for a particular indicator. There are some</p>

		strengths but they are outweighed by areas for development (weaknesses). The school needs structured and planned action to provide learners with basic education. Implementation is not effective and assisted by all stakeholders.
3	Acceptable	<p>Policies, procedures, practices and planning at school are implemented. Evidence may be gathered through observations, registers, written communication, interviews with stakeholders, questionnaires etc. Implementation must also be appropriate and in line with legislation.</p> <p>Adequate compliance with most minimum requirements, strengths just outweigh areas for development, policies, plans and procedures are fully implemented. Quality of teaching is reasonably good and learners achieve on average (60%-70%) in annual national assessments and Grade 12. Learners have access to a basic level of provision, minimum expectations are met.</p>
4	Good	The policy, plan, procedure, conduct, occurrence add most possible value to school operations. It works and is cost effective. School complies with all legislative, regulatory and policy requirements, quality of teaching is characterised by major strengths that clearly outweigh any areas for development, learners' experiences and achievement are above average expectation, the school's policies, plans and procedures are fully effective.
5	Outstanding	Exceptional, very best practice that inspires other schools. Exceptional effective implementation, exceptional quality of learning and teaching, learners' experiences and achievements are of very high quality as a result of innovative practices.

Table 2.1 shows that the ratings range from 1 to 5, of which 1 is the lowest rating associated with noncompliance and 5 is the highest rating associated with best practices or excellence.

### **2.11.1 Basic functionality of the school**

For a school to function efficiently and effectively conditions should be favourable. Ratings are made by evaluators or supervisors on the effectiveness of the school's policies and procedures; the level of absence, lateness and truancy as well as procedures for dealing with them; and learners' response to the school's provision, the ethos they show and their behaviour. The information here is gathered by the evaluators from admission policy, admission register, attendance registers, summary register, quarterly attendance returns, late-coming and truancy registers. More information can be gathered from educator time book or time register; leave register; leave forms file; any notes, letters written to learners' parents or educators with regard to late-coming and any other documents that may assist with the evaluation of this area, and the code of conduct for learners and educators.

### **2.11.2 Leadership, management and communication**

The supervisors evaluate the effectiveness of the leadership and management of the school. This is done through checking whether the School Management Team (SMT) gives clear direction to the school. The information is gathered from vision and mission statements; the school's improvement plans; SSE report; staff establishment; job descriptions; minutes and agendas of staff/SMT meetings, school calendar, prospectus, school magazine, diaries, letters; management activity calendar, monthly plan, plans of HODs/subject heads; and asset register and maintenance plan.

### **2.10.3 Governance and relationships**

The purpose is to evaluate the effectiveness of the governing body in fulfilling its roles and responsibilities with regard to the establishment of a purposeful and disciplined school environment. The evaluators establish whether the School Governing Body (SGB) is duly established and functions effectively. Some of the information is obtained

from all SGB documents, all financial documents, all asset and stock registers, all policies, minutes of SGB and committee meetings, constitution and staff records.

#### **2.11.4 Quality of teaching and learning, and educator development**

Evaluators or supervisors evaluate the quality of teaching and learning and the extent to which the school provides and promotes educator development. The rating is based on the extent to which the school embarks on effective curriculum planning. Sources of information include IQMS documents, teacher files, learner workbooks and assessment records, monitoring and control records, lesson observations etc.

#### **2.11.5 Curriculum provision and resources**

Evaluators rate the implementation of the curriculum and enrichment programmes offered at schools and to what extent it enhances the aims and objectives of the education system. The school should comply with the provisions of the CAPS in terms of notional/contact time of the curriculum offered. Sources of information are the school's curriculum; the school's year plan; timetables; school annual report; results of extra- and co-curricular activities; co-curricular planning; extracurricular planning; school inventory lists; lesson plans; distribution lists; retrieval system documents; lesson observation and the observation of storerooms.

#### **2.11.6 Learner achievement**

The purpose is to evaluate the level of achievement of learners academically as well as in extra- and co-curricular activities. The criterion is based on learner achievement in standardised assessment on an average above 50% in the different learning areas. The supervisors and evaluators source the information from the November results (Promotion Schedules), the Annual National Assessment results and other surveys/results; NSC, records of learners who participate in sports and cultural activities; records that show learner achievement in sports and cultural competitions.

### **2.11.7 School safety, security and discipline**

Supervisors evaluate the level at which the school provides for a healthy, safe and secure environment for learners, staff, parents and others. The evaluators check if Health, Safety and Security (HSS) policy includes procedures to support, care and protect the learners, staff and others at school.

Sources of information include health, safety and security policy; records of working with welfare agencies, SAPS and guidance teacher; learner profile records; records on incidents of medical emergencies and accidents at school; first aid kits; school's file on nutrition programme; safety rules and safe practices; all posters and hazard signs; records of hazards and unsafe and unhealthy structures and conditions at school; emergency and evacuation procedures and plans; fire extinguishers; visitors' books; gate control and signs at the entrance; early release registers and required letters and other required documents; campus duty rosters; Schedule 1 of Safety regulations in SASA completed for school visits; drivers' and vehicle licences; SGB roadworthy inspection document; consent forms; plans and records for random searches; code of conduct for learners; records of disciplinary proceedings, actions and sanctions.

### **2.11.8 School infrastructure**

This area of evaluation rates to what extent the school has sufficient and appropriate infrastructure and how it is maintained. There is a need to establish whether or not the school has reliable and sufficient functional services. The information is obtained from the electricity network, light fittings and plugs; water network, drinking taps; ablution block; classrooms; library; classrooms with specialised equipment; furniture in rooms; inventory list/register; offices and storerooms; staffroom, kitchens, nutrition centre, tuck shop, school hall, workshop; documentary evidence; maintenance policy; finance policy; maintenance committee minutes; project contracts; cleaner, maintenance duty roster.

### **2.11.9 Parents and community**

Supervisors evaluate the extent to which the school encourages parental and community involvement in the education of the learners and how it makes use of their contributions to support learners' progress. The schools should communicate regularly and effectively with parents. Sources of information include communication with parents, i.e. invitations, letters, newsletters, notices, learner report cards; minutes of meetings with parents; handouts at parents' meetings; proof/correspondence of partnerships with community organisations and NGOs; visitors' book and logbook; registers/correspondence of usage of facilities; environmental programme; agendas and minutes of relevant meetings; attendance registers; and written evidence of links with other schools.

### **2.12 PARENTS' INVOLVEMENT IN QUALITY ASSURANCE IN SCHOOLS**

The South African Schools Act 84 of 1996 (SASA) encourages a collaborative relationship between the school governing body (SGB), parents, the school and the principal so as to provide quality education. The Act stipulates that schools must have a governing body that is representative of all stakeholders in keeping with the policy of democratic governance and the commitment to include parents as equal partners in education (Coetzee & Bray, 2004:51). The Act differentiates between governance and professional management. The SGB is responsible for the governance of the school while the professional management of the school is the domain of the principal. The relationship between parent involvement and quality assurance at schools has been studied extensively (Mestry, 2004; Jooste, 2008). The assessment of parental involvement is located within the whole-school evaluation (WSE) component of the IQMS. In South Africa the Office for Standards in Education (OFSTED) is an external evaluation institution linked to the Department of Education and is responsible for evaluating the performance of schools as part of WSE. In order to improve quality education in schools, parents should be involved in both governance and academic policy issues (Modisaotsile, 2012). Some of the core duties parents need to do include assisting with homework, motivating learners to participate in extramural activities, guidance in behaviour and social interactions as well as helping their children to be in school on time (Modisaotsile, 2012:3). Some parents, however, may be challenged

especially in content issues as well as the use of medium of instruction (Kavanagh, 2013).

Parental involvement in teaching and learning plays an important role when it comes to learners' self-esteem, attendance and social behaviour, which may ultimately help in academic performance (Dhurumraj, 2013; Lemmer, 2007; Makgato & Mji, 2006). In those schools where parental involvement was present there was no evidence of support of learners in teaching and learning activities but only in school support and volunteering activities (Kavanagh, 2013; Lemmer, 2007:218). One of the reasons identified by Lemmer (2007) and Kavanagh (2013:250) was that educators were not trained on how to involve the parents in ways to support their children's learning. Schools should, however, strive for healthy and active relationships with parents in order to achieve quality science education (Lemmer, 2007). Parents can be involved directly in assessing their children by making informed comments in the learner books and portfolios. Whole-school evaluation seeks to make schools have quality education, develop schools to manage themselves, strengthen support given by district support services, and identify aspects of excellence and areas of improvement (Biyela, 2009:13).

## **2.13 CONCLUSION**

This chapter concentrated on the reflections of authors and scholars regarding the educational quality assurance mechanisms in the South African education system. The theoretical framework trajectory guiding this study was laid out. The meanings of the key terms central to the study, namely quality assurance, integrated quality management system and quality science education, were given. The chapter also looked at the nature of quality assurances policies implementations and shortcomings. Quality assurance is a multidimensional concept for which many definitions are given. This study accepted that quality assurance is the means by which an institution confirms to itself and to others that conditions are in place for it to achieve the quality standards set for it internally or externally. The next chapter addresses the quality science education context and identifies the loopholes in the South African education system which cause poor quality science education. The chapter further attempts to identify how quality assurance can address the challenges identified.

## **CHAPTER 3**

### **LITERATURE REVIEW (2): QUALITY SCIENCE EDUCATION CHALLENGES**

#### **3.1 INTRODUCTION**

Quality education is a difficult concept to define. According to UNESCO (2004:2) quality education should be instrumental in the child's full development in terms of cognition, emotion and creativity. It should not only focus on the aspect of achieving good grades at school but must also consider the creative and emotional development of individuals as well as inculcate citizenship values in them. Sanyal and Martin (2007:5) identify the following ten aspects of quality education according to different stakeholders: providing excellence; being exceptional; providing value for money; conforming to specifications; getting things right the first time; meeting customers' needs; having zero defects; providing added value; exhibiting fitness of purpose and exhibiting fitness for purpose.

In South Africa quality education mainly focuses on matric results and percentage pass rates. For many years the South African education system has had only one credible objective measure of learner performance, namely the National Senior Certificate Examination (DBE, 2011:20). The monitoring and evaluation of programmes delivered need to be strengthened and skilled human resource capacity needs to be developed to deal with the multiple challenges and contexts for training (DBE APP, 2015-16). The DBE has realised that more needs to be done to improve the quality of education in South Africa:

“The focus of the Department of Basic Education for the 2015/2016 financial year will be to consolidate achievements made so far while expediting strategies for improvement. We remain resolute in our quest to improve quality and efficiency throughout the schooling sector, with a renewed emphasis on curriculum coverage and the need to strengthen quality, efficiency and accountability in our provinces, districts and schools” (Motshekga, 2015).

In order to strengthen quality, efficiency and accountability there should be effective quality assurance mechanisms to be followed. This chapter identifies the loopholes in the South African education system which cause poor quality science education and proposes ways how quality assurance can address these challenges. Particular attention is paid to science education and the factors contributing to poor quality science results in South Africa. Mathematics, science and technology participation in these gateway subjects has been declining in some schools in the recent years (DBE APP, 2015-16). Experience has shown that most schools reduce the number of mathematics and science learners as they reach matric in order to boost the overall school pass rate, which the author refers to as “culling” instead of selecting capable learners in Grade 10. The identification of the areas that bring about poor science education in this study will become the basis for a framework in quality assurance which specifically targets science education.

### **3.2 THE QUALITY OF SCIENCE EDUCATION IN SOUTH AFRICA**

The quality of science education at FET level can be measured by the results of the National Senior Certificate (NSC) examination, which is written by most candidates in the country and all public school learners in South Africa. In this study “science” refers to two learning areas, namely Physical Sciences and Life Sciences. The term poor quality is, however, relative but in this study the emphasis is on the output or exit level matric results in Life Sciences and Physical Sciences. This is the measurable outcome mainly used by the DBE and institutions when selecting students for university, college intakes and job markets. From the perspective of the universities and most colleges in countries around the world the quality pass mark should be above 50%.

**Table 3.1 Overall achievement rates in Life Sciences**

Year	Number that wrote	Number achieved at 30% and above	% achieved at 30% and above	Number achieved at 40% and above	% achieved at 40% and above
2013	301 718	222 374	73.7	144 355	47.8
2014	284 298	209 783	73.8	139 109	48.9
2015	348 076	245 164	70.4	160 204	46.0
2016	347 662	245 077	70.5	157 177	45.2

Table adapted from NSC diagnostic report 2016

Table 3.1 shows that there have been steady decreases in the percentage of learners achieving at 30% and 40% in Life Sciences over the four-year period from 2013 to 2016. For the 40% and above achievers the only slight increase was in 2014, when there was an increase of 1,1%. From then there was a decrease of 2.9% and 0,8% in 2015 and 2016 respectively. The decrease over the four years was 47.8% –45.2% = 2.6%. Universities usually consider 50% and above for intakes in critical scientific areas like engineering and branches of medicine. The fact that less than half of the learners (45,2%) obtained 40% and above in 2016 leaves a lot of questions on the quality that universities are looking for. This suggests that the quality of results has been decreasing in Life Sciences, which is a worrisome trend that needs to be investigated. This study will try to unlock some of the reasons with the emphasis on quality assurance mechanisms.

**Table 3.2 Overall achievement rates in Physical Sciences**

Year	Number that wrote	Number achieved at 30% and above	% achieved at 30% and above	Number achieved at 40% and above	% achieved at 40% and above
2013	184 383	124 206	67.4	78 677	42.7
2014	167 997	103 348	61.5	62 032	36.9
2015	193 189	113 121	58.6	69 699	36.1
2016	192 618	119 427	62.0	76 044	39.5

Table adapted from NSC diagnostic report 2016

Table 3.2 shows that the percentage of learners that achieved 40% and above from 2014 to 2016 has been less than 40%, for example of the 193 189 learners who wrote in 2014 only 69 699 achieved 40% and above, which is 36.1% of the learners who sat for the examination. This suggests that 63.1% of the learners did not obtain the desired quality results sought by universities and colleges in 2015. In this study these types of results are termed poor quality results. From the relatively poor quality results in both Life Sciences and Physical Sciences in South Africa from 2013 to 2016 it can be deduced that there are a number of challenges hindering the attainment of good quality results.

### **3.3 SCIENCE EDUCATION CONTEXT**

There is consensus that in many places around the world, science education is facing serious challenges. Those seeking to improve science education face numerous, and sometimes complex, problems. In many places the lack of resources, both educational and financial, is linked to a dearth of adequately trained teachers and the growing popularity of non-scientifically based belief systems (International Council for Science ICSU, 2011:7). According to the ICSU (2011:8) science education is clearly inadequate in many places around the world, however, there are bright spots where innovative approaches have had some success, and which may form the basis for models that can be emulated elsewhere. Educational research is providing information about effective approaches to facilitate learning and the professional development of educators. In this regard the author of this thesis strongly believes that quality assurance in science education can solve the problems encountered in science education worldwide.

### **3.4 QUALITY SCIENCE EDUCATION**

According to Xanthoudaki (2010:38-39) quality science education means providing effective contexts and policy frameworks, taking into account learner and educator influence and perceptions about science, and finally encouraging, developing and fostering cooperation between formal and informal learning environments. Quality science education is accompanied by quality science learning, teaching and pedagogy. It is important to look at quality because it promotes healthy competition, results in

customer satisfaction, helps in maintaining standards, provides a platform for accountability, promotes credibility, prestige and status, as well as educators' morale and motivation (NAAC, 2007). These definitions of quality science education forms the basis of this study. Some of the attributes that promote quality education are discussed in this section.

### **3.4.1 Quality science learning**

Xanthoudaki (2010:39-40) explains quality science learning firstly as adopting an enquiry-based teaching and learning approach to science which is based on observing, questioning, hypothesising, investigating, interpreting, communicating and evaluating acquired knowledge. Secondly, learners in enquiry-based science should view themselves as active participants in the process of learning, who look forward to doing science, demonstrate a desire to learn more, seek to collaborate and work cooperatively with their peers, confident in doing science, demonstrate a willingness to modify ideas, take risks, display healthy scepticism and respect individuals and differing points of view. These ideals to achieve quality science learning in South Africa are hindered by a number of factors, which are discussed in this chapter.

### **3.4.2 Quality science teaching/pedagogy**

For quality science teaching to take place educators can enhance an internally persuasive dialogue by posing authentic questions and follow-up questions that appreciate student answers, challenge the student on a suitable level, and give room for reflection by the learner and/or among learners (SETAC, 2014). Xanthoudaki (2010:42) proposes five steps to facilitate reflections, which are to trigger an interest in knowing how the phenomenon works, allowing for full observation of the phenomenon, allowing for hypothesis-making, allowing for reasoning and allowing for verification through empirical investigation. Educators in South Africa, however, are not able to follow up on all learners' questions due to time constraints, schedule deadlines which should be met and a great deal of administrative work.

Xanthoudaki (2010) further proposes that quality science education can be achieved if educators take into account children's misconceptions by allowing learners to start

from their own ideas and go on questioning them through observation, experience and modelling through contradiction with the ideas of other learners or texts. Xanthoudaki (2010) argues that constructivism shows that a conception may be questioned by a learner at two levels, namely the knowledge and the individual level. At the first level the knowledge system must be dismantled, hence destabilising the learner, while the second level should allow the new knowledge to be restructured, thus allowing individual learning to be re-established. Educators are also urged to use experimental elements which can lead to a meta-cognitive reflection. Xanthoudaki (2010) urges educators to employ scientific debate as tools to build the essential qualities of a scientific mind and a critical stance. Questioning misconceptions through building hypotheses which can be tested via investigations was also highlighted.

### **3.5 STEPS TOWARDS ACHIEVING QUALITY SCIENCE EDUCATION IN SOUTH AFRICA**

#### **3.5.1 Vision, mission and values of DBE**

Vision statements are like roadmaps that guide institutions or countries to move in certain trajectories. The South African DBE also set its defining direction as given in the vision statement below:

“Our vision is of a South Africa in which all our people will have access to lifelong learning, education and training opportunities which will, in turn, contribute towards improving the quality of life and the building of a peaceful, prosperous and democratic South Africa” (DBE, 2015:9).

The mission statement of the Department also shows that it strives towards quality:

“Working together with provinces, our mission is to provide relevant and cutting-edge quality education for the 21st century.”

According to DBE (2015:9), in order for the Department to place the interests of the learners first, the following values are promoted:

**People:** Upholding the constitution, being accountable to the government and the people of South Africa. **Excellence:** Maintaining high standards of performance and professionalism by aiming for excellence in everything we do, including being fair, ethical and trustworthy in all that we do. **Teamwork:** Cooperating with one another and with our partners in education in an open and supportive way to achieve our shared goals. **Learning:** Creating a learning organisation in which staff members seek and share knowledge and information, while committing them to personal growth. **Innovation:** Striving to address the training needs for high-quality service and seeking ways to achieve our goals (DBE, 2015:9).

Like any organisation with a vision, mission and values, challenges are inevitable, thus the need to review or develop strategies to improve practices. The Minister of Basic Education highlighted some of the challenges faced by the Department as follows: poor learning outcomes across all grades; insufficient benchmarked measurement of learning outcomes; insufficient access to quality teaching and learning materials; unproductivity and ineffective use of time in the classroom; and a general lack of access to basic education (Motshekga, 2015b). This clearly shows that quality assurance mechanisms should be in place or should be strengthened in order to overcome these challenges. The Minister further explained that the Department of Education had split into two, namely the Department of Basic Education (DBE) and the Department of Higher Education and Training (DHET) in order to be more focused and improve the quality of basic education. The improved quality of basic education was then prioritised by the government, with the intention of building specific strategies that would transform the basic education sector.

It is evident that the DBE has been aiming towards improving the quality of science education as emphasised by the Minister when she said:

“Our focus over the next five years will also be the improvement and progression of especially mathematics, science and technology (MST). Our ultimate goal is to have MST and reading offices in all provinces as part of strengthening support for improved curriculum delivery” (Motshekga, 2015b).

South Africa has put in place strategic plans that are guided by national and departmental mandates which all aim at improving the quality of basic education. In addition to the national education legislative mandates, there are also education white papers and policies that guide South African institutions in the delivery of quality education.

### **3.5.2 Mandates towards quality education**

#### **3.5.2.1 The Constitution of South Africa, 1996 (Act 108 of 1996)**

This is a constitutional mandate and the policy requires education to be transformed and democratised in accordance with the values of human dignity, equality, human rights and freedom, non-racism and non-sexism. It guarantees basic education for all, with the provision that everyone has the right to basic education, including adult basic education (DBE, 2015). In this mandate basic education has been made a right, but at the same time quality should not be compromised just because it applies to all South Africans.

#### **3.5.2.2 The National Education Policy Act (NEPA), 1996 (Act 27 of 1996)**

This is a legislative mandate, an Act that inscribed into law the policies, the legislative and monitoring responsibilities of the Minister of Education, and the formal relations between national and provincial authorities. It laid the foundation for the establishment of the Council of Education Ministers, as well as the Heads of Education Departments Committee (HEDCOM), as inter-governmental forums that would collaborate in the development of a new education system. NEPA therefore provides for the formulation of national policy in both general and further education and training bands (GET and FET) for curriculum, assessment, language and quality assurance. NEPA embodies the principle of cooperative governance, elaborated upon in Schedule 3 of the Constitution.

### **3.5.2.3 South African Schools Act (SASA), 1996 (Act 84 of 1996), as amended**

This legislative mandate was enacted to provide for a uniform system for the organisation, governance and funding of schools. It ensures that all learners have the right of access to quality education without discrimination, and makes schooling compulsory for children aged 7 to 14 years (DBE, 2015). This mandate seeks to ensure that learners have access to quality education, thus it directly affects science education in schools.

### **3.5.2.4 Employment of Educators Act, 1998 (Act 76 of 1998)**

To provide for the employment of educators by the state and for regulation of the conditions of service, discipline, retirement and discharge of educators. The Employment of Educators Act and the resultant professional council, the South African Council of Educators (SACE), now regulate the historically divided teaching corps (DBE, 2015).

### **3.5.2.5 South African Qualifications Authority (SAQA) Act, 1995 (Act 58 of 1995)**

The South African Qualifications Authority Act provided for the establishment of the National Qualifications Framework (NQF), which formed the scaffolding for a national learning system that integrated education and training at all levels. The launch of the Human Resources Development Strategy by the Minister of Labour and the Minister of Education on 23 April 2001 reinforced the resolve to establish an integrated education, training and development strategy that will harness the potential of adult learners. The design of the NQF was refined with the publication of the Higher Education Qualifications Framework in Government Gazette No. 928, 5 October 2007, to provide ten levels of the NQF. The school and college level qualifications occupy levels 1 to 4 as in the original formulation.

## **Establishment of Umalusi**

Umalusi is the quality council for general and further education and training as contemplated in the NQF Act and has the functions contemplated in section 28 of that Act. Umalusi promotes quality and internationally comparative standards in FET; maintains and improves educational standards through the development and evaluation of qualifications and curriculum; ensures quality assurance of assessment, and the provision of education, training and assessment; continually develops in-depth knowledge and expertise in mandated areas through rigorous research; reports on the quality of education and training within the mandate; issues appropriate and credible certificates of learner achievement in terms of specific qualifications and subjects on the FET Framework of Qualifications; and provides reliable and credible leadership and guidance in standard setting and quality assurance (DBE, 2015:46).

### **3.5.2.6 Education White Paper 1**

According to DBE (2015), the fundamental policy framework of the Ministry of Basic Education was stated in the Ministry's first white paper, Education and Training in a Democratic South Africa: First Steps to Develop a New System (February 1995). This document adopted as its point of departure the 1994 education policy framework of the African National Congress. There were extensive consultations, negotiations and revision of the white paper before it was approved by the Cabinet. This then served as a fundamental reference for subsequent policy and legislative development.

### **3.5.2.7 The National Curriculum Statement Grades R to 12**

The National Curriculum Statement (NCS) Grades R to 12 is a policy statement that was designed for a liberating, nation-building and learner-centred, outcomes-based learning and teaching initiative in schools. The NCS replaced the policy document, A Resume of Industrial Programmes in Schools, Report 550 (89/03). The NCS embodied the vision for general education to move away from a racist, apartheid, rote model of learning and teaching. The reformulation was intended to allow greater mobility between different levels and between institutional sites, as well as to promote the integration of knowledge and skills through learning pathways. Assessment,

qualifications, competency and skills-based framework were developed in order to align the curriculum model to the NQF in theory and practice (DBE, 2015:12). The NCS gave rise to the enquiry-based teaching and learning of science and the integration of many teaching styles that are learner-centred.

### **3.5.3 Strategic objectives towards quality education**

#### **3.5.3.1 National Development Plan (NDP)**

The South African educational landscape, in terms of the policy directives, was influenced by the NDP. All government departments are driven by this plan, and the basic education sector aligned its plans to the NDP in order to drive this mandate. The sector plan, Action Plan to 2019: Towards the Realisation of Schooling 2030, detailed the direction which the basic education sector took to achieve the goals set out in the NDP and in the MTSF (DBE, 2015:12). A number of initiatives were put in place to respond to the NDP, namely infrastructure and learning materials to support effective education; improved quality teaching and learning; human resource development and management of schools; capacity of the state to intervene in and support quality education and increase accountability for improved learning. It is the view of the researcher that well-defined quality assurance mechanisms should be in place for these initiatives to succeed.

#### **3.5.3.2 The Medium-term Strategic Framework (MTSF)**

The Department of Basic Education has aligned its strategic plan to the following six MTSF sub-outcomes:

- i) Improved quality teaching and learning through the development, supply and effective utilisation of educators
- ii) Improved quality teaching and learning through the provision of adequate, quality infrastructure and LTSM

- iii) Improving assessment of learning to ensure quality and efficiency in academic achievement
- iv) Expanded access to ECD and the improvement of the quality of Grade R, with support for pre-Grade R provision
- v) Strengthening accountability and improving management at school, community and district level
- vi) Partnerships for educational reform and improved quality.

One of the MTSF output speaks to science curriculum and assessment which states: MTSF output 3: Regular annual national assessments to track improvements in the quality of teaching and learning. The implementation of CAPS has continued after its successful implementation in schools. The following areas, however, became critical areas of focus:

**i) Mathematics, science and technology (MST)**

Participation in these gateway subjects has been a focus in some schools and the DBE thrust to make sure that all schools offer Mathematics as a subject, and that the number of learners doing Mathematical Literacy are reduced significantly in order to offer learners a chance in their future careers. The Department asserts that there is an urgent need to identify schools that do not offer MST so as to assist them.

**ii) Improving ANAs for learning to ensure quality and efficiency in academic achievement**

The focus of DBE on ANA was to drive classroom performance and learner attainment at all levels, not just in Grade 3, 6 and 9. Standardised testing was projected to assist classroom accountability at school level, and also drive the districts' monitoring and evaluation processes. According to DBE (2015) ANA testing needed to be improved in terms of the quality of questions to make sure the system was rigorous and scientific, thus ensuring system performance being effectively tracked (DBE, 2015).

Section 3.5 has highlighted some of the steps South Africa has taken in order to improve the quality of education from a national and policy mandate perspective. It is the aim of this study to align and verify whether the steps and mechanisms taken had an effect on the quality of achievement in science.

### **3.6 Factors impeding quality science education**

A number of researchers in South Africa have studied the factors associated with the poor performance of learners in science. These factors include the language of science instruction; class sizes; a lack of qualified science educators; poor teaching methods; a lack of human and material resources; learner ill-discipline in class; poor content coverage; lack of professional leadership and poor time management (Zisanhi, 2013; Muzah, 2011; Taylor, 2009; Mji & Makgato, 2006; Phurutse, 2005). Five categories were identified as barriers to quality education, namely household barriers; policy barriers; infrastructure barriers; community beliefs and practices; and educational barriers (UNICEF, 2002a:2).

The quality of school performance in South Africa is limited to the current understanding and practice whereby the only consideration is the number of Grade 12 learners who pass the National Senior Certificate examination. A number of authors have distanced themselves from the concept of pass rates as the sole determinant of quality education (Manqele, 2012; Nsubuga, 2008). Nsubuga (2008:4) refers to quality performance in a school environment in terms of test scores, examination results, the learner's ability to socially apply what is learnt and the rate at which learners move to higher institutions of learning. As Manqele (2012) puts it:

“School performance in terms of learners’ scores does not necessarily reflect the quality of education it offers.”

The factors that bring about quality education apart from academic performance include well-motivated and committed educators, learner satisfaction and involvement, parental involvement, a clean and orderly school environment and strong principal leadership (Manqele, 2012:202).

This study uses the systems and TQM theoretical frameworks and an underlying assumption that when the inputs are present and monitored through quality assurance learners' achievement will be positively affected. Therefore, where the inputs are inadequate and compromised and quality assurance is absent, then poor quality performance will be the result. Hanushek (2007) states that the output of the educational process – the achievement of individual learners – is directly related to inputs that are controlled by policymakers.

Quality education can be achieved if there is quality control of the quality of educators, infrastructure and learning environment, resource inputs, teaching process, classroom management, academic assessment, principals' supervision roles and learners' commitment to learning (Kotirde & Yunos, 2014). Although the concept of educational quality is complex and multidimensional, the general concept of quality education is made up of three interrelated dimensions. The first one is the input to the system, which looks mainly at the quality of human and material resources available for teaching. The second is the process, which looks at the quality of the teaching process. The third dimension is the output, which mainly refers to the quality of the results (Serbessa, 2006:5, cited by Manqele, 2012:19).

With regard to the views of the different authors as well as the theoretical framework of this study the input, process and output trajectory are followed in terms of factors challenging/impeding quality science education. This study focuses on the following educational inputs in terms of quality human and material resources and the quality checks and balances:

1. Quality of science educators
2. Quality of science learners
3. Laboratories and Laboratory assistants/technicians
4. Support systems and learner/teacher support materials (LTSM)
5. Contact time and educator workload

The study also focuses on the educational processes which enhance the quality of science teaching and learning processes.

1. Language in science teaching
2. Enquiry-based teaching and learning of science
3. Science assessment
4. Motivation of science learners
5. Formal and informal learning of science

### **3.7 Educational inputs that impede attainment of quality science education**

#### **3.7.1 Quality of science educators**

Defining educator quality is not easy as any single definition will not suffice. Spaul (2013:24) defines a quality educator as someone who possesses the following four attributes: some requisite level of professionalism (values); the inclination to teach (attitudes and desires); the ability to teach (knowledge, skills and pedagogy); and the competence to teach (imparting and instilling the knowledge, skills and values to learners). This thesis examines two aspects of educators, namely educator quality and educator teaching quality. Educator quality in this case refers to the professional preparation characteristics, educator knowledge and the qualifications the educators possess. Educator teaching quality refers to what educators do in the classroom in order to promote science conceptual understanding and fostering learning (Perez, 2013). Educators are the key players in improving the quality of science learning in schools. Detailed studies show the complexity of the role of the educators as they are responsible for the greater part of or the entire curriculum transfer to learners. Long-term studies show that to change the fundamental practice of educators' takes time. To change classrooms to focus on learners' learning, as quality science education demands, is a task that requires the willing cooperation of educators, parents, learners and all stakeholders (UNESCO, 2010:37).

Quality output in terms of science education is determined by how effective educators are in class through quality teaching. However, educator quality is difficult to measure but in this thesis quantifiable determinants are used, like academic qualifications, years of experience, value addition in institutions and partly output in terms of percentage pass rates. A quality science educator is one who fulfils their purpose of simplifying the subject matter so that it can be accessible to learners (Trowbridge et al., 2004:213). A

great deal of research in South Africa links poor performance of learners in science to the quality of the educators. A number of authors have revealed that there is a serious shortage of properly qualified and competent science educators in South Africa (Stephen, 2013; Muzah, 2011:190; Cameron, 2009:16; Mji & Makgato, 2006:254; Muwanga-Zake, 2008:5; Makgato, 2007:91).

In the past few years the DOE has poured a great deal of resources into educator development through offering in-service workshops. However, research shows that in spite of significant investments in science educator development there is lack of content structure for instruction especially in science (Aldous, 2004:65). Prior to 2005 there was a recruitment drive of locally unqualified and poorly qualified science educators who lacked both subject knowledge and teaching methods as a result of the apartheid legacy (Madibeng, 2006:1).

On realising their shortfall, the DOE from 2007 onwards hired large numbers of science educators from other countries. These qualified science educators were, however, overloaded and this affected the quality of their science teaching and furthermore resulted in cognitive, instructional and affective problems (Vos et al., 2007:51). Trowbridge et al., (2004:26-32) state that there is a strong relationship between subject content and methodology in teaching science, therefore there is a need for the development of the science educator's knowledge of the subject in relation to the teaching methods. This forms the basis of science teaching and learning, and is essential for instructional theory. Stephen's (2013:106) research findings revealed that educators in the Tshwane South district who produced 50% and more in the subject had sufficient content knowledge of the subject and effectively used their resources and teaching methodologies. Furthermore, she found that those educators who had sufficient content knowledge but did not use the resources available for teaching did not deliver good lessons or produce good results.

The DBE is trying to address the quality of educators in a number of ways as shown below:

“A constant inflow of young and qualified educators into the profession will ensure that all classes have a qualified teacher, as well as ensure continued

interest in the profession. In 2014/2015 the Department improved the systems and processes aimed at improving the efficiency and effectiveness of the placement, deployment and utilisation of educators by completing the profiling of teacher qualifications and amending the post provisioning norms and model” (DBE APP, 2015-16:9).

The Department recently provided educators with lesson plans, however, they need to adapt information from the textbooks for learners to understand. Adaptation and contextualising of the learning material are a good practice because what they receive from the Department is generic material which may not have relevance to their environment (Maile, 2013:25).

A study conducted in the USA revealed that the difference between more and less effective educators lies in teaching quality as opposed to teacher quality. The findings of this study indicated that elements of teaching quality are more indicative of teacher effectiveness than elements of teacher quality among educators in the study conducted by Perez (2013:iv). Although there was some evidence of a relationship between elements of teacher quality and teacher effectiveness, there were clear differences in teaching quality among more effective and less effective educators in this single study (Perez, 2013:iv). Educator content knowledge and learner academic performance have been correlated as the educators play a central role in the effective dispensation of the curriculum (SACE, 2010:23). There is ample evidence from research showing that learners who are taught by unqualified educators will produce poor results (Lebata, 2014; Spaul, 2013; Ogonnaya, 2011:130-131).

### **3.7.2 Quality of science learners**

The performance of learners, especially at the end of Grade 12, is used by stakeholders to conclude on the quality of education received by learners (Stephen, 2013:46). There is more emphasis on the output but no real consideration of the input, i.e. the quality of the learners especially when they choose Physical Sciences, Mathematics and Life Sciences as a subject of choice in Grade 10. Guidance, counselling and learner support play an important part in upholding academic standards. They also help to ensure that learners choose subjects appropriate to their

requirements, with the attendant likelihood of greater academic success and good quality results (Wisker & Brown, 1996:12).

The quality of science learners in South Africa has declined due to a number of factors, namely policy on subject selection, science class sizes and learner discipline among others. The size of the class compromises the quality of the science educator's teaching due to reduced interaction with learners, an unsatisfactory learning process, and decreased active learner participation (Phurutse, 2005:5). Different studies carried out in South Africa have revealed that large classes are common and negatively affect the teaching and learning of science (Muzah, 2011:194; Phurutse, 2005:5; Mji & Makgato, 2006:254; South Africa, 2009:8-9). These researchers clearly showed that science educators who teach smaller classes, experience more positive attitudes from learners and their work and consequently produce better matriculation results than larger science classes. Large classes were characterised by a lack of discipline, disruptions and other problems which hindered meaningful teaching and learning.

Learners play a pivotal role in achieving quality results, hence at the entry point of the educational system learners are expected to be of high quality in terms of morals and meeting the expected standard of the level or class in which they are to be enrolled for an academic purpose (Kotirde & Yunos, 2014). There are incidences where learners of poor ability have been promoted into higher classes in educational institutions. The admission of learners with very poor academic standards into the next grade in schools has been seen as a way of laying the foundation of indiscipline (Ebenebe, 1998).

The IQMS document in South Africa is used in quality assurance and has a performance measurement instrument for teacher evaluation, where Performance Standard 1 is the "creation of a positive learning environment". Part (b) and (c) deal with the type of learners in their classes.

Performance Standard: 1. CREATION OF A POSITIVE LEARNING ENVIRONMENT  
CRITERIA: (a) Learning space; (b) Learner involvement; (c) Discipline; (d) Diversity.

The following descriptors are used:

- Unacceptable: No discipline and much time is wasted. Learners do not accept discipline or discipline is experienced by learners as humiliating. Educator and learners appear uninterested.
- Satisfies minimum expectations: Learners are engaged in appropriate activities for most of the lesson. Learners are disciplined and learning is not interrupted unnecessarily.
- Good: The environment is stimulating and learners participate actively. Learners are encouraged; there is positive reinforcement. Learners accept discipline without feeling threatened.
- Outstanding: Learners participate actively and are encouraged to exchange ideas with confidence and to be creative. Learners are motivated and self-disciplined.

These descriptors clearly show that educators are entirely responsible for the type of learners they have in their classes. The educators, irrespective of the learners they have in class, are responsible for learner discipline and learner involvement. From the researcher's experience more mechanisms should be put in place to assist educators with discipline issues. Quality education will only be achieved if learners meet a certain standard before they are admitted or promoted into certain streams and the standards should also be high (Ezezobor, 1983).

### **3.7.3 Laboratories and laboratory assistant personnel/technicians**

South African public schools do not have adequate laboratories and rarely do they have laboratory assistant personnel/technicians, which leads to poor quality science output. Research studies (Manqele, 2012; Mji & Makgato, 2006:254; Howie, 2003:2; Legotlo et al., 2002:115) have consistently shown that a lack of resources is a common problem in most South African public schools. These studies together with others have revealed that in South Africa most public schools have a serious shortage of physical facilities such as classrooms, laboratories, libraries and science equipment. These

findings show that resource availability and achievement in science positively correlate. Furthermore, the studies revealed that laboratories and science equipment have a greater impact on learners' achievement in science than other resources in a school. The absence of school laboratories in most public schools dictates the way science educators teach in class and this hugely contributes to the poor performance of learners. Hofstein and Lunetta (2003) argue that laboratories have a central and distinctive role in science education and that there are rich benefits in learning practically, using laboratory activities. Some countries have laboratory technicians or assistants to the science educator, who help reduce administrative work and preparation time for the educator. In South African public schools this is rare and most science educators are overwhelmed by their work due to time constraints. Laboratory work is the most challenging aspect of science teaching when compared to some other subjects because it requires careful planning and considerable expertise on the part of the science educator (Archer, 2006:X1, 38).

#### **3.7.4 Support systems and learner/teacher support materials (LTSM)**

A learner support system is defined as the range of activities which complement the mass product learning materials such as the electronic support subsystem, published material and contact or face-to-face support mechanisms (Tait, 1995:232). Learner support is also defined as any form of help, assistance and guidance given to learners who experience barriers to learning to enable them to overcome their barriers (Department of Education, 2001:15). The support offered can be of a low intensive, moderate or high intensive level depending on the needs of the learner. Learner/teacher support materials (LTSM) include all teaching and learning aids such as chalkboards, posters, charts, audiotapes, projectors, computers and textbooks. Learner support is further defined as all the activities which enhance the capacity of a school to cater for diversity and ensure effective learning and teaching for all learners (Department of Education, 2005:22).

Simpson (2000:6) argues that learner support falls into two broad areas: academic (or tutorial) support and non-academic (or counselling) support. Some forms of learner support are from informal study groups. The importance of learner support programmes lies in encouraging learners not to drop out of school because of limited

English proficiency, poverty, geographic location or economic disadvantage. These disadvantaged learners face a great risk of low educational achievement or reduced academic expectations, thus poor quality results (Eiselen & Geysers, 2003:118).

A learning management system emphasises self-directed learning where learners define specific learning needs that will help them achieve their desired goals. Learners are able to build on their existing knowledge through a continuous and guided process of identifying learning goals, discussing and trying ideas by themselves through participation in groups and recording outcomes in their learning outputs (Hawryszkiewicz, 2004:349). During extra classes individual and general learners' problems are solved. They also serve the function of allowing learners to meet one another to discuss common problems (Nonyongo & Ngengebule, 1998:79). Extra classes and holiday schools as support services in the Gauteng province have helped to ensure that learning is effective and the intended learning outcomes are achieved.

E-learning is essential for managing the wide range of content and tracking learner activities. It complements traditional methods of teaching and learning and serves to identify learners in need of additional support at an early stage (Barret & Douglas, 2004:99). Libraries as part of the learner support system play a leading role in developing a whole-school reading culture, promoting literacy, reading for pleasure and establishing lifelong learning (Barret & Douglas, 2004:47).

Studies by Legotlo et al. (2002:115) revealed that in some schools in South Africa there was a great shortage of learner textbooks, where a ratio of 10:1 was identified. According to Statistics South Africa's General Household Survey, 2002–2011 report, at least 6% of learners nationally indicated they had experienced a shortage of books, compared to approximately 21% in 2002. The 2011 School Monitoring Survey indicated an increase in the provision of literacy textbooks to 78% and mathematics textbooks to 83% of the learners. Despite the increase in the provisioning of LTSM, the allocation and different modalities for LTSM procurement and delivery in respect of provinces, the objective of every learner having a textbook for every subject in each grade is still a challenge (DBE APP, 2015-16:10). Whittle (2010) explains in detail the importance of textbooks and other learner and teacher material resources in delivering quality education. William (2011) proves the point that teaching and learning become

more positive, interesting, varied and more effective through the frequent and selective use of resources. Some researchers' findings in terms of science resources revealed that they were adequate, but that educators made false claims that they do not teach science practically due to a shortage of apparatus (Muwanga-Zake, 2008:3). The studies further showed that some educators could not operate certain apparatus which was already in the schools and as a result they avoided it and left it in the storerooms. Resource increases alone are not the answer to improving results in science, but rather effective and rigorous management by principals and heads of subjects (Bubenzer, 2008:3). This brings back the issue of effective quality assurance mechanisms to deal with resource management and monitoring educators.

### **3.7.5 Contact time and educator workload**

Contact time is the time educators are directly teaching their learners during allocated times. Research shows that the contact time has become reduced due to an increased workload, which results in educators having stress and burnout and then drop out. Research has also revealed that educators are required to juggle diverse, intense types of interactions and respond to colleagues, administrators, parents and community members (Naylor, 2001). Overload on educators in terms of quantity or complexity has been a major source of educator stress resulting in emotional and physical exhaustion (Starnman & Miller, 1992). Studies conducted by ERLC have shown that there is a significant difference in the amount of time spent by different educators: more time is taken preparing for mathematics and science than all the other learning areas. The workload has increased because of an overcrowded curriculum, poorly planned, cross-cutting departmental accountability requirements, class sizes and the mainstreaming of learners with barriers to learning. Educators are also expected to be school managers, treasures, fundraisers, counsellors, nurses, administrators, cleaners, teaching material developers etc. (ELRC, 2005:19-24). Some researchers have also revealed that the implemented curriculum has resulted in educators being overloaded with administrative paperwork and little time being available for teaching and contact time and content coverage (Grayson, 2010:10). It is clear that when contact time is reduced the quantity and quality of work given by educators will also deteriorate. Quality assurance mechanisms to monitor these will definitely help in preventing loss of contact time and educator burnout.

### **3.8 Educational processes that impede attainment of quality science education**

#### **3.8.1 Language as the medium of science instruction**

UNESCO (2000:17) prescribes the use of the learner's first language as medium of instruction to ensure that learners from disadvantaged backgrounds benefit from equal opportunities in education. Motshekga (2006) suggests that science should be taught in the language which the learner understands best or in the language which is most proficiently used at home. Motshekga (2006:4) further believes that mother tongue is a useful strategy for increasing learners' access to quality education in the teaching and learning of science. However, South Africa is a multilingual country with eleven official languages. In science the medium of instruction in most schools in South Africa is English, which is not the learners' first or home language.

Studies conducted by Zisanhi (2013) have revealed that learners are highly challenged when they are taught science in a language which is not their home language. This result concurs with Howie (2003), who investigated the effect of learners' language and communication skills on achievement in science and mathematics. Howie (2003:8) discovered that native English speakers performed best in mathematics and science of all the language groups while the Afrikaans-speaking group attained the next highest score. Scores were very low in learners whose main languages were African languages. The findings by Zisanhi (2013) and Howie (2003) showed that the learner's proficiency in English, the language the learner spoke at home and the language of learning in the classroom have a direct effect on the learner's performance in mathematics and science.

There is a lack of cognitive academic language proficiency that is required to execute higher order cognitive operations. However, in South Africa this must be done in a second language such as English by the majority of science learners (Zisanhi, 2013; Gopal & Stears, 2007; Pillay, 2004; Mothata & Lemmer, 2002). These science learners have to master the academic content, the mathematical concepts used in science, and English, the medium of instruction, which they are not proficient in, thus placing science learners in the difficult situation of having to deal with three different subjects (science,

mathematics and English) in one. If learners are not proficient in the language used to teach science, it may lead to poor performance as learners would not understand questions or concepts that need to be applied to solve scientific problems and would therefore give the wrong answers (Hlabane, 2014; Lebata, 2014; Setati, 2011).

### **3.8.2 Enquiry-based teaching and learning of science**

The nature of science is such that the study of it requires inquisitiveness. For learners to holistically benefit from science education, educators should encourage them to spend more time in independent, discovery-based activities in an environment which is inviting, challenging and motivating. A variety of learning materials are therefore required to help learners to interact, using all their senses (Berk, 2006:152; De Witt, 2009:13). Content knowledge, curriculum knowledge and pedagogical knowledge are all important in influencing learners' performance (Kanyongo et al., 2007:44). Science educators should therefore strive to achieve a balance between the knowledge content of science and content-specific pedagogical issues in their thinking so that instructional planning includes both content issues and issues of how learners may learn the content.

There is a need for educators to emphasise active learning in scientific investigations in classroom environments full of different materials and unfamiliar activities (Trowbridge et al., 2004:24). A number of studies have shown that science learners should be presented with problems that provide them with opportunities to engage in thinking, insights and problem-solving as an integral part of their science lessons. These studies further link low pass rates in science to educators who use old teaching methods that stick to the conventional chalk-and-talk teaching routine (Muwanga-Zake, 2008; Mji & Makgato, 2006; Madibeng, 2006). Studies by Taylor (2006) and Muwanga-Zake (2008) have shown that science teaching and learning in most public schools in South Africa still practise the old conventional system and educator-centred instruction. The old methods involve drilling in scientific concepts, recitation, memorisation of scientific definitions, formulas without logical sequence or an understanding of the relationship between scientific concepts.

Saunders and Shepardson (1987:41-49) show that laboratory activities play an important role in science achievement and cognitive development at school. Their research clearly shows that the appropriate interaction of learners with materials in laboratories that involve both hands-on and minds-on activities develops higher order skills like problem-solving skills, creative and critical thinking skills, collaboration skills and communication skills.

International research has shown that learners perform poorly in science practical activities for a number of reasons, which are similar to the situation in South Africa (Psillos & Niedderer, 2006). Some of these reasons are poor and ineffective laboratory practices; poorly designed and planned practical activities which do not reach any level of understanding in the learners; the inability of learners to use equipment; poor time management when learners engage in data gathering without thorough knowledge; and inadequate skills for processing and analysing data (Psillos & Niedderer, 2006:2-3). Zisanhi (2013) has shown that well-planned practical activities overcome even the language barrier in science learning and can assist second or third language learners. When learners are engaged in well-planned, organised and highly specific practical activities, they will understand scientific concepts much better. Motlhabane (2015) has shown that scientific enquiry and the nature of science play an important role in the teaching and learning of science by incorporating activities aimed at sparking debates about scientific concepts.

### **3.8.3 Science assessment**

Assessment is a continuous, planned process of identifying, gathering and interpreting information about the performance of learners, using various forms of assessment according to CAPS Physical Sciences: 143. The CAPS policy document further specifies that the assessment involves four steps, namely generating and collecting evidence of achievement; evaluating this evidence; recording the findings; and using this information to understand, thereby assisting learners' development and improving the process of learning and teaching. Maile (2013:18) makes the following observation:

“The Department of Basic Education (2012b) National Curriculum Statement Grades R-12, which represents a policy statement for teaching

and learning in public schools, is silent on school-based quality assurance. The silence is also conspicuous in the Department of Basic Education (2012c) National Protocol for Assessment Grades R-12. The implication of this silence is that schools undertake quality assurance without proper guidelines. The absence of policy guidelines would also mean that there are variations in the way schools apply quality assurance. The variations in turn would affect the quality of the assessment at school level.”

Donovan and Bransford (2005) state that quality assessment is central to good teaching and is inevitably a key component in learning environments that facilitate learning with understanding. Since assessment plays a key role in teaching and learning science, it is important that science educators understand and use high quality assessment processes (Edwards, 2013:213). UNESCO Surveys (2010:33) have shown that much school assessment is not carried out to support learning, but it is done for other purposes. One common purpose is for the teacher to monitor how far learners have gone in their learning. In such a case the connection with the learner’s learning is indirect. The results of the assessment can be used to develop the learner’s later learning. Less obvious purposes, according to UNESCO (2010), include the following: to group learners by attainment to make teaching and learning more manageable; to select learners for particular purposes such as the school they might go on to or the suitability for a job; to see if they meet the criteria for particular qualifications; to see how effective a teacher or a school is; to decide on the allocation of additional or scarce resources; and to judge how well a region, nation or educational system is performing.

In order to achieve high quality science education, the focus should be on prioritising the learners’ learning and assessments that support learning above other assessments. In other words, secondary purposes for testing should be downgraded or carried out through different assessment strategies. For an assessment to be valid it should match the purpose or aim of the activities being assessed and the outcomes of the assessment should match the same purposes or aims (UNESCO, 2010:34). Effective assessments in science education should encompass a variety of types of assessment for learning. The variety can lead to bigger changes across the school curriculum, for example the Trojan horse effect, where an apparently small change,

such as in the assessment in science, has a profound and positive impact on teaching and learning across the curriculum (Kirton et al., 2007).

#### **3.8.4 Motivation of science learners and educators**

Motivation can be defined as “an internal state that arouses, directs and maintains behaviour” (Woolfolk, 2013:430). There are two types of motivation, namely intrinsic and extrinsic motivation. Intrinsic motivation is internally driven, caused for example by an interest in a current activity. Extrinsic motivation is caused by external factors such as positive or negative rewards or consequences (Woolfolk, 2013).

Educators feel disempowered, deskilled and deprived of professional esteem and status by the pressure that they experience in managing the present educational policies on supervision. Studies show that educators do not have a positive image of themselves and the profession, and they tend to discourage learners from going into teaching (Samuels, 2004:33). Learners may not be intrinsically motivated to do science subjects, but those who end up doing these, definitely need extrinsic motivation. The way science is taught, especially in public high schools, encourages most science learners to rehearse scientific laws, rules and formulas without attaching meaning to them and understanding them conceptually. This leads to short-term retention, low motivation and poor performance in Grade 12 (Vos et al., 2007:52). Muwanga-Zake (2008:10-11) has shown that a lack of commitment in both educators and learners, is common in South African public high schools. The lack of commitment and the low morale of science educators are attributed to educators being overworked since science requires more input than other subjects. Other contributing factors are poor salaries for educators as compared to scientists in industries, absenteeism and non-performance of duties. Studies by Legotlo et al. (2002:115-116) have shown that learner failure is attributed to a lack of commitment and perseverance, a lack of discipline, misbehaviour and ignoring of instructions from educators.

### 3.8.5 Formal and informal science learning

South African learners need to integrate their formal learning with informal learning to improve the quality of science education.

“There is a lack of strong, valid, and meaningful evidence of the impacts of formal-informal collaborations, largely due to the lack of a well-theorised methodology that captures and describes impacts that have valence with both formal and informal stakeholders” (SETAC, 2014:24).

There are also no quality assurance mechanisms that monitor and ensure that formal and informal science learning is integrated in South African schools.

The Centre for the Advancement of Informal Science Education (CAISE) has revealed that informal science education supports people of all ages and walks of life in exploring science, technology, engineering and mathematics. CAISE defines informal science education as learning that happens in many different places and through a wide variety of ways, like film, broadcast media, science centres, museums, zoos, aquariums, botanical gardens, nature centres, gaming, science journalism and more (CAISE, 2010). Learning science in informal environments offers a structured definition of learning, considering the wider learning context in which informal learners are involved.

SETAC proposes six strands according to which learners in informal environments learn: **STRAND 1** Experience excitement, interest and motivation to learn about phenomena in a natural and physical world; **STRAND 2** Come to generate, understand, remember and use concepts, explanations, arguments, models and facts related to science; **STRAND 3** Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world; **STRAND 4** Reflect on science in a way of knowing; on processes, concepts and institutions of science; and on their own process of learning about phenomena; **STRAND 5** Participate in scientific activities and learning practices with others, using scientific language and tools; **STRAND 6**

Think about themselves as science learners and develop an identity as someone who knows about, uses and sometimes contributes to science (SETAC, 2014:24).

SETAC (2014) argues that formal-informal collaborations can lead to conceptually rich and compelling science learning programmes that build on the structural and social affordances of informal settings and objects. Formal-informal collaborations can lead to the creation of professional learning communities that develop practices, dispositions and understandings valued across multiple institutional settings and boundaries. Formal-informal collaborations, however, take significant time and energy, often unacknowledged by sponsors of the work, and are a continuing but valuable process of evolution for individuals and institutions (SETAC, 2014:25). In order to improve the quality of science in South Africa there is an urgent need to quality-assure and integrate formal and informal learning experiences. If there is no quality assurance mechanism available to monitor and integrate formal and informal science learning then learners may miss opportunities that may motivate them or bring meaningful learning to them.

### **3.9 CONCLUSION**

This chapter began by defining the concepts central to the study, namely science education and quality education in the South African context. A literature review was conducted in order to establish the steps South Africa has taken towards achieving quality science education and the factors promoting ineffective science instructional programmes or preventing the achievement of quality science education. The roles of specific inputs and processes that impact negatively on achieving quality science education in high schools were also investigated. Particular attention was paid to quality science education and the contributing factors to poor quality science results in South Africa. Research has also revealed that mathematics, science and technology participation in these gateway subjects has been declining in some South African schools in recent years (DBE APP, 2015-16). It is an assumption of this study that these challenges can be solved mainly through having proper quality assurance mechanisms on all educational inputs and processes mentioned in this chapter. This

will eradicate poor performance, which means that high failure rates will be eliminated from the South African science education vocabulary.

## **CHAPTER 4**

### **RESEARCH DESIGN AND METHODOLOGY**

#### **4.1 INTRODUCTION**

This chapter describes the research design and methodology employed in the study to answer the research questions. The motivation for conducting the study is also explained. Population, sampling, sampling techniques, data collection instruments, data analysis and reliability and validity modalities are discussed. Three methods were employed in collecting data, namely interviews, questionnaires and the viewing of documents.

“Research” has been described as an open-ended process that is likely to generate as many questions as it does answers (O’Leary, 2004:1). There is no research type that can be referred to be the best, there are only good questions that can be matched with appropriate methods of enquiry. Research methodology is a framework associated with a particular set of paradigmatic assumptions used to conduct research (O’Leary, 2004:9,85).

#### **4.2 QUANTITATIVE, QUALITATIVE AND MIXED RESEARCH PHILOSOPHIES**

Three main philosophies have evolved over the years, namely positivism, constructivism and pragmatism. The distinction between the qualitative and quantitative paradigms lies in the quest for understanding and in-depth enquiry (O’Leary, 2004:99). The research method used in this study is pragmatic in nature and makes use of both qualitative and quantitative philosophies. Questionnaires, interviews and document analysis were used as data collection techniques.

##### **4.2.1 Positivist philosophy**

Positivist philosophers believe that the world is a fixed entity with mysteries that are beyond human comprehension such that their findings should be quantitative, statistically significant and can be generalised (O’Leary, 2004:5). According to

Creswell and Clark (2007:22) post-positivism research claims that there should be determination-cause-effect thinking; reductionism, narrowing and focusing on select variables to interrelate; and detailed observations and measures to interrelate theories that are continually refined.

#### **4.2.2 Constructivist philosophy**

Qualitative purists, also called constructivists and interpretivists, believe that multiple-constructed realities abound, and that time- and context-free generalisations are neither desirable nor possible. According to constructivists, research is value bound; it is impossible to differentiate fully between causes and effects; logic flows from specific to general and the knower and known cannot be separated (Cameron, 2009:140; Ngulube, Mokwato & Ndwandwe, 2009:106). By using the constructivist qualitative approach, the researcher aimed to gain an in-depth understanding of the feelings, experiences and views of the science quality assurance implementers, managers, district officials and educators. Through the qualitative approach, as indicated in Chapter 1, the researcher aimed to investigate quality assurance in science education as part of individuals or groups ascribing to a social or human problem. Merriam (1998:5) defines qualitative research as an umbrella concept covering several forms of enquiry that help the understanding and explaining of the meaning of social phenomena with as little disruption of the natural setting as possible. The reason for using a qualitative approach in this study was that the researcher needed a complex and detailed understanding of the use of the phenomenon of quality assurance in science education (Creswell, 2013).

Qualitative research begins with assumptions of the world view that use theoretical lenses of research problems enquiring into the meaning of individuals or groups ascribing to a social or human problem (Creswell, 2013). Qualitative research involves going into the field, where the researcher talks or observes the people, settings and sites, and records a certain phenomenon in its natural setting. The process of research is inductive in nature, where the researcher builds abstractions, concepts, hypothesis and theories from details obtained in the field (Creswell, 2013). The detailed understanding of quality assurance is gained through talking directly to the implementers of the quality assurance policies, namely district officials, HODs and

educators, through interviews so that they may relate their experiences. “Qualitative approach” is an umbrella phrase covering an array of interpretive techniques which seek to describe, decode, translate and come to terms with the meaning of naturally occurring phenomena in the social world (Welman, Kruger, & Mitchell, 2005). Creswell (2013) tried to dissect qualitative research and came up with the following building blocks: paradigm or a set of philosophical assumptions; the research methods and research design; data collection techniques; qualitative data analysis and a written record of the findings.

#### **4.2.3 Pragmatic philosophy**

Pragmatists promote mixed-method research, a philosophy that attempts to fit together the insights provided by qualitative and quantitative research (Johnson & Onwuegbuzie, 2004:16). Pragmatism offers an epistemological justification and logic and uses the combination of methods and ideas that give tentative answers to research questions (Johnson, Onwuegbuzie & Turner, 2007:125). The pragmatist worldview focuses on the consequences of research. Mixed-method research is an approach to knowledge that attempts to consider multiple viewpoints, perspectives, positions, and standpoints of qualitative and quantitative research (Johnson et al., 2007:113).

The mixed-method research methodology helped to answer the main question and the sub questions below:

Main question:

- How does quality assurance influence the quality of science in South African secondary schools?

The following were the sub questions:

1. What are the factors impeding the quality of science education in secondary schools?
2. What mechanisms have been put in place in the South African education system to instil quality science education?

### 3. How do secondary schools manage quality assurance in science education?

#### 4.3 RESEARCH PARADIGM

“Paradigm” is defined by Myers, Well & Lorch (2010) as a philosophical perspective that is positivist, interpretive or critical in nature. A paradigm is a set of basic beliefs that deal with ultimate first principles and represents the worldview that defines a personal nature of the world (Guba & Lincoln, 1994:107). A paradigm in this case represents the worldview that defines for its holder the nature of the world and the individual’s place in it. “Paradigm” is defined by Terre Blanche Durrheim & Painter (2006) as a common-sense understanding of science which emphasises and encompasses interrelated practices that define the nature of the enquiry for researchers. Denzin and Lincoln (1998), Terre Blanche et al. (2006) describe positivist, interpretive and constructivist paradigms through three dimensions/elements in research paradigm. The first element is ontology, which deals with the question of what is real, i.e. how individuals think the social world is constituted. The second element is epistemology, the branch of philosophy that studies the nature of knowledge and the process by which knowledge is acquired and validated. The third element is methodology, which involves the methods used to search for knowledge or how knowledge is gained. The functions of paradigms are spelt out by Higgs & Smith (2006) as follows: to define how the world works, how knowledge is extracted from this world and how one is to think, write and talk about this knowledge; to define the types of questions to be asked and the methodologies to be used in answering; to decide what is published and what is not published to structure the world of the academic worker; and finally, to provide the meaning of the paradigm and its significance. This study is phenomenological in nature (McMillan & Schumacher, 2010:24) it aims to transform lived experience into descriptions and allows for reflection and analysis. These types of research may involve repeated and lengthy face-to-face interviews with the participants. The constructivist paradigm upon which this qualitative research is built, assumes that reality is interpreted by individuals, is interactive and is a shared social experience (McMillan & Schumacher, 2001:396).

#### 4.3.1 Ontological dimension

The main question in the ontological dimension is: “What is real” or “what is truth?” i.e. reality or truth (Higgs & Smith, 2006). **Logical empiricism** or **logical positivism** believes that truth is found by looking at the hard facts through the use of sense experiences and that reality is obtained through the use of logical and linguistic analysis as well as sense experiences. The world view of logical empiricism says that the world is real, objective and knowable through scientific investigation, therefore reality or truth is objective. **Hermeneutics** believes that truth is found through interpretation and dialogue; there is no objective truth, in actual fact truth or reality is subjective. **Systems theorists** believe that society and social issues can be studied objectively while **phenomenology** claims that truth has a perceivable, objective existence (Higgs & Smith, 2006).

#### 4.3.2 Epistemological dimension

Epistemology is the branch of philosophy that studies the nature of knowledge and the process by which knowledge is acquired and validated. **Logical empiricism** or **logical positivism** defines education in terms of acquiring competence in logical, clear, critical thinking and learning from experience. **Hermeneutics** believes that education is a process which assigns meaning to achieve understanding. **Systems theory** asserts that education is the practice of information exchange through interactions and the improvement of the system. **Phenomenology** believes that education seeks to uncover the essence through creating environments to discover the true self (Higgs & Smith, 2006). In this study no single epistemological dimension was adopted but a mixture of those mentioned was used.

### 4.3.3 Methodological dimension

Methodology involves the methods used to search for knowledge or how knowledge is gained. **Logical empiricism** or **logical positivism** believes that knowledge can be obtained through manipulation of physical objects in the world to arrive at the truth. Knowledge is received through our senses and direct experiences. **Hermeneutics** uses heuristics and discourse analysis to understand the truth. **Systems theory** says that knowledge is found in systems through a problem-centred approach. **Phenomenology** extracts knowledge via authentic dialogue through putting aside all theories, prejudices and ideologies and looking at what is actually happening (Higgs & Smith, 2006:56). However, this study is biased towards the phenomenological ideology as there is a need to understand the actual processes taking place in schools that are helping to move towards quality science education through quality assurance.

## 4.4 RESEARCH DESIGN AND METHODOLOGY

A research design is a detailed description of the procedures that the researcher will use to investigate a problem. The research design includes justification for the hypotheses or an exploration of research questions and a detailed presentation of the steps to be taken in collecting, choosing and analysing data (Gay & Airasian, 2003:78). A research design refers to all the decisions the researcher makes when planning the study, such as sampling sources and procedures for collecting data, measurement issues and data analysis plans (De Vos, 1998:77). A research design involves specifying exactly who or what is to be studied, and when, how and for what purpose (Babbie, 2001:90). McMillan and Schumacher (2010) further explain that a research design refers to a plan for selecting subjects, research sites and data collection procedures to answer the posed research questions. Mrazek (1993:42) defines research design as a plan to use one or more techniques to collect data in an organised manner. With regard to planning, research design has been referred to as the blueprint for the collection, measurement and analysis of data (Cooper & Schindler, 2004:140). Research methodology refers to a process whereby the researcher collects and analyses data in a particular fashion. It is systematic and purposefully planned to obtain the relevant data on a particular research problem. Data collection may include extensive interviews, observations and questionnaires (Schumacher & McMillan,

2010). The research methods include a qualitative method, quantitative method and mixed-methods research, where a researcher mixes or combines quantitative and qualitative research techniques into a single research study (Johnson & Christensen, 2004:410).

#### **4.4.1 Types of mixed-methods designs**

According to McMillan and Schumacher (2010:401) there are three types of mixed-methods designs, namely sequential explanatory design; sequential exploratory design and concurrent triangulation designs. Hui Bian (2013) describes mixed methods as follows:

“As a method, it focuses on collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches, in combination, provides a better understanding of research problems than either approach alone.”

Hui Bian (2013) divides mixed methods research into six major designs, namely convergent parallel design, explanatory sequential design and exploratory sequential design (instrument development design), embedded design, transformative design and multiphase design.

##### **4.4.1.1 Explanatory sequential design**

Explanatory sequential design is a design in which quantitative and qualitative data collection is implemented in two phases. This type of design puts more emphasis on the quantitative method where data is collected and analysed. The second phase consists of a follow-up analysis using qualitative data collection methods (McMillan & Schumacher (2010:401).

#### **4.4.1.2 Exploratory sequential design**

According to McMillan and Schumacher (2010:402) the second method in mixed-research methods is called exploratory sequential design, which involves the collection and analysis of qualitative data followed by quantitative data. The quantitative part may be used to confirm, determine or expand on qualitative findings, in which case there will be greater emphasis on the qualitative part. The second scenario is that more emphasis may be placed on the quantitative part of the study if that is used to explore relationships found in the qualitative data (McMillan & Schumacher, 2010:402).

#### **4.4.1.3 Concurrent triangulation designs/Convergent parallel design**

The third type of mixed-method study is known as concurrent triangulation, integrative or convergent parallel design. The purpose of this design is to develop a more complete understanding of the research problem by obtaining different but complementary data mainly for validation purposes. This is an approach where the researcher collects quantitative and qualitative data at the same time and then integrates the information (McMillan & Schumacher, 2010:402). The results in such a study design may support or contradict each other, therefore there is a need for the meticulous interpretation of these results. In this study a concurrent mixed approach was used, where quantitative data collected from the schools was integrated with the qualitative data collected from the district officials and deputy principals. The design was arrived at because the researcher wanted to enhance generalisability, explain the context of the study and triangulate the findings.

#### **4.4.2 Quantitative data (Surveys approach)**

In a survey research there a sample of respondents is selected from a target population. Questionnaires are distributed or interviews conducted to collect information on variables of interest (Schumacher & McMillan, 2010:235). Surveys are ideal in education research because accurate information can be obtained for a large number of people by means of a small sample. Surveys can be used to describe the incidence, frequency and distribution of the variables. Besides being descriptive surveys can be used to explore relationships between variables in an explanatory

manner. This study followed the survey design because it provided information directly from the experiences of science educators and officials involved in quality assurance implementation. The data was then analysed using pivot tables to come up with the strongest positive or negative drivers of quality assurance and science challenges. Further analysis then showed the relationship between the drivers and the quality of science education.

#### **4.4.3 Qualitative data (Phenomenological approach)**

In this study qualitative data was gathered through documents supplied by school staff and district officials as well as official documents from the websites of the national Department of Education and the Gauteng Department of Education (GDE). More qualitative data was obtained from interviews with the purposefully selected district officials.

### **4.5 POPULATION AND SAMPLING**

#### **4.5.1 Population**

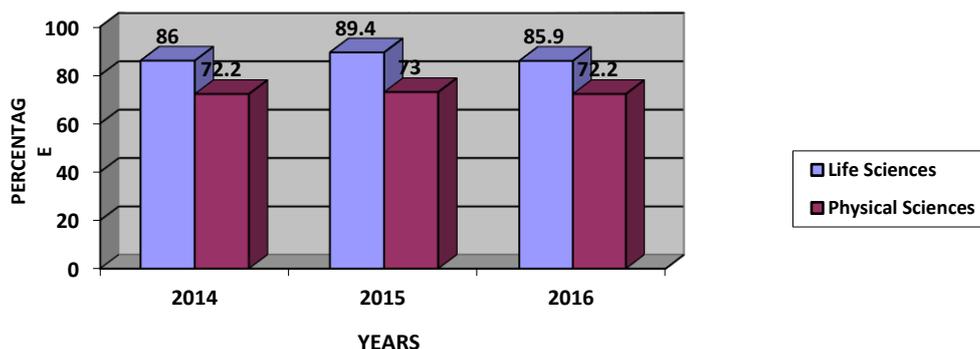
Best and Kahn (2006:13) define a population as a group of individuals that have one or more common characteristics that a researcher is interested in. According to Johnson and Christensen (2004:199) a population or a target population is a large group with certain characteristics from which a researcher wants to generalise the sample results. In this study the population was purposefully selected from the Johannesburg South district, which is one of the fifteen school districts in the province. In this study the schools and the respondents are anonymous. The elements chosen for the study comprised IQMS district managers, science HODs, science educators and science facilitators, principals/deputy principals, SMT members and SGB members. The study was also restricted to seven public schools in the Gauteng Department of Education.

## 4.5.2 Purposeful sampling

In this study a purposeful sampling strategy was employed as there was a need to get rich descriptive information from knowledgeable quality assurance personnel in science. McMillan and Schumacher (2010:489) define purposeful sampling as a type of sampling that allows the choosing of small groups or individuals who are likely to be knowledgeable and informative about the phenomenon of interest. According to Punch and Punch (2005), purposeful sampling is a method of sampling that deliberately focuses on certain qualities provided by the sample. Purposeful sampling seeks to include the full spectrum of cases and reflect the diversity within a given population by including extreme or negative cases (De Vos et al., 2009:1445). Sample sizes in qualitative studies are much smaller than those of quantitative studies although the numbers vary depending on the breadth and complexity of the enquiry. Researchers are urged to think critically about the population parameters so that the best representation of the population is chosen (De Vos et al., 2005:329).

### Johannesburg South district results analysis

The results in science (Life Sciences and Physical Sciences) for grade 12 in the selected district were analysed over a period of three years.



**Figure 4.1 Johannesburg South percentage pass rate**

Figure 4.1 above shows the percentage pass rates of Life Sciences and Physical Sciences for a period of three years, 2014 to 2016. The percentage pass rates for the schools for 2016 in this study were used in the analysis of the impact of quality assurance on the quality of science in Chapter 5. The extent of quality assurance

practices in the different schools was matched with the pass rates in Chapter 5. The choice of the district and the schools in the district is explained below.

**Table 4.1 Selected schools subject percentage pass rates**

SCHOOL AND PROFILE	YEAR	LIFE SCIENCES		PHYSICAL SCIENCES	
		% pass	No wrote	% pass	No wrote
A Quintile 3 Dominant home language(English)	2013	95	21	91	21
	2014	100	32	91	32
	2015	97	35	83	35
	2016	100	25	96	25
B Quintile 4 Dominant home language(English)	2013	64	213	78	50
	2014	77	113	93	30
	2015	92	135	86	36
	2016	86	164	54	56
C Quintile 5 Dominant home language(Afrikaans)	2013	83	245	79	76
	2014	79	200	62	61
	2015	86	160	68	72
	2016	98	133	76	60
D Quintile 4 Dominant home language (African)	2013	65	106	79	38
	2014	83	72	69	26
	2015	94	52	94	17
	2016	68	73	78	45
E Quintile 1 Dominant home languages(African)	2013	57	53	48	21
	2014	77	43	33	18
	2015	86	42	100	12
	2016	54	112	41	54
F Quintal 1 (African languages)	2015	100	24	75	24
	2016	100	58	92	26
G Quintal 2 (African languages)	2015	95	21	100	3
	2016	70	54	86	21

Table 4.1 shows the pass percentages of schools A, B, C, D and E from 2013 to 2016 for Life Sciences and Physical Sciences, and schools F and G from 2015 to 2016 for the same learning areas.

The schools were selected based on a number of criteria as shown below.

#### **4.5.2.1 Pass rates and WSE reports**

The researcher believed that a large amount of information would come from the schools that had an average performance in Life Sciences and Physical Sciences above the national pass rate average. The national pass rate average is obtained by calculating the number of all learners who passed the subject/learning area divided by all learners who wrote the subject nationally/ in South Africa. This would help in obtaining credible information on the status and quality of the results. The schools selected did not maintain the percentage pass rates year on year, implying that there should be some hindering factors that need to be investigated. Table 4.1 shows that the results of one school selected were below the national pass rate average, which helped the researcher to look further to understand the challenges causing poor results. Some of the schools were selected because they had been externally evaluated during WSE and the impact of such quality assurance processes may be evident in this study.

#### **4.5.2.2 Quintiles/Communities**

The quintile ranking system was introduced by the DOE. It uses the poverty index of the communities served by the individual schools, where quintile 1 serves the poorest communities and quintile 5 serves affluent communities. This is one of the indicators used to analyse performance in the National Senior Certificate (NSC) examinations (GDE, 2015:20). The communities which the schools serve were considered in this study. Most of the schools selected are from medium income areas to low income or poor communities. The schools in these areas have more challenges compared to schools in affluent suburbs, where compliance with policies is much easier than in poor communities. The researcher wanted a representation from all quintiles within the district. Table 4.2 shows that quintile 1 was represented by 29%, quintile 2 by 14%, quintile 3 by 14%, quintile 4 by 29% and quintile 5 by 14% of the schools sampled.

### **4.5.2.3 Language**

There was a careful selection of schools based on the home language spoken by the learners. The researcher believed that schools with learners who use various languages as home language, including English, Afrikaans and African languages, would benefit more as they represented the diversity of South African communities. Some schools had greater populations speaking Afrikaans and others English; however, the majority of four out of seven (57%) were predominantly African home language speakers. Two of the schools (29%) had more learners whose home language was English and one school (14%) had more learners whose home language was Afrikaans. However, the medium of teaching and learning (LoLT) was English in all the schools sampled. The language issue in this case helped in obtaining more information on how language affects the quality of science in schools and to check if there are any quality assurance mechanisms to curb these challenges.

### **4.5.2.4 Accessibility**

The researcher also considered ease of access to the schools so that the collection of data would be easier. This researcher required entry into the schools multiple times to collect quality assurance documents, verify certain information and follow up on questionnaires given to the purposefully selected educators. Since the selected educators possessed rich information and knowledge on the aspects asked it was necessary to have good rapport with the schools.

### **4.5.2.5 Public schools**

Only public schools were selected in order to synchronise the processes taking place in the majority of schools in South Africa. Private schools were not selected because they differ from government schools in terms of their quality assurance mechanisms, recruitment of educators, enrolment of learners, interaction with the district and selection criteria for science learners, among others. In the researcher's opinion these variations would result in skewed results that would not be a true reflection of the majority of South African schools.

### 4.5.3 The sample size

De Vos et al. (2005:74) argue that qualitative studies that employ non-statistical methods should have a small sample to prevent data saturation. From the entire population of quality assurance monitors and implementers in science education a total of seventy-three participants would be given questionnaires or interviewed from the chosen district. Based on the parameters in the population with ideal knowledge to help answer the main research questions and research sub-questions the sample size was chosen as follows:

**Table 4.2 Composition of the sample**

<b>SET 1</b>	<b>SET 2</b>	<b>District</b>
School A, B, C & D	School E, F & G	Johannesburg South D11
4 Principals/Deputy principals 4 HODs science 2 Deputy principals (interviews)	3 Principals/Deputy principals 2 HODs science 2 Deputy principals (interviews)	2 Quality assurance directors/Officials 2 IQMS managers/officials
12 Science educators	9 Science educators	2 Science facilitators
4 SMT members 4 SGB members 4 IQMS coordinators 4 SAT coordinators	4 SMT members 4 SGB members 3 IQMS coordinators 4 SAT coordinators	2 Special projects managers
TOTAL 36	29	8 + 4 Deputy principals
TOTAL	65	12
GRAND TOTAL	77	

The selected schools were categorised into two sets: the first set of four schools as based on the quintal ranking system (see section 4.5.2). These schools were from quintile 3, 4 and 5 and there were more learners whose home language was English or Afrikaans. The second set consisted of three schools and had learners from very poor communities. The schools were classified as quintal 1 and 2 and most learners' home language was an African language. The sampled educators responded to questionnaires and provided quality assurance documents and all the other documents relevant to the study. Two deputy principals from the first set of schools and two from

the second set who were in charge of curriculum were involved in interviews. This brought the individuals who were interviewed to a total of twelve.

#### 4.6 DATA COLLECTION

Data collection in terms of possible sources of data was aligned to the research objectives. The data was collected concurrently and was analysed at the same time as guided by the research design.

**Table 4.3 Research objectives and sources of data**

	<b>Research Objectives</b>	<b>Possible sources of data</b>
<b>1</b>	How does quality assurance influence the quality of science in South African secondary schools?	Literature, documents, questionnaires and interviews
<b>2</b>	What mechanisms have been put in place in the South African education system to instil quality science education?	Documents, questionnaires and interviews
<b>3</b>	How do secondary schools manage quality assurance in science education?	Documents, questionnaires and interviews
<b>4</b>	What are the factors impeding the quality of science education in secondary schools?	Documents, questionnaires and interviews

Table 4.3 shows that the different research objectives were all aligned to possible data sources which the researcher used to gather all information.

##### 4.6.1 Triangulation

Researchers use triangulation, which is a cross validation among data sources, data collection strategies, time periods and theoretical schemes to find regularities in the data (McMillan & Schumacher, 2010). According to Stringer (2008:49) triangulation involves the use of multiple and different sources, methods and perspectives to corroborate, elaborate or illuminate the research problem and its outcomes. Triangulation is the process of using multiple data-collection methods and sources to

check the validity of case study findings. It helps to eliminate biases that might result from relying exclusively on any one data collection method, source or theory. Validity can also be checked by having different researchers conducting the same interview (Gall, Borg & Gall, 1996:574-575). Burton and Bartlett (2009:26) define triangulation as navigation by fixing one's position from two known bearings. This is a process that increases the validity research findings by making comparisons with several points of reference, thus helping researchers to gain a greater understanding of the phenomenon under investigation. In this thesis triangulation is used where more than one data collection method is used to gather information about quality assurance mechanisms in science education, namely interviews, questionnaires and document analysis.

#### **4.6.2 Interviews**

Interviews are defined as methods of data collection that involve seeking open-ended answers related to a number of questions, topic areas or themes (O'Leary, 2005:113). Interviews help one to get out there and actually talk to real people, asking them what they really think and obtain first-hand information on how they genuinely feel. When researchers conduct interviews, they are able to put themselves in a position to see, hear and get a sense of their participants. Interviews provide relatively systematic collection of data and, at the same time, ensure that important data is not forgotten (O'Leary, 2005:114).

Interviews were conducted with quality assurance officials and GDE officials involved in science quality planning and implementation. More information was gathered through questionnaires directed to SMTs, science HODs and educators from the purposefully chosen schools in Johannesburg South. Informal interviews were also conducted with science educators and SGB members in these schools.

The interview questions covered the items summarised in the table below.

**Table 4.4 Content in interview schedules**

	Content
1	Policies of quality assurance

2	Implementation of policies
3	Rationale for quality assurance in education
4	History of quality assurance
5	Types of quality assurance policies
6	Assessment quality assurance
7	LTSM quality assurance
8	Quality assurance in schools (checks and balances)
9	Integrated Quality Management System (IQMS)
10	The role of the district in IQMS
11	Science education quality assurance management
12	Impact of quality assurance mechanisms on science education
13	Improvement of science quality
14	Challenges in science education

### 4.6.3 Questionnaires

A questionnaire is a set of questions on a form which is completed by the respondent in respect of a research project and will probably contain as many statements as questions, especially if the researcher is interested in determining the extent to which respondents hold a particular attitude or perspective (De Vos et al., 2005:166). A questionnaire aims at obtaining facts and opinions about a phenomenon from people who are informed on the particular issue (De Vos et al., 2005:166). The Likert scale was used to gather information where respondents rated items in terms of level of agreement.

#### 4.6.3.1 Questionnaire contents

**Section A:** This section requested biographical information of respondents with regard to age, gender, qualifications, teaching experience and administration experience.

**Section B-C:** This section attempted to identify the educational inputs in terms of quality human and material resources and the quality checks and balances. These inputs included the quality of science educators, quality of science learners,

laboratories and laboratory assistants/technicians, support systems, learner/teacher support materials (LTSM), contact time and educator workload.

**Section D:** This section concentrated on the process of attaining quality science teaching and learning. The items sought for were language in science teaching, enquiry-based teaching and learning of science, science assessment, motivation of science learners and the formal and informal learning of science.

**Section E:** This section tried to unlock the impact of the various quality assurance mechanisms on the quality of science education.

**Table 4.5 Content in questionnaires**

	Content	Section	Items
1	Biographical information	A	A1 -A5
2	Quality assurance policies	B	B1-B8
3	Quality assurance mechanisms	B	B9-B14
4	IQMS process	B	B15-B20
5	Quality of science educators	C	C1-C10
6	Quality of science learners	C	C11-C19
7	Quality of science assessment	C	C20-C25
8	Support systems and Learning and teaching support materials (LTSM)	D	D1-D6
9	Contact time and educator workload	D	D7-D12
10	Language in science teaching	D	D13-D17
11	Enquiry-based teaching and learning of science	D	D18-D21
12	Motivation of science learners	D	D22-D24
13	Formal and informal science learning	D	D25-D28
14	Impact of quality assurance on the quality of science education	E	E1-E11

#### 4.6.4 Documents

Official documents like results, quality assurance documents and results analysis were used to check for the quality of the results based on science quality assurance

programmes in the Johannesburg South district. Artefacts of present day groups and educational institutions may take three forms: personal documents, official documents and objects (McMillan & Schumacher, 2010:361). A personal document is any first person narrative that describes an individual action, experiences and beliefs. Personal documents include diaries, personal letters and anecdotal records. Anecdotal records include logs, journals and notes on lesson plans or a parent's development record of a child. Official documents include memos, policy documents, minutes of meetings, working papers and drafts of proposals. They describe functions and values and how various people define the organisation (McMillan & Schumacher, 2010:361). The official documents in terms of results per school in science, the trends and quality of results in science were requested from district science specialists. The quality assurance checklists were requested from district officials and deputy principals responsible for curriculum and from HODs in the schools. The other documents that were analysed included school improvement plans, IQMS documents, internal departmental policies, subject policies, and educator and SGB duties.

**Table 4.6 Documents analysed**

	<b>Document</b>	<b>Names</b>
<b>1</b>	<b>Policy documents</b>	CAPS Physical Sciences CAPS Life Sciences Assessment policy Departmental policies IQMS/LTSM/SAT/PAM documents
<b>2</b>	<b>Whole-school evaluation reports</b>	Whole-school evaluation tool Internal whole-school evaluation reports External whole-school evaluation reports (if available)
<b>3</b>	<b>Quality assurance documents</b>	Lesson observation tools/lesson plans/learner books Moderation report tools (internal HOD) Moderation report tools (facilitators) Moderation report tools (externally appointed moderators) Curriculum coverage reporting tools LTSM requisition/asset forms
<b>4</b>	<b>IQMS</b>	Evaluation tools

		PGP summaries School improvement plan
<b>5</b>	<b>Results analysis</b>	National, provincial and district results Physical Sciences and Life Sciences matric results

Table 4.6 above shows the documents requested from the schools and districts that were analysed and merged with findings from questionnaires and interviews, as described in Chapter 5.

## **4.7 DATA ANALYSIS**

### **4.7.1 Qualitative data analysis**

Qualitative data analysis is primarily an inductive process of organising data into categories and identifying patterns and relationships among categories. Inductive analysis is the process through which qualitative researchers synthesise and make meaning from data, starting with specific data and ending with categories and patterns (McMillan & Schumacher, 2010:367). The general process of inductive data analysis follows some phases which are overlapping:

Phase 1 involves fieldwork recording, data and coding and categorising.

Phase 2 involves data, coding and categorising.

Phase 3 involves coding and categorising, patterns (themes/concepts).

Phase 4 involves either patterns (themes/concepts) to form narrative structures or patterns (themes/concepts) to form visual representations or both. There is, however, no set of standard procedures for data analysis in most qualitative research, and making sense of the data depends largely on the researcher's intellectual rigour and tolerance for tentativeness of interpretation (McMillan & Schumacher, 2010:367-368).

**Data coding:** Data coding begins by identifying small pieces of data that stand alone (segments). Data segments are text that is comprehensible by itself and contains one idea (McMillan & Schumacher, 2010:370).

**Forming categories:** Categories or themes are entities comprised of grouped codes which represent the first level of induction by the researcher. In order to come up with categories the researcher is engaged in a recursive/constant comparison process that involves the repeated application of a category to fit codes and data segments (McMillan & Schumacher, 2010:377).

**Discovering patterns:** The goal of qualitative research is to make general statements about relationships among categories, through discovering patterns in the data. Coming up with patterns involve examining the data in as many ways as possible, thorough searching through the data, and challenging each major hunch by looking for negative evidence and alternative explanations. A deductive mode of thinking should then be employed moving back and forth among codes, categories and tentative patterns for confirmation (McMillan & Schumacher, 2010:378).

#### **4.7.2 Quantitative data analysis**

Quantitative data gathered from the questionnaires in this research was presented in the form of tables and graphs. The responses of the deputy principals, heads of departments and science educators were presented as pie charts, bar graphs, line graphs or tables, which were analysed using descriptive statistics. SPSS software was used for descriptive and inferential statistics whereby pivot tables were used to come up with the strongest positive or strongest negative drivers. All the possible pair combinations were identified and calculated and only the strongest drivers were illustrated in the study. The strongest variables were analysed to check their impact on the quality of science results. Quantitative results in this study enhanced generalisability whereas the qualitative results helped to explain the context of the study (McMillan & Schumacher, 2010:403).

## **4.8 CREDIBILITY**

Credibility involves establishing that the results of the study are credible or believable. Since it is hard to ensure that the study results are accurate, the following aspects were considered during the research: reliability, validity and conducting a pilot study.

### **4.8.1 Reliability**

McMillan and Schumacher (2010) define reliability as the consistency of measurement, the extent to which the scores are similar over different forms of the same data instrument or occasions of data collection. Reliability in data collection is achieved when the same data is obtained from different observations during any measuring instance from time to time for a given unit of analysis measured twice or more by the same instrument. In other words, when different researchers give out the same instrument the same results should be obtained under comparable conditions (Robson, 1995). Yin (2008) views reliability as a matter of whether a particular technique when applied repeatedly to the same object, would yield the same result each time. From these definitions it becomes clear that reliability is concerned with the clarity, stability, quality, consistency, adequacy and accuracy of the measuring instrument, which is questionnaires and interview schedules. Reliability in this study was assured by pilot testing the instruments, revising them and giving them to experts for refining.

### **4.8.2 Validity**

Validity can be described as whether or not something actually measures what it claims to measure for particular people in a particular context and that the interpretations made on the basis of the test scores are correct (Johnson & Christensen, 2008:150-151). According to Johnson and Christensen (2008:151) there are two types of validity, namely construct validity, which involves relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumptions that are employed; while content validity is the degree to which a measuring instrument measures an intended content area. To ensure validity the instruments were given to colleagues, experts, experienced researchers and the study supervisor to check the validity of the questionnaires and

interview schedules before administering them. Validity in this research was further enhanced by giving equal priority to quantitative data and qualitative data using the concurrent triangulation design, also known as integrative or convergent design (McMillan & Schumacher, 2010:403).

#### **4.8.3 Pilot study**

A pilot study was conducted in two schools that were not part of the final sample. One science head of department, one science educator, one school management team member and two colleagues doing research were consulted. Pretesting was done in order to identify deficiencies in the questionnaire and the interview schedule (Gay, 1992:229). Errors regarding the questionnaire were corrected based on the responses and questions posed by the educators and colleagues to whom the questionnaires had been given. The response time to the questionnaire was also adjusted during the pretesting. The interview schedule was rectified by a colleague as well as the supervisor. Any misleading questions were rephrased and refined. The pilot study revealed that the best school governing body (SGB) members to respond to the questionnaire were the teacher representatives, who had experience of both the governing principles and the curriculum issues or any SGB member who is or was part of the current education system. There was also an addition of one educator from the different schools who was a coordinator of IQMS, as this educator would be best positioned to give informed responses regarding IQMS in schools. The recommendations from the pilot study were implemented in the final study.

#### **4.9 ETHICAL CONSIDERATIONS**

Ethical aspects that were considered included informed consent, confidentiality and the anonymity of the respondents. Informed consent is the procedure in which individuals choose whether to participate in an investigation after being informed of the facts that would be likely to influence their decision (Johnson & Christensen, 2008:112). Since the research is both quantitative and qualitative there is the anticipation of personal intrusiveness, thus ethical considerations enjoyed priority. Policies regarding informed consent, deception, confidentiality, anonymity, privacy and

caring were adopted. The research design not only involved selecting respondents but also adhering to research ethics. Ethical clearance was sought in accordance with the UNISA policy on research ethics. It was granted as all the requirements were met by the researcher (Appendix E).

#### **4.9.1 Permission**

Permission to enter the field was sought from the Gauteng Department of Education head office (GDE) according to their protocol. To gain permission the prescribed completed application form was sent to the GDE. Permission was granted to collect information from the district and the schools in the district. To gain permission from the district and schools letters seeking permission were sent to the District Director and principals (Appendix B and C).

#### **4.9.2 Informed consent**

To obtain permission participants signed the protocol for informed consent (see Appendix D). They selected the interview times and places, and trusting relationships were established. The time required for participation was non-interfering. The setting was as natural as possible (McMillan & Schumacher, 2010).

#### **4.9.3 Confidentiality and anonymity**

The settings and participants were disguised so as to appear similar to several possible places. Code names were given to people and places if anonymity was requested. There was a dual responsibility to protect the individual's confidences from other persons in the setting and to protect the respondents from the general reading public. In survey research there is dissociation of names from responses during the coding and recording process (Creswell, 2013).

#### **4.9.4 Privacy and empowerment**

There were negotiations with participants so that they might understand the power that they had in the research process. The power and mutual problem-solving were used and participants were informed that the results would not be an exchange for their privacy if they participated in the study (Lincoln, 1990).

#### **4.9.5 Caring and fairness**

Open discussion and negotiations were carried out to promote fairness to the participants and to the research enquiry. A sense of caring and fairness was part of the researcher's thinking, actions and personal morality in the research (McMillan & Schumacher, 2010).

#### **4.10 CONCLUSION**

This chapter began with the description of the theoretical and philosophical underpinnings of research design and the methodology used to investigate the research questions. Discussions of data collection instruments, population, sampling and data analysis techniques used were done. Descriptions of ethical considerations for the study were also given in this chapter. In the Chapter 5 the data gathered forms the empirical evidence of the research. The data is presented and analysed and interpretations are made.

## CHAPTER 5

### RESEARCH FINDINGS

#### 5.1 INTRODUCTION

This chapter presents the data obtained from the documents, questionnaires and interviews. It presents the views of the respondents in the schools who are the curriculum drivers and implementers of the quality assurance processes at a micro level. These views were collected using questionnaires and the responses are analysed, summarised, organised and presented in this chapter. The views of the monitors and policymakers of the different quality assurance mechanisms enforced in schools were collected through interviews and these are presented in this chapter. The interpretations of the research findings were in accordance with the specific objectives and theoretical framework. The information from the literature review provided a source for comparison with the rich findings from interviews, documents and questionnaires used in the study.

The research findings presented in all sections answered the main question on how quality assurance influences the quality of science education in the Johannesburg South district secondary schools. The impact of the quality assurance mechanisms on the quality of science education is summarised in section 5.4.4.

The following sub-questions were also answered through the findings:

1. *What mechanisms have been put in place in the South African education system to instil quality science education?*

In order to answer this question policies and mechanisms in place at district level and school level were examined and findings presented in this chapter section 5.1 and 5.4.

2. *How do secondary schools manage quality assurance in science education?*

This sub-question was answered by examining documents, interviewing and presenting questionnaires directly to the implementers, managers and monitors of quality assurance practices in schools. The findings answering this question are presented in sections 5.4.1 up to 5.4.4 and then linked to the main question on how these quality assurance practices influence the quality of science education.

*3. What are the factors impeding the quality of science education in secondary schools?*

The schools examined in the study had average to good results in science. However, they did not reach 100% as matric pass rate and the quality of the passes resembles those obtained by most South African schools. In order to thoroughly investigate the challenges faced by schools that prevent the attainment of quality results eight factors are presented in section 5.3 and 5.4.

### **5.1.1 QUALITATIVE DATA ANALYSIS: PROCEDURES AND PRESENTATION**

Interviews were conducted with the quality assurance officials from the district as well as deputy principals in charge of curriculum in the schools. Due to the busy schedules of the officials some of them opted to respond to the interview schedule in writing. Requests were, however, made to do follow-up questions orally, to which the officials agreed. The other officials responded orally at agreed sites at times convenient to them and the processes were successfully concluded. The data obtained underwent an inductive process of being organised into categories and by identifying patterns and relationships among categories. The coding process was done through identifying small pieces of data that stood alone or in segments. These segments were then used to form categories or themes comprising grouped codes. This represented the first level of induction in this part of analysis.

In order to come up with categories there was a recursive, constant comparison process that involved the repeated application of a category to fit codes and data segments (McMillan & Schumacher, 2010:377). Finally, there was the discovering of patterns which helped to make general statements about relationships among categories. Deductions were made through moving back and forth among codes,

categories and preliminary patterns. The qualitative data categories in this case were matched and some fitted perfectly into the categories identified in the questionnaires designed earlier.

The interview questions revealed the following codes, segments, categories and themes and are summarised in the table below.

A sample of extracts from the interviews and highlights of some of the segments are shown below:

*“The curriculum framework is underpinned by the predictability framework for curriculum support, the curriculum support strategy, Support and monitoring instruments, roles and responsibilities for curriculum officials at all levels and the curriculum calendar.”*

*“We provide schools with the syllabus/pacesetters (work schedules) that show content to be covered in each term. Schools are also provided with the assessment that must be covered in each term. We also weight each topic in the pacesetters to enable monitoring and reporting against the pacesetters more precisely.”*

*“We also make sure schools receive all policies, lesson plans, workbooks, exam guidelines, examiners’ and moderators’ reports.”*

*“A guideline to assist educators to close the content gaps for gateway subjects in Grade 10 and 11 has been completed. As district we mediate and will inform the teacher development and support programmes. We implement support programmes for poorly performing schools.”*

*“Schools complete support requirements for each subject and these are used to inform teacher development plans.”*

*“The functionality of a school is determined by its academic performance, therefore our school visits check whether schools have effective measures to manage, monitor and support the curriculum.”*

*“The Curriculum Management Model (CMM) says that it is incumbent upon the School Management Team to **manage, monitor and support** curriculum management within the school. SMT should promote the culture of learning and teaching.”*

*“Effective **curriculum management** can only take place once strategic planning and assessment has been developed.”*

The above processes were done over and over in order to discover connecting themes deductively. Some of the codes, segments, key words, themes and categories are shown in the table below although they are not exhaustive.

**Table 5.1 Analysis of qualitative data**

	<b>Information intended to be collected</b>	<b>Codes and segments</b>	<b>Possible categories and themes</b>
1	Policies of quality assurance	Policy, guidelines	Policy formulation, IQMS, WSE
2	Implementation of policies	Follow up, check, monitor, visit	Policy implementation, IQMS, WSE
3	Rationale for quality assurance in education	Quality, standards, provide, manage, assessment quality, learner achievement	Standards improvement, IQMS, WSE, learner achievement
4	History of quality assurance	Inspection, support, manage, monitor	Inspection model to examination model
5	Types of quality assurance policies	IQMS, Whole School Evaluation, parents' involvement, achievement, safety	Policy formulation and implementation, whole-school evaluation
6	Assessment quality assurance	Umalusi, HODs, moderators, Quality Assurance directorate	Moderation, school-based, provincially based, pre- and post-moderations
7	LTSM quality assurance	Monitoring, accountability, managing, resources,	School and district monitoring, challenges in schools
8	Quality assurance in schools (checks and balances)	Tools, checklist, HODs, monitoring, accountability, curriculum coverage	Implementation
9	Integrated Quality Management System (IQMS)	Ongoing, DSGs, HODs, DSGs, peers, Head Office, QA officials	School implementation and monitoring

10	The role of the district in IQMS	Visit, check, quality-assure, providing support, policy implementation, monitoring, support	District monitoring and support
11	Science education quality assurance management	District officials, principals, HODs, moderation	District and school monitoring, assessment moderation
12	Impact of quality assurance mechanisms on science education	Improved results, passing, quality results, top schools	Improvement of standards
13	Improvement of science education quality	Quality passes	Quality improvement
14	Challenges in schools	Overload, burdened, no laboratories, no technicians, language barriers, learner attitudes	Educator overload, resources shortages, infrastructure, language challenges, attitudes

Table 5.1 shows some of the steps taken in order to untangle the information from the interviews conducted. The themes and categories above were then grouped together and the seven themes listed below emerged. Section 5.3 in this chapter gives a detailed analysis of these themes.

### 5.1.2 QUALITATIVE DATA PRESENTATION OF THEMES

The following themes emerged from the study and are presented in the order below.

#### **Themes on mechanisms have been put in place in the South African education system to instil quality science education?**

Theme 1: Main quality assurance system: Integrated Quality Management System (IQMS).

Theme 2: National Policy on Whole School Evaluation

Subtheme 1: Basic school functionality

Subtheme 2: Leadership, management and communication

Subtheme 3: Governance and relationships

Subtheme 4: Quality of teaching and learning, and educator development

Subtheme 5: Curriculum provision and resources

- Subtheme 6: Learner achievement
- Subtheme 7: School safety, security and discipline
- Subtheme 8: School infrastructure
- Subtheme 9: Parents and Community

**Themes on how secondary schools manage quality assurance in science education.**

- Theme 1: Standards and quality improvements in schools
- Theme 2: Monitoring and support by the district
- Theme 3: Assessment quality assurance
  - Subtheme 1: Policy on assessment
  - Subtheme 2: Pre-moderation of assessments
  - Subtheme 3: Post-moderation of assessments
  - Subtheme 4: DBE's and Umalusi's role in moderation of assessments

**Theme on the factors impeding the quality of science education in secondary schools.**

- Theme 1: Infrastructure and resources
- Theme 2: Learner attitudes to science
- Theme 3: Language challenges
- Theme 4: Educator workload
- Theme 5: Informal and formal learning of science
- Theme 6: Influence/Impact of quality assurance on the quality of science education

The themes above were arrived at through an analysis of the responses from the interviews with the district officials and deputy principals as explained below.

The responses from the interview district officials were indicated as follows: IQMS district official (DO 1.1: Rose; DO 1.2: Jacky); quality assurance district official (DO 2.1: Pamela DO 2.2; Eve); special projects manager district official (DO 3.1: Jacob; DO 3.2 Steve) and science facilitator/subject curriculum specialist district official (DO 4.1: Alice; DO 4.2 Siphwe). Set 1 deputy principals (DP 1.1: Phila in school 1; DP 1.2; Siphw in school 2) and set 2 deputy principals (DP 2.1: Moodley in school 3; DP 2.2:

Jane in school 4). The responses from the district officials and deputy principals were given under pseudonyms and codes were used to protect their identity as agreed in the interviews and ethics form.

## **5.2 EMERGING THEMES ANALYSIS**

### **THEMES ON MECHANISMS THAT HAVE BEEN PUT IN PLACE IN THE SOUTH AFRICAN EDUCATION SYSTEM TO INSTIL QUALITY SCIENCE EDUCATION.**

#### **5.2.1 THEME 1: Main quality assurance system: Integrated Quality Management System (IQMS)**

All the respondents pointed out that quality assurance in science is guided by IQMS. Most deputy principals, however, associated IQMS with two main aspects, namely whole-school evaluation (WSE) and developmental appraisal (DA). District officials, on the other hand, had a full picture of the three aspects, namely developmental appraisal, performance measurement (PM) and whole-school evaluation.

Phila, for example, referred to only two aspects of IQMS:

*“The main quality assurance processes in our schools are guided by the integrated quality management system, which aims at developing educators in all aspects of teaching and evaluating the overall effectiveness of the school through whole-school evaluation.”*

The deputy principal of school 1 knew that IQMS is the main quality management system that is currently used in schools and one component is WSE. The deputy principal from school 2 also knew about IQMS and its focus.

Sipho also made an almost similar statement about IQMS which excluded performance measurement when he said:

*“IQMS focus is on developing our educators through identifying their weaknesses and also to evaluate the school effectiveness.”*

The main focus according to Siphos is educator development, which falls under developmental appraisal in IQMS, and school effectiveness, which falls under WSE.

Pamela, as a district official responsible for monitoring quality assurance practices in schools, pointed out the philosophical mandate of IQMS:

*“All quality management initiatives must be incorporated in the IQMS in schools in order to determine competence, assess strengths, weaknesses, accountability, monitoring schools’ effectiveness and to develop and then reward accordingly.”*

All three areas of IQMS were mentioned, which include PM, when she mentioned: ...reward accordingly.

Another district official, Jacky, agreed with the deputy principals who knew that IQMS is the main policy guiding quality assurance in schools:

*“Quality assurance in schools is guided by IQMS where whole-school evaluation falls in place. This involves verification, monitoring, maintaining standards and improving quality.”*

Jacky continued to mention the link between IQMS and quality improvement as one of its intended outcomes. The findings in this section are in agreement with Akhemonkhan & Raimi (2013), who that policymakers need to apply quality assurance instruments to determine whether educational standards are maintained and quality sustained.

Rose, one of the district officials in charge of IQMS, gave a historical perspective of how IQMS evolved when she explained:

*“Quality assurance and evaluation can be used interchangeably as they entail quality control measures. Prior to 1994 evaluation was done through inspections where inspectors visited schools and evaluated them. After*

*1994 the types of evaluation changed to systemic evaluation, performance measurement, developmental appraisal and whole-school evaluation, which I believe are all incorporated in the IQMS.”*

Rose mentioned all the aspects covered in IQMS that are currently used according to policy. She further mentioned in detail the twelve steps for conducting performance measurements, as she read the list quoted below:

*“The twelve steps in conducting performance measurements are drawing up a timetable for performance measurement; pre-evaluation meeting for summative evaluation; conducting lesson observation; post evaluation meetings and feedback on observations; resolution of differences; completion of composite score sheets; updating of PGPs (Personal Growth Plans); completion of documents of performance measurements; making copies of signed forms, plans, reports and files; submitting original signed documents to my office for processing; capturing the summative evaluation scores into a composite schedule and submitting it to the provincial office; and finally implementation of salary and grade progression.”*

The twelve steps were in agreement with the documents available in all the school management plans on IQMS, for example in the management plan in school 3 dates for pre-evaluation, lesson observation, and post-evaluation meetings were all present.

The research findings revealed that the main policy that guides quality assurance is based on Education Labour Relations Council, Resolution no 8 of 2003: Integrated quality management system (IQMS). The main purpose of the agreement was to align the different quality management programmes and implement an integrated quality management system, which includes developmental appraisal (DA), performance measurement (PM) and whole-school evaluation (WSE) (ELRC, 2003). As indicated above all respondents pointed out that IQMS is the main quality assurance system being used in schools. District officials showed knowledge of the three overall programmes and their focus whereas some school officials only emphasised two programmes, namely the developmental appraisal and whole-school evaluation. The reason, however, might be that performance measurement is linked with educator

rewards and is mainly processed at district level, therefore it is less significant to schools in terms of quality assurance.

Due to the nature of IQMS there is greater emphasis on WSE as it was mentioned by all principals and schools. They went further to prepare for external WSE when the schools were selected.

The next theme identified in the interviews is the national policy on WSE. Of the three programmes of IQMS the programme that digs deeper into quality assurance processes is whole-school evaluation, therefore a thorough study of the WSE processes is presented below.

### **5.2.2 THEME 2: National policy on whole-school evaluation**

The findings on whole-school evaluation agree with the statement from the National Policy on Whole School Evaluation, which asserts that WSE is an effective monitoring and evaluation process that is vital to the improvement of quality and standards of performance in schools (Department of Education, 2001a:iii). South African quality assurance or evaluation is in line with international standards, for example Europe evaluates its institutions of education in the following areas: classroom level quality of learning and teaching; institution's learning, social and professional standards; school relations between school, parents and local community; and learner outcome as determined by academic achievement, and personal and social development (European Union, 2011). The five key indicators in quality assurance according to UNESCO (2002) are also covered in the South African system, which include quality learning environments; quality content; what learners gain; processes that support quality; and outcomes from the learning environment (UNESCO, 2002).

The deputy principals and district officials all had very good ideas and knowledge of whole-school evaluation. Phila, the deputy principal of school 1, said:

*“Whole-school evaluation is a quality assurance system that enables schools and external supervisors to provide an account of the performance of various schools. The policy seeks to improve the overall quality of*

*education and aims at ensuring that all learners are given an equal opportunity to make the best use of their capabilities.”*

Phila described WSE as one way schools become accountable for their performance as well as seek to improve the quality of education. The view is in line with TQM theory, which states that there should be a focus on the continuous improvement of quality (cf. 2.2.1).

Jane, the deputy principal of school 4, confirmed the purpose of WSE:

*“The main purpose of the national policy on WSE is to identify areas of strength as well as areas requiring development in schools nationally. This is intended to enable schools to improve the overall quality of education they provide as well as to effect improved learner performance. The intention is also to diagnose areas needing urgent support in order to enable districts to provide informed services to schools.”*

The improvement of the overall quality of education was linked to improved learner performance. This shows that all the quality assurance processes taking place are aimed at the satisfaction of the customer (cf. 2.2.1.2.i), in this case learners. Areas that require support are also identified through conducting WSE.

One district official, Eve, explained the steps that were taken by DBE to promote external WSE:

*“The Department of Basic Education in order to strengthen accountability and promote functional schools, they hosted training for whole-school evaluation supervisors in Centurion, February 2015. The training covered the WSE policy and guidelines and informed the supervisors, who included former school principals and deputy principals, on how to conduct credible assessment using rigorous assessment tools.”*

WSE here is taken as a tool that strengthens accountability as well as assists schools to become more functional, which leads to improved quality. This is in agreement with

Sambumbu (2010) and DOE (2001) (cf. 2.11). The supervisors of WSE are former principals and deputy principals who are actually quite familiar with the nine focus areas. The tools used in WSE evaluation are referred to as “rigorous” tools, which is in agreement with Ayeni (2012); Chalmers (2008) and UNESCO (2002). All rigorous tools should have certain indicators that rate quality learning environments, quality content, processes that support quality and outcomes from learning environments (cf. 2.11).

*“Whole-school evaluation from my perspective is the core of quality assurance because it’s evidence-based and seeks to improve the quality of education in schools via the nine focus areas.”* – Moodley explaining her understanding of WSE

Moodley, the deputy principal of school 3, was of the opinion that the nine focus areas of WSE led to improved quality of education. She also mentioned that WSE was evidence-based, which means that decisions will be made based on facts. This agrees with the eight principles of quality management systems theory (cf. 2.2.1.2. vii).

Ratings from supervisors (EWSE) or assigned school personnel (SSE) need to be checked by schools from time to time. They should then strive to improve on areas of weaknesses. This was echoed by Jane when she said:

*“WSE has 9 focus areas, of which all need to be consistently maintained, improved and revisited from time to time.”*

Both Jane and Moodley mentioned the nine focus areas of WSE. These are all mentioned and clearly defined in the WSE policy. The policy highlights nine key focus areas for evaluation, namely: basic school functionality; leadership, management and communication; governance and relationships; quality of teaching and learning, and educator development; curriculum provision and resources; learner achievement; school safety, security and discipline; school infrastructure; and parents and community.

Jacky from the district explained the processes followed by external whole-school evaluators, who are also known as supervisors:

*“The external whole-school evaluators, when they visit schools they engage in examining the school self-evaluation (SSE) report, scrutiny of relevant school records, lesson observations, conduct interviews with relevant stakeholders, analyse questionnaires and provide feedback to the school.”*

Schools are therefore supposed to conduct SSE every year in accordance with policy and this becomes a baseline for supervisors' evaluation. The reports generated at the end are evidence based as the supervisors will require the SSE report, school records, observe lessons, conduct interviews and analyse questionnaires. Jacky concurred with the WSE policy, which mentions these external supervisors' expectations. The feedback given to the schools helps them to do introspection on their practices, which is in line with Deming's TQM theory and QMS principles (cf. 2.2.1.1. v, 2.2.1.2. viii).

The role of WSE in quality enhancement as well as the working together of implementers and monitors was mentioned by Pamela:

*“Whole School Evaluation is the first step in the process of school improvement and quality enhancement. The national policy on WSE is designed to achieve the goal of school improvement through a partnership between supervisors, schools and support services at one level, and national and provincial governments at another.”*

Macro and micro level quality assurance relationships as well as the working together of different parts are mentioned here. This is in line with the systems theory as well as the principles of QMS (cf. 2.2.1.2 iv, 2.2.2.1, 2.2.2.4).

From the information above it is clear that both the district officials and school management have clear views of the whole-school evaluation programmes and processes. The National Policy on Whole-School Evaluation points out that objective criteria and performance indicators should be used consistently in order to determine quality education in schools. The findings should then be used to improve the quality and standards of individual and collective performance (DOE, 2001a:iii).

Quality assurance indicators (QAIs) were factored in to come up with the nine focus areas since they concur with the indicators proposed by UNESCO (2002), Chalmers (2008) and Ayeni (2012). Quality science education is directly or indirectly affected by the nine focus areas, which quality-assure different areas. These are examined from (i) to (ix) below. An in-depth analysis is indicated below and then link quality assurance processes to the attainment of quality science education. Supervisors or external evaluators should use the nine key areas as listed below when evaluating schools (RSA, 2001:14).

The WSE policy makes provision for the following rating scale.

**Table 5.2 Whole-school evaluation rating scale**

<b>RATING SCALE/SCORE</b>	<b>DESCRIPTION</b>
5	Outstanding
4	Good
3	Acceptable
2	Needs improvement
1	Needs urgent support
0	Insufficient evidence

### **5.2.2.1 SUBTHEME 1: Basic school functionality**

The purpose of the basic functionality focus area is to evaluate whether the school functions efficiently and effectively to realise its educational and social goals. The criteria used are based on whether the school has appropriate procedures for dealing with absence, lateness and truancy; whether the school has procedures to monitor and curb absence and late-coming among educators and whether the code of conduct for learners aims to establish a disciplined and purposeful school environment (RSA, 2001). In all the schools there were a number of documents that dealt with basic functionality, which included latecomers' register for both learners and educators, class attendance period register, discipline reports, minutes of disciplinary hearings as well as suspension letters.

The respondents believe that quality education is achieved when areas of basic school functionality are considered, like the discipline of learners and adherence to the school code of conduct.

For schools to become functional WSE should be conducted, according to Eve:

*“The department of basic education in order to strengthen accountability and promote functional schools they hosted training for Whole School Evaluation supervisors...”*

Training of supervisors meant the proper implementation of the WSE process, which in turn creates functional schools.

One of the deputy principals of school 2, Siphon, explained how quality results in science are obtained in his school:

*“To ensure quality results there are a number of things which we have to look at which includes learner behaviour, regular attendance, truancy, homework and so on. We normally don’t have problems with our science learners in our school.”*

The evaluation tool had different sections on basic functionality which rated the areas mentioned by Siphon. In the SSE report the school rated itself as 4. The external WSE supervisors also rated them at 4.

Siphon mentioned learner behaviour and regular attendance. One district official, Siphon, shared his view that discipline and regular attendance of classes result in quality learner results.

*“The other things that promoted quality results in our district in science were discipline and regular attendance of both term classes and SSIP classes.”*

The deputy principal of school 1, Phila, explained that procedures are followed from the beginning of the year to set the tone for quality assurance:

*“Our quality assurance procedures begin from term one where we give all learners the code of conduct and class educators ensure that rules are set from the beginning and this helps with the smooth running of the schools.”*

Phila associated the basic functionality of the school with the code of conduct, which is in agreement with the WSE policy. Siphwe, as a district subject specialist, checks on educator attendance. The reports show that science educators in the sampled schools attend their classes regularly, which may have led to the completion of work schedules, thus steps towards quality science education.

*“Our science educators in our district are dedicated and most of my visits show that educators attend classes regularly.”*

When quality assurance mechanisms are in place there will be quality teaching time, as pointed out by one of the deputy principals below:

*“Procedures are in place when it comes to late-coming, bullying, truancy and disruptions in classes. We have systems in place and they are followed, that’s why this year we have few incidences of learners misbehaving.”*

One other challenge highlighted by the district official with regard to the basic functionality of schools is policy review.

*“I think the basic functionality area that deals with amending policies of schools is very weak in some schools, reason being that schools just don’t give themselves time to review timeously their policies and they just comply for the sake of submissions.”*

All these procedures were followed according to school policies. Rules, regulations and procedures were clearly laid out in the code of conduct of all schools.

### **5.2.2.2 SUBTHEME 2: Leadership, management and communication**

The purpose is to evaluate the effectiveness of the leadership and management of the school. The first criterion is whether the SMT gives clear direction to the school. Phila said:

*“We plan and give direction to all educators, HODs disseminate policies circulars and they do have regular departmental meetings.”*

The second criterion evaluates whether all managers have clear roles and responsibilities, delegated in a fair and equitable manner.

*“All HODs quality-assure the lesson plans, assessments and also do class visits to ensure that educators are teaching effectively.”* – Jane explaining the role of the SMT

The third criterion checks whether the SMT promotes the quality of teaching and learning in the school through the appropriate curriculum management. The fourth is similar to the third as it evaluates whether the SMT promotes quality teaching and learning through physical resource management. The fifth criterion checks whether SMT promotes quality teaching and learning through human resource management. The sixth criterion evaluates the degree to which the SMT promotes stakeholder involvement through communication strategies. The last criterion seeks to ascertain whether school policies and related procedures are in place as well as whether the school community is familiar with the school’s policies and procedures.

Documents like minutes of departmental meetings and staff meetings all showed that the SMTs in schools communicated with and gave direction to the educators.

### **5.2.2.3 SUBTHEME 3: Governance and relationships**

The main purpose is to evaluate the effectiveness of the governing body in fulfilling its roles and responsibilities with regard to the establishment of a purposeful and disciplined school environment. The criterion evaluates the following areas: the

constitution of the governing body; the organisation of the governing body and its committees; the membership of the governing body; the part played by the governing body in the formulation and implementation of the school's policies; the suitability and effectiveness of the policies; and systems the school governing body has for monitoring and evaluating the quality of education provided by the school.

Good governance of schools will translate to schools running efficiently, thus directly and positively affecting educator and learner morale. Improved relationships would lead to improved quality of results as there will be maximum cooperation among stakeholders in schools.

The evaluators and supervisors make judgements based on the following criteria: the school governing body (SGB) is duly established and functions effectively; SGB provides the school with clear strategic direction; SGB executes its function with regard to the school's finances within its legal mandate; SGB executes its function with regard to human resource within its legal mandate.

However, the comment from the district IQMS official revealed that most SGBs do not contribute to the vision of schools as they do not revisit their policies timeously:

*"...that schools just don't give themselves time to review timeously their policies..."*

The SGB members are supposed to contribute to and review school policies in the areas of school hours, language policy, religious policy, dress, code of conduct for learners among others. In cases where the SGB do not review policies timeously, this may be because they do not have constitutions or they do not follow their constitution if it is available. The reports of two of the schools that were externally evaluated indicated that they had not reviewed their vision and mission statements, for example the report for school 3 read:

*"The SGB did not develop strategic goals stemming from the Vision and Mission and the Self School Evaluation (SSE) in order to provide clear direction to the school."*

The recommendation by the supervisors for the school SGB was to “review the SGB constitution and develop strategic goals to guide them in providing clear direction to the school”. The recommendation to the district cluster leader/circuit manager/IDSO was to “assist the SGB in developing clear strategic goals and a School Development Plan (SDP) for their term of office to enable them to give clear direction to the school”.

School 2 report reads as follows:

*“No evidence can be found in minutes of meetings that the school reviewed its vision and mission statements for at least the last five years.”*

This shows that these schools did not review their mission statements as mandated by SASA, section 20(1) c and they should share it with all relevant stakeholders when reviewed. The responses and documents therefore show that the SGBs need to get fully involved in the school duties on governance.

#### **5.2.2.4 SUBTHEME 4: Quality of teaching and learning, and educator development**

It is the view of the researcher that quality teaching and learning entails the use of multiple methods informed by contextual factors. Different teaching techniques and methodologies are also informed by the type of assessment tasks that will be given to learners. In the South African education system these tasks are prescribed per year, for example research project tasks require learners to be hands-on and find information on their own with the guidance of the educator.

The quality assurance tool used by the supervisors and internal evaluators makes judgements and rates regarding the following:

Effective time-management of teaching and learning; creation of positive learning environment; knowledge and understanding of the curriculum; lesson planning, preparation and presentation; learner assessment and achievement; the school conducts appropriate assessment of learner competencies; assessments are of good standard and correctly recorded; educators make use of sufficient and a variety of

informal assessments; the quality and quantity of forms of informal assessments as per CAPS document; the school supports and encourages educator development through IQMS processes; and staff participation in professional development.

Deputy Principals and the district officials believe that quality teaching and learning results in learners achieving quality results. This was the view of Jane when she said:

*“For our learners to achieve there is a need for quality teaching and learning practices.”*

It is the view of the researcher that quality teaching and learning involves the use of multiple ways of teaching. In science these methods are embodied in learner-centred enquiry-based teaching and learning. Moodley shared the thoughts when she said:

*“We promote learner-centred teaching instead of the old style chalk-talk method. Educators should be versatile and use multiple methods of teaching so as to suit every learner.”*

Learner-centred teaching requires a lot of time and resources. In the schools in the study the others have electronic or smart boards and learners also make use of tablets, which enhance learning experiences. Moodley supported the idea that resources also assist in learner-centred teaching and learning:

*“The use of tablets in our school and the smart boards resulted in educators saving a lot of time as there is no more writing for learners to copy questions, they simply start working and educators employ many techniques that way.”*

There is a general feeling that science educators in the schools make use of different methods that enhance teaching and learning. Siphos said:

*“I know for a fact that all our science educators are highly qualified and employ various techniques when teaching to achieve the good results we have now.”*

One deputy principal, Moodley, pointed out how quality teaching had helped improve results in her school, at the same time acknowledging how science educators get overloaded:

*“The good results we have in both Life Sciences and Physical Sciences emanate from quality teaching and learning which I don’t doubt in our school. Due to tight schedules and not so friendly time factors our educators teach extra hours even over the holidays.”*

Quality teaching and learning is also associated with teaching extra hours apart from the prescribed notional times which is not enough to allow learners to achieve quality passes. Siphso said:

*“HODs and DSGs inform us through IQMS of the areas educators need development in. As a school we can organise workshops to develop educators. The district also offers workshops to educators for example the MST (Mathematics, Science and Technology) workshops being offered on selected Saturdays.”*

According to Deming’s theory on TQM institutions should be in a position to institute training on the job. WSE in this indicator easily identifies the training needs of educators.

*“As a district we compile information from the SIP (School Improvement Plan) and we compile it to form the district improvement plan, where schools are trained in the lacking areas like content in certain subjects.” – Jacky*

The WSE and SSE reports of all the schools showed that this area had the highest ratings: four schools had a rating of 4, two with a rating of 3 and one with a rating of 5. The views of the respondents therefore agreed with the documents available.

### **5.2.2.5 SUBTHEME 5: Curriculum provision and resources**

The WSE tool evaluates four aspects that check whether the curriculum offered complies with CAPS; the school provides curriculum resources to support teaching and learning; the school manages procurement, distribution and retrieval of LTSM effectively and the school enrichment programme provides for extra- and co-curricular activities.

*“We expect learners to achieve quality results and one very important aspect is making sure the curriculum is supported in all ways especially resource availability and accessibility to both educators and learners.”*

Phila outlined the LTSM management plan in their school in order to meet the department’s requirements:

*“Every year around May HODs are furnished with needs analysis forms, which inform the school needs especially on LTSM like textbook shortages, chemicals, equipment requirements for the following year etc.”*

Schools plan in advance their needs in terms of curriculum provisions and resources. Moodley concurred with Phila when she said:

*“This is one area as schools that we cannot compromise. The Department requires every learner to have a textbook for every learning area and they are supposed to be delivered timeously therefore we order well in advance.”*

The SSE and WSE reports from all the schools showed that ratings of 3 and 4 were given and they concur with the views above.

### **5.2.2.6 SUBTHEME 6: Learner achievement**

In line with the TQM theory the learner determines the level of quality. No matter what processes and efforts are put in place, the customer (learner) still determines whether the efforts were worthwhile (Westcott, 2013). Learner achievement is one of the criteria

universally used to determine quality. The WSE quality assurance tool has five areas that are considered when evaluating this focus area, namely:

- Learner achievement.
- Learners read, speak, listen and write well in the language of learning and teaching.
- Learners can handle numbers with ease, calculate mentally and with electronic devices and apply these skills to solve problems in mathematics.
- Supporting learners with barriers to learning.
- Learners participate and achieve well in extracurricular activities as part of the school enrichment programme.

It was apparent in the TIMSS study that learners who attended schools that placed a high emphasis on academic success scored 34 points higher on average for mathematics and 38 points higher for science than those who placed moderate emphasis on academic success.

Both district officials and school authorities emphasised academic success and achievements. This was pointed out by Siphon:

*“Our ultimate goal as a school is to make sure learners achieve the best results and are ready to face the world challenges in a holistic manner.”*

The comment by Siphon concurs with TIMSS 2015 results, which revealed that there is a strong positive correlation between learners’ achievement and the emphasis placed on academic success in schools (Reddy et al., 2016).

Moodley concurred with Westcott (2013) when he talked about school rankings determined by learner achievement:

*“If I put the nine focus areas in a pyramid of hierarchy at the peak I would put learner achievement ... schools are ranked based on learner achievement regardless of all other variables.”*

The deputy principal of school 4, Jane, commented:

*“Learner achievement is not only in the academics but all the other activities that are done in the school and the community.”*

The observation is in line with the WSE, where learners should also participate in extracurricular activities. Siphso also agreed with WSE and Jane:

*“Learners should not just achieve academically in our school for example we have soccer, netball, choir, dancers etc. who made the school proud by winning their respective disciplines.”*

A number of areas were mentioned by Moodley where learners should achieve, and this is prescribed in the WSE policy. Moodley went on to say:

*“We mould our learners holistically. When they finish matric they should have different skills that will help them to generate money for a living. We inculcate entrepreneurship skills, sporting skills, talent search and community enhancement skills. If learners grasp and achieve these apart from the academic skills we impart then they have achieved on our part.”*

Phila mentioned that other skills are considered when looking at learner achievement:

*“It is a fact that not all learners will achieve good matric results that will lead them to universities, therefore we promote other skills especially sports, cultural and technical skills.”*

WSE and SSE documents revealed that all schools in this study scored high in extracurricular activities but average scores in reading and calculating mentally.

### 5.2.2.7 SUBTHEME 7: School safety, security and discipline

According to Reddy et al. (2016) schools with discipline and safety problems do not provide conducive environments to either teaching or learning. TIMSS results indicated that well-disciplined schools where stable environments exist in which educators and learners feel safe were strongly associated with high performance. TIMSS results for South Africa revealed that on average, learners who have almost never experienced bullying scored 68 points more for mathematics and 97 points more for science than learners who were bullied on a weekly basis (Reddy et al., 2016:13).

The WSE tool used in quality assurance makes judgement in the following areas: the school implements a Health, Safety and Security (HSS) Policy to support, care and protect the learners, staff and others at school; the school implements safety practices against potential hazards, unsafe or unhealthy structures and conditions at the school; the school implements security regulations that aim to ensure the safety of the learners, staff and visitors on the premises; school implements regulations in compliance with legislation to keep the school violence and drug free; learner discipline policy and procedures and the contribution to the welfare of learners.

It is the researcher's view that one of the key areas that enhance quality teaching and learning in schools is the safety and security of the learners and all school staff. The deputy principals shared the same sentiments when they gave statements that linked the presence of good discipline, health and security to quality results.

Phila showed confidence in the discipline of science learners in his school:

*“Educators find it easy to teach and impart knowledge to learners who are disciplined and non-disruptive. Our science classes are much disciplined and learners are very cooperative, therefore it translates to the quality results we are currently enjoying as a school.”*

The link between safety and the attainment of quality results was expressed by Siphon:

*“Quality results are obtained especially when the school environment is secure and safe. Every term we do safety assessments and the Department supplies security personnel to our schools.”*

All the schools had security personnel who manned the main entrance as well as the school premises. In addition the local police also are involved by being visible, they sometimes address the learners in the different schools, according to Jane:

*“We collaborate with the local police for all threats of safety for our learners and staff and two police officers are assigned to our school. They sometimes come to talk to learners during assemblies and when we have serious security threats or breaches they respond very fast.”*

Moodley agreed with Jane in terms of working with the police:

*“The police conduct random searches for drugs and weapons from the learners.”*

Health issues were mentioned by Phila and Siphon:

*“All health campaigns, health education, immunisations the Department of Health is always communicating with the schools and we give them time to interact with our learners.” – Phila*

One other factor that is linked to health was seen as promoting good results by Moodley:

*“Good results are achieved if the mind is at ease knowing very well that safety is guaranteed and health issues are attended to immediately.”*

All the schools indicated that all quality assurance practices on safety and security are present and this helped them to manage their learners.

*“Over the years discipline has improved a lot and learners cooperate with educators in our school.” – Siph*

These findings agree with TIMSS report, where there have been slight improvements between TIMSS 2011 and TIMSS 2015 cycles (Reddy et al., 2016:15). The improved results in circuit 2 of the Johannesburg South district may be due to improved discipline over the years. The researcher holds the view that discipline should be inculcated from the classrooms where educators should be firm after involving all learners in proposing classroom and grounds rules. If the learners work together and decide on common rules, rights, responsibilities and consequences, the schools become environments that are conducive to learning, thus ensuring quality teaching and learning. Such initiatives will help learners respect educators and other learners and this will produce morally upright and active citizens who benefit humanity.

#### **5.2.2.8 SUBTHEME 8: School infrastructure**

It is the researcher’s view that, for effective quality science education to be achieved, the schools should ensure that all related school infrastructure be maintained and become fully equipped, as this creates a perfect climate conducive to teaching and learning. The WSE quality assurance tool designed in South Africa helps supervisors to make judgements and report on the effectiveness of five aspects, namely: the school has reliable and sufficient functional services; the ablution facilities at the school are appropriate, sufficient and in working order; classrooms are sufficient, appropriately furnished, maintained and used for the intended purpose; school has non-educational rooms to support a positive teaching/learning environment; and the school has appropriate school grounds, play areas and sport facilities.

Most of the schools in this study are from the medium to low income townships in Johannesburg South. Some of the schools are relatively new, for example two schools have temporary mobile classrooms only. One of the deputy principals, Siph, commented on the unfavourable conditions of some mobile classrooms:

*“Infrastructure especially in our school is a big challenge. You can see for yourself that the school has a lot of mobile classes. When it’s hot they become hot and unbearable for proper learning and when it’s cold they become very cold. Such conditions may cause learners not to concentrate in class thus compromising quality results at the end.”*

The sentiments clearly show that the conditions of some mobile classrooms are not conducive to teaching and learning and do not promote quality results. Sipiwe added:

*“Our school’s laboratory is not as fully equipped as we want although all the equipment necessary for most experiments and practical activities in science is present.”*

In addition to the non-conducive environments there were no proper laboratories and in the schools that had laboratories only one was well equipped. The positive thing revealed in all the schools was that even if there were not enough or well-equipped laboratories, all the prescribed experiments or practical activities and projects in science were completed by all educators.

*“To a certain extent quality of results can be negatively affected by the lack of infrastructure like proper classrooms and well equipped laboratories.”*

The Department of Education responds promptly to school infrastructural needs as indicated by one deputy principal in a quintal 5 school:

*“The Department is very swift when it comes to school infrastructure that needs repair. Last year the school was revamped. All structures that needed repair were attended to and the school was repainted.”*

One deputy principal, Phila, complained about the non-provision of brick and mortar structures in their school since its inception:

*“Our school has mobile classes only and we are waiting for permanent structures to be built, it may take some time due to the number of other schools being built around the province.”*

This concurs with studies by Manqele (2012), Risimati (2007), Mji and Makgato, (2006:254) who mentioned the lack of resources in some South African schools.

The quality assurance role of WSE was mentioned by Jacky:

*“The whole-school evaluation report informs the school improvement plan where infrastructural needs are highlighted.”*

Jane indicated that their school laboratory was not fully equipped:

*“Science laboratories in our school are not well equipped but they do serve the purpose they are intended to.”*

Alice further highlighted the infrastructure plight in schools and suggested solutions:

*“In terms of infrastructure like laboratories there are a few schools that are well equipped but majority of the schools do not have enough. Due to large numbers of learners some of the schools turned the laboratories into classes. We, however, encourage educators to be innovative and make use of science kits which were distributed to all the schools. The laboratory kits are like mini-laboratories which contain most equipment and chemicals which mainly allow educators to do demonstrations to learners. The other alternative is booking learners to go to Sci-Bono and conduct their experiments and practical activities. Educators are also advised to communicate with neighbouring schools so that they assist each other or contact us for help.”*

The schools in this study quality-assure their infrastructure, according to the whole-school evaluation reports. The school improvement plans in all the schools indicated

the needs and requirements for the schools ranging from repairs to requesting permanent structures.

From the checklist it does not, however, directly talk about specialised rooms like science laboratories, and whether they are well equipped and in good working order. In almost all the schools visited the laboratories are not well equipped except for one school. The views of the respondents shows that there is an urgent need to look at science laboratories and equipment. The quality of science education may be compromised if learners do not do certain practical activities individually, since a lack of facilities may result in more group work and teacher demonstrations. The findings here are in agreement with Manqele (2012), Risimati (2007), Mji & Makgato (2006:254), Howie (2001) and Legotlo et al. (2002:115), who found that there was a lack of facilities like libraries, laboratories and computer centres. Their findings also revealed that resource availability and achievement in science positively correlate.

#### **5.2.2.9 SUBTHEME 9: Parents and community**

The aim of this section is to evaluate the extent to which the school encourages and interacts with the community and parents and how it makes use of their contributions to support learners' progress. The first indicator that supervisors make judgements and report on is:

##### **i) The school communicates regularly and effectively with parents.**

Records in all the schools show that the schools have strategies to inform parents about school activities. Reports on learners' progress are issued every term and parents' attendance of meetings was evident. From almost all books checked by the researcher, the parents do not get involved in schooling as there was no evidence of signing or checking of learners' work/diaries. A rating of 2: "needs improvement" was given to one of the schools that underwent external WSE. It is the researcher's view that educators should plan and encourage parents to become more involved in the learning of their children. There are a number of ways schools communicate with parents and the community. The old methods of using newsletters is still leading. Due

to technological advancements the short messaging services (SMS), WhatsApp, emails and the recently introduced app D6 are being used. Moodley explained:

*“In order to improve communication with parents we use newsletters, SMS messaging, and emails and recently we have a D6 app communicator where parents can download on smartphones and view all school announcements.”*

The second indicator is:

**ii) School uses local services and institutions.**

All the schools in this study had evidence that they make use of local services and institutions to benefit the school and learners. There is evidence of learners using the local library, hall, swimming pools, radio stations and health facilities.

The third criterion is:

**iii) The school encourages learners to respect the local and global environment.**

Notices about the proper disposal of waste were displayed throughout the school premises and records showed that educators and learners were involved in environmental activities.

*“Our science learners always participate in world environmental day, water week, posters have been designed and displayed.”*

The schools’ year plans and management plans also indicated the observance of such days by the learners.

The fourth criterion is:

**iv) The school has developed good links with other schools.**

This has been evident in all schools as they had cluster meetings and sports tournaments. Ratings were 4 and 5 in the two schools that were externally evaluated. There were plans and most meetings took place with the guidance and support from the district. Alice confirmed that schools met during cluster meetings:

*“We disseminate most of our information directly to our educators during cluster meetings which we conduct once or twice a term per cluster.”*

Johannesburg South cluster 2 schools met on a number of occasions as directed by the district officials and in some cases schools made arrangements especially in sporting activities. School 1, 2 and 3 had all their circulars readily available, which showed that they had cluster competitions in sporting activities.

The last criterion is:

**v) Parental involvement in the school**

This last criterion, however, only refers to involvement in the school and is silent about parental input at home, on curriculum issues or the provision of conducive environments for learners. All the school had strategies to involve parents and the communities in the school activities through either informing them about school activities, curriculum feedback and learner behaviour. There is a general awareness of the importance of parents and communities around the schools as pointed out by Jane:

*“We owe our existence to the parents and community, thus as our clients we strive to involve them in most of our activities and inform them always on activities that concern their children.”*

The importance of the SGB was spelt out as the greatest link between the school and parents/community by Siphon:

*“The school governing body represents our community parent component and they definitely contribute to us achieving quality results.”*

In order to enhance the quality of science education in schools parents should be actively involved in curriculum matters. However, most parents do not check or sign their children’s books and this was revealed by deputy principals of school 1 and 3 presented respectively below.

*“We expect parents to monitor their children’s work and if possible help with homework. One thing that is clear to me over my teaching career is that most parents in this community do not support their children.” – Phila*

Moodley added:

*“Some parents don’t even know what their children are doing in school, they are so busy especially with work.”*

The quotations from the deputy principals are in agreement with Risimati (2007) and Monareng (1995).

Most parents become more active when their children are in their final year of high school. This was revealed by Jane:

*“When we call parents’ meetings some don’t come, which is very worrying. However, for Grade 12 learners they do support and attend meetings.”*

There is ample evidence that all schools in this study have mechanisms in place to involve parents and the community in school activities. The interviews and documents observed clearly show that parents are involved in supporting general school activities and attend meetings. There is, however, a concern regarding the involvement in curriculum matters where parents do not check or sign learners’ books. The results here concur with Risimati (2001:4), Monareng (1995), who all believe that strategic parental involvement by providing a wide range of opportunities would help schools interact productively with parents. The concerns raised about lack of parental

assistance in curriculum matters are in agreement with TIMSS 2015, which revealed that home conditions conducive to learning are still lacking in South Africa (Reddy et al., 2016:15).

## **THEMES ON HOW SECONDARY SCHOOLS MANAGE QUALITY ASSURANCE IN SCIENCE EDUCATION**

### **5.2.3 THEME 3: Standards and quality improvements in schools**

The District Support Services use the reports from the supervisory teams to discuss with schools and guide them in implementing the recommendations. Furthermore, they are responsible for setting up and monitoring clusters of schools with a view that they can better integrate approaches to improving the performance of schools (DOE, 2001a:13).

In order to evaluate schools holistically it is imperative that standards are set as part of the criteria. One district official, Eve, explained one of the duties of District Support Services:

*“Quality assurance involves the upholding of a set of standards put in place by institutions. One of our mandates as district officials is to make sure that standards are maintained by visiting schools, requesting for information.”*

Eve agreed with the deputy principals on how the district gets information relevant to support planning:

*“The main tools that we rely on are the Whole School Evaluations, IQMS and statistics of learner attendance, needs and results. This information will help us to give appropriate support to schools which enhances quality improvements.”*

One condition that helps quality attainment according to Eve is having standards:

*“In our district standards are key to attaining quality.”*

The setting of standards at various levels was reiterated by Siphon:

*“The Department has set standards for schools and as schools we also set our own standards.”*

Siphon mentioned the importance of pass rates as one of the indicators of standard:

*“One way in which we as schools maintain certain set standards is by setting targets like the pass rates and then we work towards that.”*

Steve explained why intervention classes were introduced:

*“Intervention classes were introduced in our district due to the fact that we wanted to improve the quality especially of science and mathematics.”*

Jacob showed the importance of checking on standards and the effects thereafter, which include support to schools:

*“The intention is also to diagnose areas needing urgent support in order to enable districts to provide informed services to schools.”*

One way that helps standards to be maintained is through quality assurance of assessments, according to Alice:

*“All school-based assessments are pre-moderated and post-moderated. This ensures that the standards are not compromised.”*

The views presented above clearly show that the schools strive towards maintaining set minimum standards in various ways.

#### **5.2.4 THEME 4: Monitoring and support by the district**

District Support Services were put in place by the national government in order to monitor and support schools on an ongoing basis for quality improvement. The district teams are composed of experts in general school management, leadership, governance, curriculum, staff development and financial planning (RSA, 2001:20). The Johannesburg South district is on track in terms of its role as a monitoring and support system for the schools.

The district director as the head of the district took it upon herself to be hands-on in terms of leadership and support in order to improve results in the district, as explained by Steve, one of the district officials:

*“Our district director had a campaign this year where she motivated educators and learners to improve the quality of their passes. Her main thrust especially to principals and HODs was for them to monitor all educators and check if all activities are being executed as planned.”*

The role of the district in terms of quality assurance and enhancing or maintaining standards in schools was spelt out by Sipiwe:

*“The role of the district is to support the schools through visiting, checking, verifying and quality assuring standards. We also check if they are compliant to submissions and deadlines and also if they implement policies. The district acts as a watchdog at the same time being like giving pastoral care to the schools”.*

The subject curriculum specialists, who are also referred to as facilitators, play an important role in supporting educators through school visits, cluster meetings, workshops and information sharing sessions.

*“As facilitators or subject specialists our main focus is on supporting the educators. This is done through the use of checklist tools we provide to schools. The HODs give the educators for example the curriculum coverage*

*reports. The educators fill them in based on the work schedule and the HOD then verifies by checking learner books. There is a lot of verifications and accountability at every level, from the educators to the HODs to the deputy principals and principals. These processes that take place in schools and district level are summarised in the SWISSIS document.” – Sipiwe*

A probing question on the SWISSIS document revealed that it has a number of clauses that help schools and districts to be accountable through verifications at every stage of monitoring and support. The following statement from the SWISSIS document was quoted by Sipiwe:

*“The curriculum framework is underpinned by the predictability framework for curriculum support, the curriculum support strategy, support and monitoring instruments, roles and responsibilities for curriculum officials at all levels and the curriculum calendar.”*

Alice, one of the district curriculum specialists, explained her duties which enhance teaching and learning in the schools in terms of curriculum support:

*“We provide schools with the syllabus/pacesetters (work schedules) that show content to be covered in each term. Schools are also provided with the assessment that must be covered in each term. We also weight each topic in the pacesetters to enable monitoring and reporting against the pacesetters more precisely.”*

Alice further gave examples of the documents they supply schools with:

*“We also make sure schools receive all policies, lesson plans, workbooks, exam guidelines, examiners’ and moderators’ reports.”*

The district ensures that teacher development plans and implementation take place based on information received from the schools:

*“A guideline to assist educators to close the content gaps for gateway subjects in Grade 10 and 11 has been completed. As district we mediate*

*and will inform the teacher development and support programmes. We implement support programmes for poorly performing schools.”*

Schools need to inform the district officials on their teacher development requirements:

*“Schools complete support requirements for each subject and these are used to inform teacher development plans.”*

The district officials’ school visits aim to enhance quality and improve academic achievement, as explained by one official:

*“The functionality of a school is determined by its academic performance, therefore our school visits check whether schools have effective measures, to manage, monitor and support the curriculum.”*

*“The Curriculum Management Model (CMM) says that it is incumbent upon the School Management Team to manage, monitor and support curriculum management within the school. SMT should promote the culture of learning and teaching.”*

*“Effective curriculum management can only take place once strategic planning and assessment have been developed.”*

Alice mentioned one of her duties to the schools they support:

*“If educators are not doing what they are expected to do we assist in every way possible. The first line of assistance comes from the HODs. When we go for school visits we check the Annual Teaching Plans (ATPs) and compare against the learner books.”*

According to DOE (2001a:13) the District Support Services should form school clusters in order to improve the performance of schools as well as guide schools in implementing whole-school evaluation recommendations. The District Support Services are responsible for ensuring the availability of adequate transport, and substance budget for the district support teams in collaboration with the provincial head

office and district office. The district also coordinates staff development activities that respond to individual needs and local needs as provided by schools in their SIP reports (RSA, 2001:20).

### **5.2.5 THEME 5: Quality assurance of assessments**

There are two main documents that guide schools on assessment quality assurance, namely the National Protocol on Assessment (NPA) and the National Protocol Pertaining to Progression and Retention (N4PR). These two documents work hand in hand with specific clauses in the CAPS document. Extract 5.3.1 is compliant with the CAPS documents and the NPA document as the areas for quality assurance are all covered in the tool. The results here corroborate the quantitative findings, which indicate that all formal assessments are undergoing pre-moderation and post-moderation (cf. 5.3.2.5.ii, 5.3.2.5.iii, 5.4.).

#### **5.2.5.1 SUBTHEME 1: Policy on assessment and the role of Umalusi**

The link between the Policy for the General and Further Education and Training Qualifications Sub-framework and Umalusi was not clear to most respondents and the researcher explains it below. This policy provides for the development of general and further education qualifications. This policy fosters the development of a single yet diverse general and further education and training sector committed to serving the needs of the individual, South African society and the economy. In 2001 Umalusi, the Council for Quality Assurance in General and Further Education and Training, was mandated by parliament, in its founding Act, the General and Further Education and Training Quality Assurance Act, 2001 (Act 58 of 2001) as the quality assurance body for Levels 1-4 of the National Qualifications Framework. All qualifications are nationally assessed through external examinations set by the national departments of Education (Basic Education and Higher Education and Training) and private Umalusi accredited assessment bodies. The prescribed qualification specifications, evaluation of curriculum statements or syllabuses to establish comparability, the verification of the quality of external examinations, and the monitoring of provision are all significant and relevant ways of establishing coherent standards, as well as measuring and improving quality in the education and training system. Umalusi develops processes that

measure, evaluate, monitor and report against the standards set in the qualification, the curriculum/programme, the related assessment, the implementation and assessment of the curriculum in the institution and/or by the assessment body. This General and Further Education and Training Qualifications Sub-framework formally demarcate Umalusi's quality assurance responsibilities, and to that end, Umalusi develops a policy that expresses the standards used for quality assuring the qualifications on the sub-framework, their provision and assessment.

Documents from the SAT file demonstrated that the quality assurance of assessment is a very thorough process, as emphasised by Moodley:

*“When it comes to assessment I believe we have one of the best quality assurance practices which take places at various stages. School-based assessments are quality-assured first by the HOD in the school through pre-moderation and post-moderation. This is followed by district moderations, which have three phases. The first one takes place in the second term where term 1 tasks are moderated, the second phase takes place in the third term where term 2 tasks are moderated and the third phase takes place in the fourth term where term 3 tasks are moderated.”*

The above statement concurs with the quality assurance steps and processes in the assessment policies.

*“Highly qualified and experienced educators are appointed to be moderators in science. The requirements are very clear on the application forms that the educator fills in when applying.”*

The process of selection of moderators was explained by Sipiwe, who further explained the steps in moderation taken by the district, province and Umalusi:

*“After the district moderations we have the province-based moderations that usually take place in the fourth term. Schools are selected on a rotational basis for them to submit samples of learner tasks that are then moderated against certain standards. The provincial moderations are usually coupled*

*with Umalusi. Furthermore, Umalusi also pre-moderate final national exams and also post-moderate them.”*

### 5.2.5.2 SUBTHEME 2: Pre-moderation of assessments

The following assessment quality assurance tool is an example that is used in Life Sciences for pre-moderation in the district.

#### Extract 5.1 Life Sciences pre-moderation tool

PRE-MODERATION			
STANDARD OF ASSESSMENT TASK	YES	NO	COMMENTS
Does the task/test correspond with the <b>programme of assessment</b> ?			
Does the task/test reflect the <b>SAs</b> for the grade?			
Is the <b>duration</b> of the paper/task indicated?			
Are the <b>instructions</b> clear and unambiguous?			
Is the <b>mark allocation</b> for the task/test in accordance with CAPS Document?			
Does the paper/test cater for a <b>variety of questions</b> ?			
Does the task/test incorporate the different <b>cognitive levels</b> (Bloom’s Taxonomy)? (Refer to the weighting grid of the test)			
Is the assessment task pitched at the appropriate cognitive level?			
Is there a correct distribution of marks according to the norms?			
Are the time allocation, name of subject and instructions to candidates clearly indicated?			
Are the language and terminology used appropriate and relevant?			
Is the mark allocation on the assessment task the same as that on the memo?			
Is the time allocated for the completion of the task adequate?			
Is the quality of the illustrations, graphs or tables clear, relevant and user-friendly?			
Does the assessment task have the correct numbering?			
<b>ASSESSMENT TOOLS</b>			
Are the <b>assessment tools</b> for every assessment task included in the educator’s portfolio file e.g. rubric, memoranda etc.?			
Are the marks <b>appropriately allocated according to the CAPS</b> ?			

Is the marking tool relevant and appropriate for marking of the set task?			
Does the marking tool allow for alternative responses?			
Is the marking tool clear and neatly typed?			
Is the marking tool complete with mark allocation and mark distribution within the questions?			
Is the marking tool easy to use?			
Is the mark allocation commensurate with the level of difficulty and time allocated for completion of the task?			

The HOD quality-assures all the tasks given and if the HOD is not competent in some of the learning areas a subject head is assigned to moderate. The tool above concentrates on pre-moderation, where a number of areas are matched against set criteria and standards. From the Life Sciences pre-moderation checklist in extract 5.3.1, two main areas are quality-assured, namely the standard of tasks set and the assessment tools used. The standard of tasks set in schools have a bearing on the quality of results learners will produce. If educators set standard and quality papers according to the CAPS document then the learners to a greater extent will be able to answer the external papers, which are quality-assured by DBE and Umalusi in the same manner as in the schools. Schools that properly quality-assure all tasks according to policy have greater chances of achieving quality passes since the standards will be on par or exactly the same. Results are in agreement with subsections 5.3.2.5.i, 5.3.2.5.iii, 5.4.

Pre-moderation is mandatory and is a requirement by the Department of Education in South Africa to maintain standards, and this was affirmed by Phila and Alice:

*“HODs have the sole responsibility to make sure that all school-based assessments are pre-moderated and post-moderated. This ensures that the standards are not compromised. Some of the things HODs check are whether the given tasks are in line with the CAPS document and the level of difficulty should be based on Bloom’s taxonomy, as outlined in the subject CAPS documents.”*

The difficulty levels in Physical Sciences examinations should be allocated according to Bloom's taxonomy. This was clearly defined in the CAPS document, where certain percentages were allocated per difficulty level. AT all the schools the pre-moderation tools for Life sciences and Physical sciences were within the stipulated ranges of difficulty levels.

The last section of the pre-moderation and post-moderation tools requires the signatures of the principals. All moderation tools in the educator files were signed and stamped. Phila agreed with the findings:

*"As deputy principals we then check and verify whether HODs have done the quality assurance job."*

The line management of the quality assurance process was highlighted by Phila above and this is in line with the CAPS policy.

Jane explained the process of post-moderation and also highlighted compliance in terms of content coverage and Bloom's cognitive levels in question papers:

*"Pre-moderation of school-based tasks is in two phases. The first phase involves checking if the educators have set quality papers that are CAPS compliant in terms of content and cognitive levels. When HODs receive the corrected papers back and they re-check if all recommendations are done. The schools then send these moderated papers to the district for quality assurance by the facilitators/subject specialists. If the paper is compliant according to CAPS requirements then the district gives the go-ahead for the papers to be administered."*

The subject specialist or facilitators from the district are also responsible for the pre-moderation of papers and this fact was confirmed by Alice:

*"We receive papers from the schools and we quality-assure them. HODs would have moderated them already but our job is to make sure that the papers are set according to the CAPS document."*

All the schools in this study had the same checklist for Life Sciences. There was evidence of both pre-moderation and post-moderation in all FET grades. There was also evidence of the pre-moderation of tasks in Physical Sciences. The checklist format was different but the contents were the same. The moderation tools in Physical Sciences were highly specific and separate. One addressed the experiments and practical tasks and the second one the tests and examinations. Closer examination of these tools showed that they were CAPS compliant.

### 5.2.5.3 SUBTHEME 3: Post-moderation of assessments

The following extract was taken from the Life Sciences moderation tool. It shows the aspects that are moderated after the exams were written.

#### Extract 5.2 Life Sciences post-moderation tool

POST-MODERATION					
MARKING	YES	NO	COMMENTS		
Are the tasks dated?					
Is <b>marking</b> done according to the assessment tool?					
Are the marks <b>correctly added and transferred to the mark sheet</b> ?					
Are the quality and standard of the marking acceptable?					
RECORDS					
Is the <b>subject recording mark sheet</b> included in the educator's portfolio file?					
Are the recording mark sheets in accordance with the guidelines given in the CAPS?					
Are the <b>learners' marks</b> corresponding with the mark sheet?					
Are the marks correctly <b>converted</b> according to the CAPS documents?					
Number of activities completed	<table border="1"> <tr> <td>NO.</td> <td><input type="text"/></td> </tr> </table>		NO.	<input type="text"/>	Specify:
NO.	<input type="text"/>				

Post-moderation is a process that quality-assures the marking process. It judges or rates the markers as to whether they were free and fair and following the marking guidelines and memoranda. The markers are also rated as strict or lenient. The transfer, addition and recording of marks are all checked during post-moderation. The

findings here are in accordance with the CAPS document on the quality assurance of assessment tasks. The views aired here are in agreement (cf. 5.3.2.5.i, 5.3.2.5.ii, 5.4). All schools had post-moderation tools in both Life Sciences and Physical Sciences and they were specific to these learning areas. The main aspects relating to post-moderation were the re-marking of scripts by the HODs or subject head, adherence to timeframes, fair marking according to the marking memorandum, proper addition and allocation of marks, and finally correct recording and conversion of marks. One official mentioned adherence to timeframes after writing exams.

*“After administering the tests, exams, practical tasks, assignments or projects then the process of post-moderation kicks in. HODs are to ensure that the three-day turnaround strategies are applied especially exams where marking should be done timeously and thoroughly.”*

The process of post-moderation was explained by Phila, who highlighted the re-marking, allocation and addition of marks:

*“Post-moderation involves checking of at least ten percent of the scripts of learners and re-marking them against the memorandum/answers. The HODs should make sure that the memo was followed when marking, was there proper allocation of marks and addition of marks was done correctly.”*

The role of the district and the process of moderation was highlighted by Moodley:

*“Post-moderation also involves the district sampling schools portfolio tasks and appointed moderators, peer educators or facilitators may moderate the tasks from schools.”*

It is the view of the researcher that when post-moderation at school and district level is followed correctly, it will result in learners getting fair marks. This will not compromise the quality marking processes. Learners will get the marks they deserve, therefore unbiased decisions can be made in terms of promotion to the next grade. Learners with poor marks at lower grades in science subjects will choose the proper subjects in which they will be able to achieve.

The district agreed with both Phila and Moodley when Alice explained:

*“It is mandatory for HODs to post-moderate as this ensures quality marking. Learners will not unnecessarily be disadvantaged as educators may miss some areas or calculate wrongly.”*

The process of post-moderation assists in making sure standards are maintained and individual educator error is eliminated. The results obtained through quality marking become reliable and credible, and giving a true picture of learner performance.

#### **5.2.5.4 SUBTHEME 4: District, provincial and Umalusi moderation**

External WSE and internal WSE reports indicate that quality assurance of assessments was done by most schools. The findings from documents showed that all the common examinations and formal school-based assessments were done and moderation was monitored in schools. However, there were discrepancies in informal and in some cases school-set papers. Some were not quality-assured by the subject specialists from the district but by the HODs only.

As seen in the previous section, the first stage of quality assurance is the responsibility of the HOD or subject head. The principals verify by signing the moderation tools. Support services from the district include the quality assurance of tasks given in school. The subject specialists mainly do the pre-moderation of papers and then they initiate and monitor the post-moderation of scripts as explained by Alice:

*“The district arranges cluster moderation days from second term onwards, where the formal tasks given every term are moderated, usually by peer educators. Educators bring at least three learner portfolios with formal learner tasks. They exchange and re-mark the formal tasks given to learners. The subject specialist also checks the proceedings where educators should avoid shadow marking but re-mark based on the memorandum of answers.”*

The processes of quality assurance of assessment go beyond district level as the provincial assessment teams have mechanisms in place to moderate the papers. Alice explained further:

*“Provincial moderation is done only by appointed educators who are highly qualified and experienced. Application forms are sent, educators apply, and panels sit and sift and select the most suitable moderator candidates who meet the requirements. Appointments are made and these educators become the provincial moderators”.*

Experience is taken into account when appointing moderators. This is a good move as they may have the ability to pick up inconsistencies of markers.

The credibility of the national examinations and school-based assessments lies in the hands of Umalusi as they are actively involved in checking the quality of assessments, marking processes and moderation. According to Sipiwe:

*“Umalusi is a special quality assurance body and they do moderate all tasks given in schools as well as the national exams”.*

Every year some school-based assessments are rejected as some educators are lenient or inflate the SBA marks to such an extent that there are huge variances between SBA and examination marks. This was explained further by Sipiwe:

*“One thing I know about Umalusi is that their quality assurance processes are clear, for example SBA tasks are accepted or rejected based on whether the SBA marks deviate from the exam mark.”*

These findings showed that at those schools where external WSE was done all assessments were quality-assured. The findings concur with those of Mathaba (2014) and Risimati (2007), who did extensive studies on school-based quality assurance. The views also concur with 5.3.2.5.i, 5.3.2.5.ii, 5.3.2.5.iii, 5.4, which all revealed that in the Johannesburg South district quality assurance of assessment is taking place at various levels.

## **THEMES ON THE FACTORS IMPEDING THE QUALITY OF SCIENCE EDUCATION IN SECONDARY SCHOOLS.**

### **5.2.6 THEME 6: Infrastructure and resources**

The Gauteng province is one of the well-resourced provinces in comparison with other provinces. Science learners in all schools had adequate textbooks, in some cases more sets of books. Grade 12 learners had tablets loaded with textbooks and past question papers. Concerns about resources only surfaced for the GET band, where learners may have to share certain textbooks. TIMSS key findings in South Africa revealed that the availability of school resources has improved, for example eighty-two percent of mathematics learners and 69% of science learners reported having their own textbooks (Reddy et al., 2016:15).

One of the challenges highlighted by some schools in this district was infrastructure, as indicated by Sipho below:

*“There are a number of challenges in our school which are mainly infrastructure. As you can see our school is mainly made up of mobile classes. In actual fact we do not have laboratories for science practical activities but the educators always improvise and make use of Sci-Bono laboratories and science kits.”*

Science practical activities and experiments in two of the schools that did not have laboratories were negatively affected as pointed out by Sipho:

*“It is difficult to quality-assure practical activities especially when learners do them in groups. The learners need to experiment individually and do all the practical activities. In the absence of such then effective teaching and learning is compromised.”*

The Department of Education has definitely made great strides in ensuring basic resources are provided in schools, however, pedagogical resource provision like libraries, laboratories and computers are still lagging behind (Reddy et al., 2016:16). In terms of resources like textbooks all schools in the study had enough textbooks for their learners. Siphon said:

*“All our Physical Sciences and Life Sciences learners have all textbooks, two or three different sets to be precise.”*

Some of the schools in quintal 4 and 5 indicated that they had sufficient resources to cater for their Grade 12 learners. This clearly shows how the lower grades are neglected. Moodley said:

*“Grade 12 learners even have tablets and their classes are smart classes with interactive smart boards.”*

Although resources were adequate in some schools, there was a need of more resources especially in the lower grades. Jane indicated some shortages in resources:

*“We are a no fee paying school, so all our resources come from the Department which in some cases are not adequate.”*

The same view of the neglecting of the lower grades was held by Phila:

*“Our resources are enough for all FET learners, in some cases, however, the learners in Grade 8 and 9 share additional textbooks.”*

All the schools had LTSM policies that were specific for every school. Only two schools had an active LTSM committee which held regular meetings every term. In the other schools records indicated that the committees met once at the beginning of the year and one school did not have this committee. Schools take care of their resources, as Jane explained about their retrieval mechanism:

*“We have a strong retrieval system and we order our LTSM on time yearly. However, I won’t say we have all resources we require for the smooth running of the school’s teaching and learning processes.”*

All the schools provided the researcher with retrieval forms that made learners accountable for lost textbooks. Subject educators were also accountable to the HOD in terms of the number of books given to learners. The schools have documents that reveal that they retrieve their LTSM and also check their status every term.

The results from quintal 1 and 2 schools in this study are consistent with Manqele (2012); Mji and Makgato (2006:254); Howie (2003:2); and Legotlo et al. (2002:115), who found that a lack of physical facilities and resources, like laboratories and science equipment, is a common problem in most South African public schools. Quintal 3, 4 and 5 schools had all physical resources but not enough laboratory equipment.

#### **5.2.7 THEME 7: Learner attitude towards science subjects and subject selection**

A positive attitude to school, learning and teaching is important in achieving success at school (Reddy et al., 2016). The TIMSS report for South Africa showed that there is a positive relationship between learners’ belief in their ability and their performance in mathematics and science. In 2015, the difference between the scores of confident learners and those of non-confident learners was 89 points in mathematics and 65 points in science. According to Reddy et al. (2016) confidence levels in science increased in all provinces and independent schools from 2011 to 2015.

Learners’ attitudes to science subjects differ widely. The deputy principals also had different views about learner perceptions:

*“I can say learner attitudes towards science differ widely. We have the majority of learners who always say science subjects and mathematics are difficult. We know of learners who are capable or have the potential of achieving good results but because of fear do not choose science subjects.”*

Sipho further contrasted the learners, where some still have a set of beliefs that science subjects are difficult. This is a notion that requires effort from the school management and educators to help learners to understand that all learning areas are equally challenging but that attitude may affect achieving required levels. When assessments in Physical Sciences and Life Sciences are set both at school and at national level Bloom's taxonomy is followed according to CAPS policy. This is a requirement for all the learning areas that are assessed in the South African context, where Bloom's or Barret's levels are used depending on the learning area. Alice spoke about this:

*"We also have another group of learners who don't choose their subjects wisely based on their performances in previous grades. They select science even if they know they won't cope maybe because of pressure from parents or friends."*

Learners should be in a position to know their capabilities.

The attitude of some learners is influenced by their peers and this influences their choices of subjects.

*"For a fact I know peer pressure plays a major role when learners select subject choices for FET. Friends usually choose the same subjects but when reality sets in we see some learners opting to change subjects and those who continue may end up repeating a grade."*

Preconceived perceptions about science subjects were also pointed out by the educators:

*"There is a belief that learners have that science subjects are difficult to the extent that some capable learners may not select the courses in Grade 10."*

Subject selection flaws came to light once again as one of the deputy principals blamed the policy on subject selection by learners. Jane said:

*“Choice of subjects at Grade 10 is at fault as learners are given free-will choice, which may not be based on their subject strength.”*

The findings on subject selection concur with Stephen (2013), who observed that there was less consideration of input (quality of learners taking science) than of output (results of learners).

Moodley expressed one way that attitude can be changed:

*“Motivation plays a central role in changing the attitude of learners to mathematics and science subjects.”*

These findings are similar to those of Phurutse (2005) and Wisker and Brown (1995). The findings in this section also concur with quantitative research responses (cf. 3.6.1.2, 5.4.2.2).

## **5.2.8 THEME 8: Language challenges**

The TIMSS results from 2015 showed that the learner’s language of learning and teaching (LOLT) corresponds to the language frequently spoken by the learner. A positive association with performance is noted, especially in language-intensive subjects like science (Reddy et al., 2016). The difference in the average scores of learners who always or almost always spoke the LOLT at home and those who sometimes spoke the LOLT at home is 60 points for mathematics and 84 points for science. In 2015, almost one-third (31%) of learners used the LOLT at home. Analysis of the use of LOLT by learners over the period 2003–2015 shows that by 2015 Gauteng had more learners speaking the LOLT at home (Reddy et al., 2016:12).

Almost all deputy principals held the view that most learners were not proficient in the language of learning and teaching, which is English.

Phila had the following view about learners in his school:

*“The majority of our learners are not fluent English language speakers, although we offer English as a home language, and this definitely affects their learning in one way or the other.”*

The researcher’s view is that if learners are not fluent in a language there is a great likelihood that they may have challenges with cognitive academic language proficiency. The interpretation of questions may be negatively affected, resulting in learners writing the wrong answers. Moodley commented:

*“Learners will not understand science because it’s in a language they are not competent in.”*

This statement by the deputy principal of school 3 suggests that learners should be competent in the language of learning and teaching in order to understand scientific concepts.

The issue of home language code switching was raised by Jane as one way learners try to cope with a language they are not fluent in:

*“Our learners always speak in their home language even in science classes and educators may end up code switching to explain some concepts in class.”*

It is the view of the researcher that learners should become fluent and competent in the language of learning and teaching. Schools should make provision so that all learners become competent in English or Afrikaans since these are the languages used in science subjects. In cases where learners are not fluent code switching may be used to help learners understand scientific concepts that are beyond their language capabilities.

The above statements were in agreement with the findings of TIMSS 2009, which highlighted that learners in South Africa could not communicate their scientific conclusions in English or Afrikaans as the medium of instruction (Howie, 2003). Siphos also felt that language affects quality results:

*“The quality of results will be compromised by language barriers.”*

This shows that language plays a major role in the achievement of quality results by learners.

The results in this section concur with Cummins (2000), Howie (2003) and Zisanhi (2013) when they observe that learners in townships communicate in their home languages, which then challenge learners who fail to bridge the gap between the home language and the language of reading, writing and assessment. A lack of cognitive academic language proficiency results in learners not engaging meaningfully with the curriculum, therefore their performance in science is poor.

### **5.2.9 THEME 9: Educator workload**

The findings are supported by Maile (2013), who points out that educators spend a substantial amount of time developing materials for use in the classroom. In instances where educators are supplied with ready-made lesson plans, they always develop teaching and learning materials from scratch (Maile, 2013:25). In addition there are views that science subjects require careful planning and considerable expertise on the part of the science educator (Archer, 2006:X1, 38).

All the schools visited indicated that science educators have a lot of work that they need to do, thus they are overloaded as highlighted below:

*“Science educators are overloaded...” – Phila*

This statement is in agreement with Naylor (2001), ELRC (2005), Starnman and Miller (1992) and Grayson (2010).

Almost all deputy principals shared the view that science educators were overloaded with work in their schools. Moodley said:

*“There is a need for them [science educators] to have enough time for preparation.”*

One of the deputy principals held the view that science subjects are challenging, therefore educators needed to have more time for preparation. According to Siphon:

*“...challenging learning areas require more time for preparation.”*

This statement corroborates studies (ERLC, 2005) that revealed that mathematics and science learners spent more time in preparation than the other learning area educators.

Laboratory activities and experiments dominate the idea that a lot of preparation is required. This was echoed by Alice:

*“Laboratory activities seem to drain the educators as there is a lot of preparation to do.”*

A great deal of paperwork and planning on the part of science educators were also blamed for them being overloaded. Jane commented:

*“Educators still have a lot of paperwork to do, from planning, executing lessons and they need to follow the IQMS processes in order to produce quality results.”*

One deputy principal acknowledged that science educators overwork in order to get good results in their school. Moodley said:

*“Due to tight schedules and not so friendly time factors our educators teach extra hours even over the holidays.”*

D3 comments were in agreement with ERLC studies as well as Grayson (2010). Responses from the participants indicated that science educators are overwhelmed by preparations for practical or laboratory work. This is coupled with the normal daily duties of the educators as stated in the PAM document, which does not make special provisions for science educators. The district officials also concurred with the findings above, for example:

*“Absolutely I agree as most of our educators are burdened by a lot of work. Laboratory technicians’ duties usually are to prepare practical activities, prepare workstations and clean materials as well as to maintain equipment and taking stock. These duties are all done by science educators if the science lab is available.” – Alice*

These views showed that if schools have laboratories there is a need for laboratory assistant personnel or technicians. The absence of the key personnel is a threat to quality science education because the educators would be strained. All the responses quoted here are in agreement with a number of authors (Maile, 2013; Grayson, 2010; Archer, 2006; Naylor, 2001; Starnman & Miller, 1992). The quantitative results also corroborate the findings in this section (cf. 3.6.1.5, 5.4).

#### **5.2.10 SUBTHEME 10: Formal and Informal learning of science**

Environments for both formal and informal learning should be created in schools to optimise learning experiences in schools. Both school deputy principals and district officials pointed out that these environments are present in schools.

Moodley from school 3 argued her point:

*“To enhance quality science learning we have a schedule of events that are internally and externally set. These include excursions, educational tours, career expos, universities open days and so on.”*

All the schools in this study had lined up events on their calendars, as illustrated by Sipho:

*“Every term we have excursions which may cover the different learning areas directly or indirectly.”*

School 1 had many informal learning experiences for science learners as they had a number of educational tours as well as school events lined up on the school calendar. Phila said:

*“Formal learning is strictly adhered to and informal learning is somehow not strictly adhered to.”*

There is a need in school 4 to document some informal learner experiences or for schools to have quality assurance measures for informal learning experiences for learners.

*“Projects in science and many research tasks expose learners to informal learning environments, which help them to grasp concepts better.” – Jane*

The district official agreed with deputy principals and further indicated that the assessment given, although formal, creates a lot of informal learning experiences for the learners.

From the interviews conducted there are planned informal learning environments by the schools. Assignments and some projects, although formally given, expose learners to some informal learning experiences. The overall view in this subtheme is that schools have not yet come to the full utilisation of informal learning experiences and that there are no quality assurance mechanisms in place to ensure that learners are fully exposed to informal learning settings. The presence of excursions and educational tours, in both Physical Sciences and Life Sciences, were evident in all the schools, exposing learners to informal learning environments. This is in agreement with SETAC (2014) and CAISE (2010) (cf. 3.6.2.5).

#### **5.2.11 THEME 11: Influence of quality assurance on the quality of science education**

When quality assurance practices like WSE are in place in schools the quality of results also improves. The findings from the documents revealed that schools' quality improved after external WSE. These findings are in line with those of Mathaba (2014:188). The results in this section are in agreement with qualitative results, section E4, which revealed that assessment quality assurance improved the quality of results. Infrastructure development also took place after whole-school evaluation reports were submitted to the relevant authorities for action.

*“Whole-school evaluation is the first step in the process of school improvement and quality enhancement.”*

Quality assurance processes in science were viewed as having an impact on the quality of science education. This was confirmed by Jacky:

*“I believe that quality assurance actually influences the quality of science results. If all quality assurance processes are followed like quality assuring assessments in school even the quality of results will be good.”*

The district officials confidently boasted that the quality assurance processes were followed, according to Alice:

*“In our district quality assurance processes have been followed thoroughly especially in our science subjects and I believe this has contributed to the quality results we are currently enjoying.”*

One district subject adviser, Sipiwe, also reiterated that quality assurance processes were followed in the district and had an influence on the quality of the results.

*“Quality assurance is like engine oil which makes engine parts work smoothly together which results in quality engine output. For us to be the top district in Life Sciences last year these quality assurance practices in our district were followed.”*

There was an indication that results were poor before thorough quality assurance practices were introduced, but at present there is an improvement due to increased quality assurance practices in the district.

*“Historically our results used to be poor but because of the systematic way of quality assurance introduced by the Department our results have been steadily increasing year after year.” – Sipiwe.*

There are views that when educators are aware of the policies on quality assurance and implement them, they contribute to the quality of science education.

*“Yes of course educators understand the importance of quality delivery at schools. I can safely say that our quality assurance practices have helped to improve the quality of science education in our district.” – Moodley*

There is an overwhelming sense from all respondents that quality assurance practices in the schools have enhanced the quality of science education.

### **5.3 Qualitative data summary**

Qualitative data revealed that the schools in Johannesburg South apply IQMS as the main quality assurance system, which encompasses the WSE. The quality assurance processes are implemented in schools and the district support teams support the schools to attain the minimum standards set by the Department of Education. South Africa uses the examination model that incorporates school-based assessments (SBA). In this regard robust assessment quality assurance processes were put in place at various levels and were implemented in the schools in this study. A number of challenges were identified that had negative effects on attaining quality science education. Finally there were overwhelming views that quality assurance practices and mechanisms have helped to improve the quality of science education.

## **5.4 QUANTITATIVE DATA ANALYSIS**

### **5.4.1 Quantitative data analysis procedures**

Data was collected from all the sampled schools using questionnaires. The respondents were forthcoming and all responded positively. Dates were given for the collection of questionnaires and assurances were made of the anonymity of participants and their institutions. Questionnaires were directed to principals, deputy principals, heads of departments, school governing bodies personnel, school assessment teams (SAT) coordinators, integrated quality management systems (IQMS) coordinators, science HODs and educators. The responses were analysed

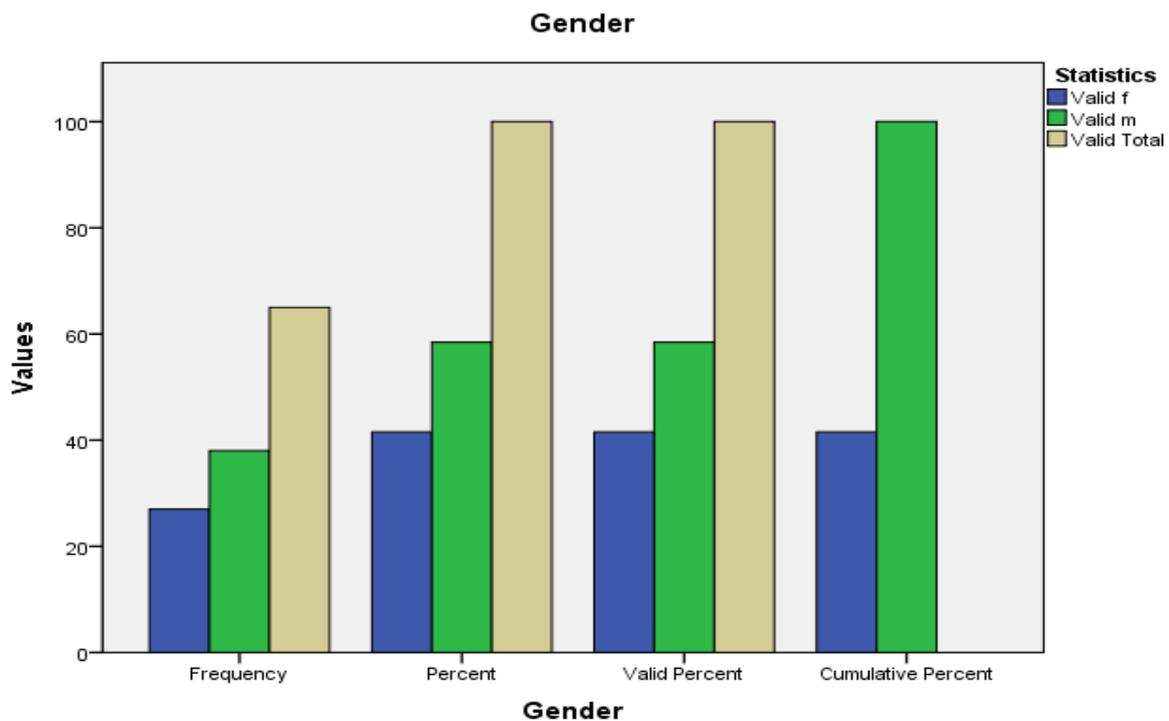
statistically and the results were presented as pie charts, bar graphs, line graphs or tables. A five-point Likert scale was used, where the respondents were asked to rate each item in section B to D with *Definitely No, Maybe No, No Idea, Maybe Yes and Definitely yes* and section E with *Strongly agree, Agree, Disagree, Strongly Disagree and Not certain*. These choices were used to ascertain the degree of certainty of each item according to the circumstances in the particular school in terms of the quality assurance processes and challenges faced in science education. For presentation purposes in some cases the responses were categorised into positive (Yes), no idea (Neutral) and negative (No) answers.

With regard to these presentations descriptive statistics in the form of graphs, tables or pie charts were used to report the results (cf. 5.4.). Inferential statistics began by identifying the driving questions based on the overall responses of all respondents per question. Pivot tables or cross tabulations were used to identify the strongest positive or negative drivers or responses that could represent the themes identified. All the possible combinations of the pivot tables were analysed and only the strongest positive or strongest negative pairs are presented here. The strongest positive variables were analysed by matching them with the target or dependent variable (quality passes) in science using univariate analysis to produce Gini statistical values. Gini statistical values were obtained and inferences were then made based on the observed results. The driving questions identified were then used to check the strongest quality assurance themes and the impact they have on the quality of science education (cf. 5.3.7). A multivariate analysis was used to determine the relationship between all the theme variables. Measures of variability were used whereby the variation inflation factor was calculated to find out whether there was auto-correlation between the theme variables. Finally a regression analysis was used to determine the strongest quality assurance drivers for quality science passes.

## 5.4.2 Quantitative data presentation and analysis

### 5.4.2.1 Biographical information of questionnaire respondents (gender and age)

The respondents to the questionnaires by gender are illustrated in Graph 5.1 below.



**Graph 5.1 Gender of questionnaire respondents**

Males (58%) dominate the respondents to the questionnaires, as is evident in Graph 5.1. Only 42% of the responding quality assurance implementers in the sampled schools are females. The distribution of the science quality assurance respondents according to gender is, however, a true reflection of the entire population and in this study there was no sampling error.

The ages of the respondents are shown in Table 5.3 below.

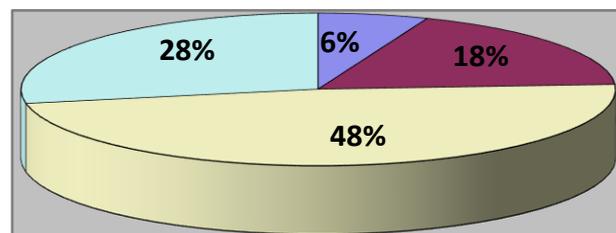
**Table 5.3 Age of the questionnaire respondents**

Age				
	Frequency	Percentage	Valid percentage	Cumulative percentage

Valid	20-34	7	10.8	10.8	10.8
	35-49	47	72.3	72.3	83.1
	50-65	11	16.9	16.9	100.0
	Total	65	100.0	100.0	

The educators' age groups varied from 20 to 65 years, of which the highest number (47%) was in the 35 to 49 age group, followed by the 50 to 65 age group (11%). The age group between 50 and 65 had most educators in management positions in the schools. Only 4% were in the age group between 60 and 65, which is the age when educators are expected to retire. The smallest number of the questionnaire respondents (7%) was the age group from 20 to 34, which is the age group that recently qualified. This shows that a lot of input was provided by both genders and a representative spectrum in terms of age.

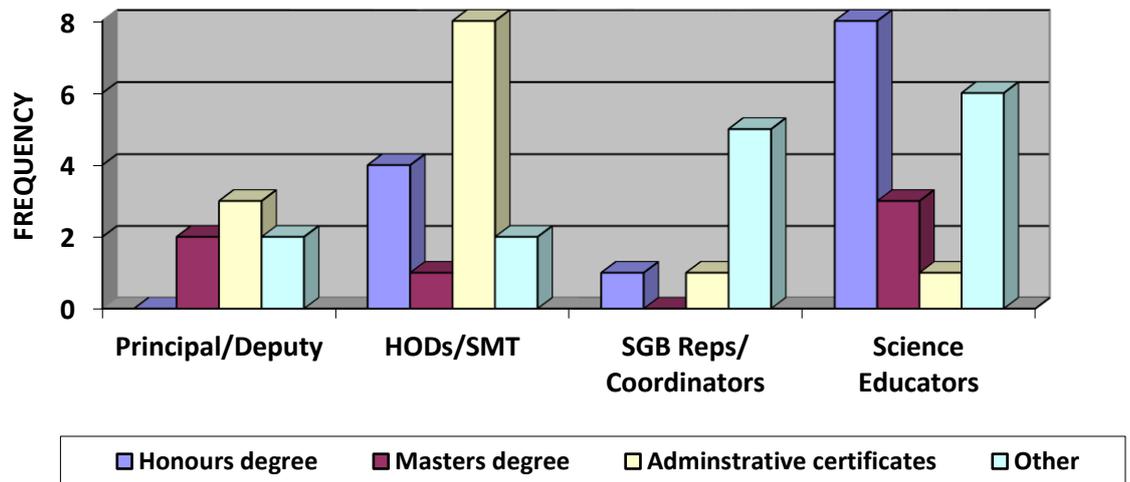
#### 5.4.2.2 Qualifications of questionnaire respondents



**Figure 5.2 Initial teacher qualifications of questionnaire respondents**

All respondents (100%) were qualified educators with an initial teaching qualification and holding various positions in the schools. The SGB component was represented by the teacher representatives of the schools, therefore they all had teaching qualifications. The principals/deputy principals gave well-informed inputs with regard to SGB matters as they were members by virtue of their positions. Only a few educators (6%) had post-matric teaching certificates. They were well seasoned in their profession

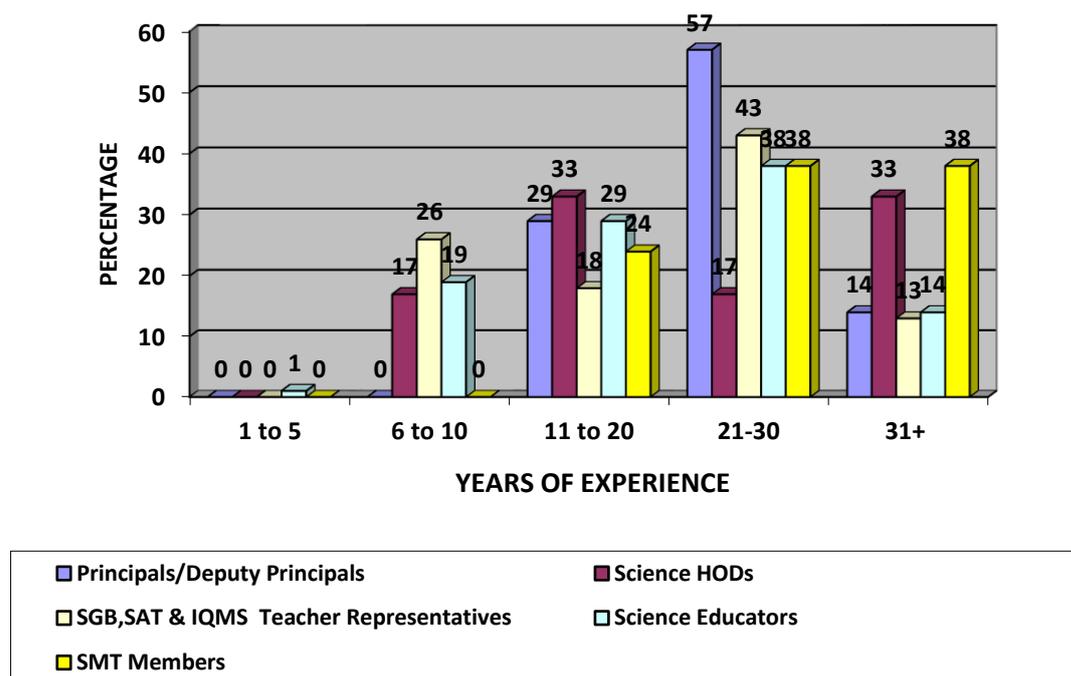
as all had more than 20 years' experience. The second lowest number (18%) was educators with teaching diplomas and the highest percentage (48%) was respondents who had three-year bachelor's degrees. Educators with a four-year degree accounted for 28%. Most of the science educators had four-year degrees although they represented the second lowest percentage.



**Figure 5.3 Subsequent qualifications of questionnaire respondents**

From Figure 5.3 above, of the principals and deputy principals two had master's degrees, three had administrative certificates and two had other certificates. Of the heads of departments (HODs) and school management teams (SMTs) four had honours degrees, eight had administrative certificates, one had a master's degree and two had other certificates. Of the SGB representatives, integrated quality management systems (IQMS) coordinators and school assessment teams (SAT) coordinators only one had an honours degree, one had an administrative degree and five had other certificates. Of the science educators eight had honours degrees, two had master's degrees, one an administrative certificate and six had other certificates.

### 5.4.2.3 Years of experience



**Figure 5.4 Years of experience of the respondents**

The principals/deputy principals had a lot of experience (29% + 57% + 14% = 100%). Their experience started from 11-20 years (29%), the highest among the principals (57%) represented those with 21-30 years' experience. The science HODs' experience was represented by 17% with 6-10 years' experience; 33% with 11-20 years' experience; 17% with 21-30 years' experience and 33% with 31 years and above experience. From the category of SGB representatives, SAT coordinators and IQMS coordinators the experience of the groups 6-10, 11-20, 21-30 and 30+ was represented by 26% + 18% + 43% + 13% = 100%. The experience of school management team members ranged from 11 years to 30+, of which those with 11-20 years' experience were 24%; 21-30 years were 38% and those with 31 years and above accounted for 38%. The science educators who responded in the questionnaires indicated that 1% had 1-5 years' experience; 19% had 6-10 years' experience; 29% had 11-20 years' experience; 38% had 21-30 years and 13% had 31+ years' experience.

The experience of the respondents clearly showed that they were the right sample to give informed responses on most sections of the questionnaires.

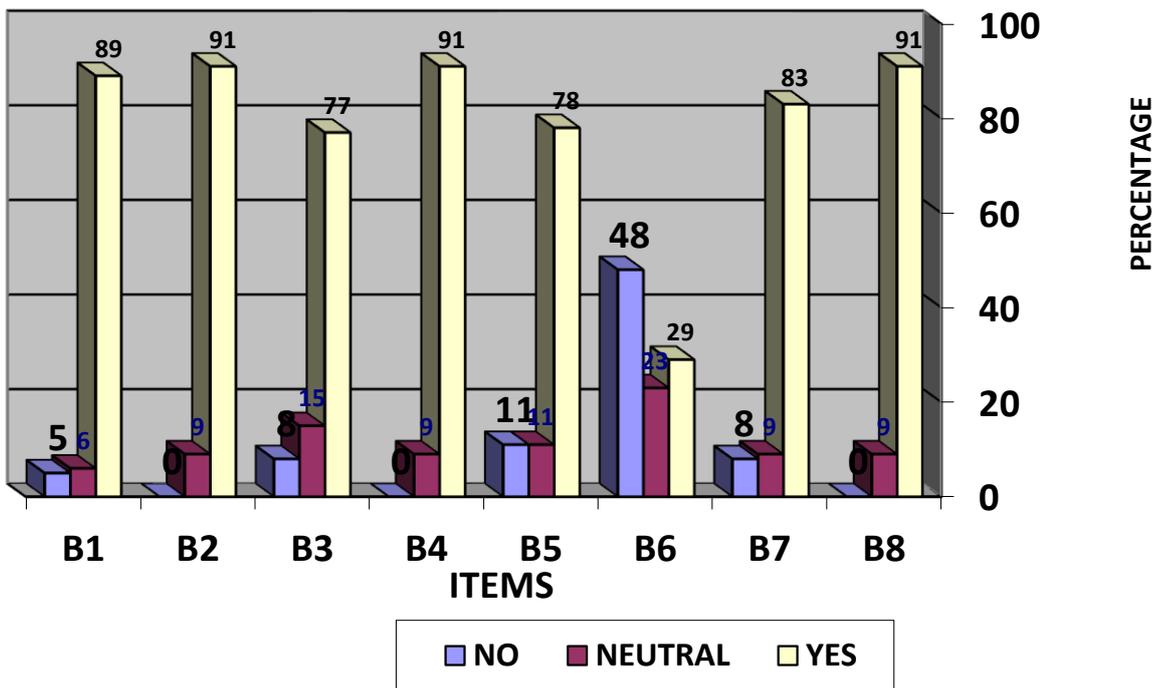
The responses from the questionnaires and the interviews were presented concurrently in this section. The arrangement of the responses was according to the questionnaires as most of the responses from the interviews tallied with questionnaire responses. Documents that were relevant to the study were requested from schools and the district and also presented in this section concurrently (cf. 4.6.4).

### **5.4.3 Quality assurance policies and mechanisms**

Section 5.2 revealed that there are quality assurance policies available for all public schools to access and implement. Furthermore interviews revealed that a number of mechanisms are available to make sure that policy access and implementation are not compromised. This section will further show the responses of respondents to the presence of quality assurance policies and mechanisms.

#### **5.4.3.1 Quality assurance policies**

Policies are crucial in any organisation since they give direction and procedures to be taken to fulfil their vision and mandates or accomplish goals. In order to answer the sub-question on the mechanisms put in place to ensure quality science education in South Africa a series of questions were asked in the questionnaire from item B1 to B8. The items from B9 to B20 tried to establish the mechanisms put in place to accompany the policies. The success of any policy depends on two main things, namely the mechanisms in place and the implementation thereof. In the first set of questions respondents were asked questions that related to quality assurance policies. The following questions were asked to gather the views of the educators on policies: **B1**: Does the school have a clear vision, mission, aims, policies and management structure? **B2**: Does the school have any policies regarding quality assurance? **B3**: Does the school conduct annual self-evaluations (SSE)? **B4**: Are there school improvement plans (SIP) produced after SSE? **B5**: Do you have subject policies that are customised for the school? **B6**: Do you have the authority to review any of the policies you have? **B7**: Do you have meetings to disseminate the policies? **B8**: Are the district officials actively involved in evaluating school implementation of policies? Figure 5.5 below provides a breakdown of the responses.



**Figure 5.5 Quality assurance policies**

The average score of agreement is 78.6%, while disagreement is 10.0% and neutral 11.4%. The overwhelming sense obtained from the responses is that schools do have quality assurance policies in place and educators are aware of such policies.

**B1: Does the school have a clear vision, mission, aims, policies and management structure?**

Most of the respondents 89% agreed that their schools had clear vision, mission and aims, policies and management structures. Six percent had no idea and the other 5% did not agree with the statement. As the researcher moved to the school administration blocks the vision and mission statements were clearly displayed in three of the schools. Only one school did not have any displayed documents.

The following extract from the Whole-school Evaluation tool shows that all schools are supposed to have the documents mentioned above.

**Extract 5.3 Whole-school Evaluation Tool 1**

5.1.1	The school has a vision that is current and provides the school with clear direction and motivation	5	4	3	2
5.2.2	The school has a clear set of values that is embedded in school documents and activities	5	4	3	2
5.1.3	The school has a clearly defined mission statement	5	4	3	2
5.1.4	The vision & mission statements are displayed for all to see in the school building	5	4	3	2
5.1.5	The vision & mission statements are well known to and supported by the school community	5	4	3	2

All the schools in this study had clear vision and mission statements. However, in one school reports from the external Whole School Evaluation there was an indication that both the vision and mission statements had not been reviewed for a long time. This may have contributed to the 5% who did not agree with the statement. When schools have clear vision and mission statements it means they have direction and will introduce mechanisms to make sure they move towards the vision. In this case the results suggest that schools have clear visions, therefore a greater likelihood of having quality assurance processes that will help realise their vision. The results here are in agreement with the document analysis, where school A, C and D scored averages of 5 and school B scored an average of 4 on their WSE ratings.

## **B2: Does the school have any policies regarding quality assurance?**

An overwhelming majority (91%) of the respondents agreed that the school had policies regarding quality assurance. Only 9% remained neutral and none of the respondents did not agree with the statement. The results were backed up by the district officials, who pointed out the existence of quality assurance policies, namely Whole School Evaluation Policy (WSE), National Protocol on Assessment (NPA), and Integrated Quality Management Systems (IQMS) among others.

One of the checklists that the district officials use when they visit schools clearly indicates that schools' HODs should have policies in their files that are aligned with national policies.

## Extract 5.4 District official checklist tool 1

2. Learning Area Policies			
2.1 Alignment to the DBE policies. Comment on the relevance of the policies with regard to national policies on assessment and the NCS/CAPS)			
2.2 Policy gives a clear indication of classwork/homework activities, record keeping, meeting of deadlines/due dates, compulsory forms of assessment and monitoring/quality control processes.			
2.3 Clarity is given in terms of content, learning outcomes and assessment standards that need to be covered.			
2.4 Quality-assured and signed copies of the Work Schedule and Assessment Programmes per grade in the HOD's care.			
2.5 Circulars from the provincial department, memoranda and cluster material from the District Office.			

Extract 5.4, section 2.1 of the extract, clearly shows that schools should have relevant policies in line with national policies. HODs are also expected to have customised departmental/subject policies (see 2.2 in the extract). Quality assurance activities by the HOD are also mentioned in section 2.3 in the extract. Quality assurance processes are the cornerstone of organisations if they want to improve practices or maintain standards. The schools being guided by the Department of Basic Education (DBE) have quality assurance policies, some of which directly impact on science education. The findings concur with the document analysis, where all schools in the study had all relevant policies at their disposal.

### **B3: Does the school conduct annual self-evaluations (SSE)?**

About three-quarters (77%) of the respondents agreed that their schools conducted annual school self-evaluations (SSE). It is, however, expected by the policy that all schools should conduct whole-school self-evaluations. The fact that 8% disagreed and 15% remained neutral leaves a lot to be desired. From the interviews conducted it is

clear that some of the schools do not conduct SSE. The following answer was given by a district official when the researcher asked about improvements that need to be done from the weaknesses identified:

*“Policies need to be reviewed and internal whole-school evaluation conducted yearly.”*

The response above therefore is in agreement with the 8% who disagreed with the statement.

All schools in the district need to do an honest self-evaluation every year as this will help schools to maintain standards as well as improve their practices, thus enhancing quality practices that will definitely help to improve science education. The documents available in all schools, however, showed that all schools in the study conducted SSE every year.

#### **B4: Are school improvement plans (SIP) produced after SSE?**

The majority of the respondents (91%) agreed that school improvement plans (SIP) are produced after SSE. The whole-school evaluation policy requires schools to produce a school improvement plan. The introductory statement under important notes of the tool, bullet 2 and 3, states that:

- Every school is required to have an annually updated School Improvement Plan, detailing what the key challenges of the school are and how they will be addressed.
- Prior to developing a School Improvement Plan, it is essential that school communities undertake School Self Evaluation, in accordance with the National Policy on Whole School Evaluation (Government Gazette Vol. 433: No. 22512 of 26 July 2001, Pretoria).

The results in this section are still in agreement with the results in B3, whereby if schools do not conduct self-evaluations it will be impossible to produce the SIP.

However, the district officials in the interviews were concerned about compliance, as indicated by the response below:

*“They just comply for the sake of submissions.” – Alice*

The reason is that every year the district receives SIP documents from all schools, as indicated by one district official about her duties:

*“I also receive reports on the development of educators, giving detailed information who was involved developed against the educator’s Personal Growth Plan and the School Improvement Plan.”*

The school improvement plans help the district to formulate a district improvement plan that will inform the Department of needs in terms of resource allocations and support needs from different schools. If schools do not thoroughly do their SSE then the SIP will be at fault and will not address the real needs of the schools, therefore the quality assurance processes will be compromised.

#### **B5: Do you have subject policies that are customised for the school?**

The results suggest that schools have subject policies that are customised to each school as 78% of the educators agreed with the statement and 11% were neutral. The result was corroborated by the district officials. Rose commented:

*“Generally they comply, if not by visiting them at school or by conducting workshops.”*

This was in response to the availability of school policies. According to the checklist of the district officials (see Extract 5.2 section 2.1 to 2.4) HODs complied with these categories – an indication that customised subject policies are available in schools.

Contextual factors should be taken into consideration when formulating subject policies. The different schools have different experiences and different challenges, therefore there will be a need for schools to customise their policies based on their

circumstances. It would be fruitless to simply use premade policies and adopt them. Policies should be guidelines that should help schools to improve their practices.

**B6: Do you have authority to review any of the policies you have?**

“If educators take an active part in the formulation of school policies they will own and proudly implement them” (Mbalati, 2010). The majority of the respondents (48%) disagreed with the statement whereas 23% were not sure if they had the authority to review policies and they remained neutral. The reason might be that the quality assurance policies from the Department of Education are handed from the top down and educators have no say in them. At the same time school policies are supposed to be reviewed, sometimes once a year or in a cycle of three years. About 29% agreed with the statement that they have the authority to review some of the policies they have. The responses from the interviews with district officials were in agreement with the questionnaire responses, as quoted below:

Question: Outline the areas in your district regarding WSE that were considered very strong and weak.

*“Amending policies of schools is very weak in some schools, reason being that schools just don’t give themselves time to review timeously their policies and they just comply for the sake of submissions.” – Alice:*

SMTs and SGBs should be spearheading the drafting and refining of the school policies according to regulations. If policies are outdated they won’t speak to the current situation of schools and will not enhance quality practices in schools but will instead be detrimental to progress.

*“The policies are also reviewed time after time so as to improve standards if there are any shortcomings found. The other reason the policies are changed is to suit the Department of Education’s goals and vision.” – Rose*

There is need for all SMTs and SGBs to undergo training on policy reviewing as this will ensure that schools operate at their best. The findings here concur with the WSE, for example school C was rated 2 from the external WSE subsection on the current or reviewed vision.

**B7: Do you have meetings to disseminate the policies?**

The majority (83%) of the respondents agreed that they held meetings to disseminate the policies. However, it is worrisome that about 8% disagreed and the other 9% remained neutral.

**Extract 5.5 District official checklist tool 2**

1.1 Dates of departmental meetings with educators. (Verify and comment on minutes)			
1.2 Dates for curriculum support for educators by SMT – orientation programmes/training sessions/workshops. (Verify and comment on minutes/training material if already completed)			
1.3 Dates for all assessment activities including moderation of assessment tasks – both pre- and post-moderation. (Verify and comment on the alignment of dates with the TAP)			
1.4 Dates for the monitoring of learners’ classwork and homework activities and educator records. (Comment on the appropriateness of the tools used)			

Extract 5.5 shows that section 1.2 deals with departmental meetings at which all information regarding policies is supposed to be disseminated (see also Extract 5.2 section 2.5).

The interview responses from the facilitator from the district also suggested that the is smooth flow of information from one level to the other

Question: Do you have mechanisms in place to disseminate policies to the schools?

*“The moment we receive any policies we definitely disseminate them to all concerned stakeholders. We send emails to principals, HODs and the educators, sometimes we even send CDs, DVDs and hard copies to schools. If there is a need to conduct workshops to explain further we do that, for example when CAPS was launched we had a series of workshops where educators compared the old NCS policy with the CAPS documents and they managed to pinpoint the new aspects and the aspects that were retained. During the term cluster meetings and school visits we also disseminate and emphasise the important.” – Rose*

Phila agreed with Rose:

*“Meetings are held frequently in our school. We have staff meetings twice a term, SMT meetings as often as necessary, SGB meetings once a month. Furthermore the HODs meet their departments at least twice a term. Policies and all necessary information is shared or discussed during these meetings.”*

All policies that are received should be disseminated to the relevant stakeholders so that implementation takes place timeously. Principals and HODs in schools should make sure the educators receive the policies and that monitoring strategies are resumed. One of the ways that is effective is to have meetings with the educators or stakeholders in question. The moment there is interaction with the policies it becomes easy to customise them or implement them as they are. Since the majority agreed with the statement and there is evidence of such meetings taking place in all the schools then the foundation is laid in the schools for the implementation phases of the policies. The document analysis revealed that in all the schools science HODs conducted at least two meetings with their departments per term where some points on the agendas dealt with policy dissemination.

**B8: Are the district officials actively involved in evaluating school implementation of policies?**

A substantial number of respondents (91%) have the view that the district officials are actively involved in evaluating school implementation of policies. The remaining 9% remained neutral on this question.

Responses from one of the district officials clearly show that they do follow up on the implementation of policies:

*“Advocacy of policies is very crucial for better understanding by all those who will be involved. This allows educators to be able to raise their concerns and fears regarding new policies to be implemented by them. Training allows educators to understand purposes and the advantage of the transformation.”*

One district official gave a summary of her duties:

*“We always check the work being done by educators in our schools and make sure that the educators achieve minimum standards according to NCS/CAPS policy and NPA, N4PR documents.”*

The district officials as support personnel move to schools with checklists and support where necessary. Some of the policies like CAPS and the assessment policies should be adhered to in all the schools so that there is consistency. Quality assurance policies are crucial, therefore there is a great need for all the schools to comply.

Some of the weaknesses identified by one of the district official include:

*“Poor implementation in some schools due to time constraints, lack of management plans and poor monitoring.”*

The above statement suggests that district officials actively evaluate their schools, hence the findings. The implementation phase of policies is as important as any other phase, thus monitoring at this stage will help to make the processes smooth. The majority of respondents as well as documents in the schools prove that the role of district officials in evaluating policy implementation cannot be disregarded.

## Drivers based on Pivot tables

Cross-tabulation or pivot cells analysis was used to determine the strongest responses that acted as positive or negative drivers that were used to represent the theme for quality assurance policies. All the different cross-tabulation combinations were studied. The strongest pairs are illustrated in Table 5.4.

**Table 5.4 Strongest positive drivers B2 vs B4**

	Count of Gender	B4 Are school improvement plans (SIP) produced after SSE?			
		No idea (3.00)	Maybe yes (4.00)	Definitely yes (5.00)	Grand Total
B2 Does the school have any policies regarding quality assurance?	No Idea (3.00)	1		1	2
	Maybe Yes (4.00)	3	4	5	12
	Definitely Yes (5.00)	2	7	42	51
	Grand Total	6	11	48	65

Table 5.4 shows the first strong drivers of the theme of quality assurance policies. From the analysis of all the different cross combinations from B1 to B8 the highest percentage of respondents who said “definitely yes” to B4 was 42 out of 51 = 82% and the same respondents (42 out of 48 = 88%) also said “definitely yes” to B2. The theme driver that appeared stronger than the rest from the responses is therefore B4 (“Are school improvement plans (SIP) produced after SSE?”) followed by B2 (“Does the school have any policies regarding quality assurance?”). The respondents strongly held that their schools had quality assurance policies and that they produced SIP after conducting SSE. From these two it can be concluded that when schools have quality assurance policies, conduct school self-evaluation and produce school improvement plans then quality science education can be achieved.

**B2** “Does the school have any policies regarding quality assurance?” emerged as the strongest positive driver for the theme on policies. This means that all the schools in the study had quality assurance policies in place. This is a positive move because if all educators are aware of the quality assurance policies the implementation of such policies may become easier than when they did not know about them. B1 & B2: Almost 90% of respondents agree that their schools had a vision and policies in place, with none of the 65 respondents saying that policies were not in place or that the school had no aims or a vision. What is worth noting here is that 6% of respondents were unsure of whether policies were in place. This is particularly concerning since if policies are in place but the staff do not know about them, it equates to the absence of policies in schools. In fact, even in the 90% of cases where policies were in place, the question should be raised: How many of the members of staff are aware of the policies and are aware of the mission and vision of the school they work in?

Another interesting aspect that can be drawn from this is that the articulation of aims and vision to staff members influences overall performance. Education is no different from business, in fact it can be argued that having an understanding of the aims and vision of the organisation is even more important for educators. It is an understanding of this that needs to be translated to passion and excellence through teaching. However, this speaks more to the character of the educators than the practices of the institution, although the institution cannot be absolved from culpability.

**B7** and **B2**: It is not surprising to have found that 9% of the respondents were unaware of any meetings that might be held to communicate policies, and another 8% saying no such meetings were held. This highlights the role that schools have to play in making sure that policies are communicated. However, it was pleasing to see 83% of respondents saying the school had meetings to communicate policies. B2, B7 and B8 responses highlighted the trend relating to effective communication within schools. B3 and B4 responses showed that schools conduct annual self-evaluations and also implement corrective plans thereafter. B8 revealed that the district was actively involved in enforcing policies and implementing the policies. In fact, none of the respondents gave negative feedback in this regard, except for the seemingly uninformed 9%. B6 was given the most negative answers in this set.

The fact is that the educators and schools themselves are really the ones best placed to introduce effective policies. The finding that schools were unable to inform policies is thus disheartening as it might reduce the effectiveness of these policies. The second effect is that almost 30% of the respondents said that they had the capacity to change the policies, which raises the question: Do the different schools have different mechanisms in place to allow respondents to effect policy decisions?

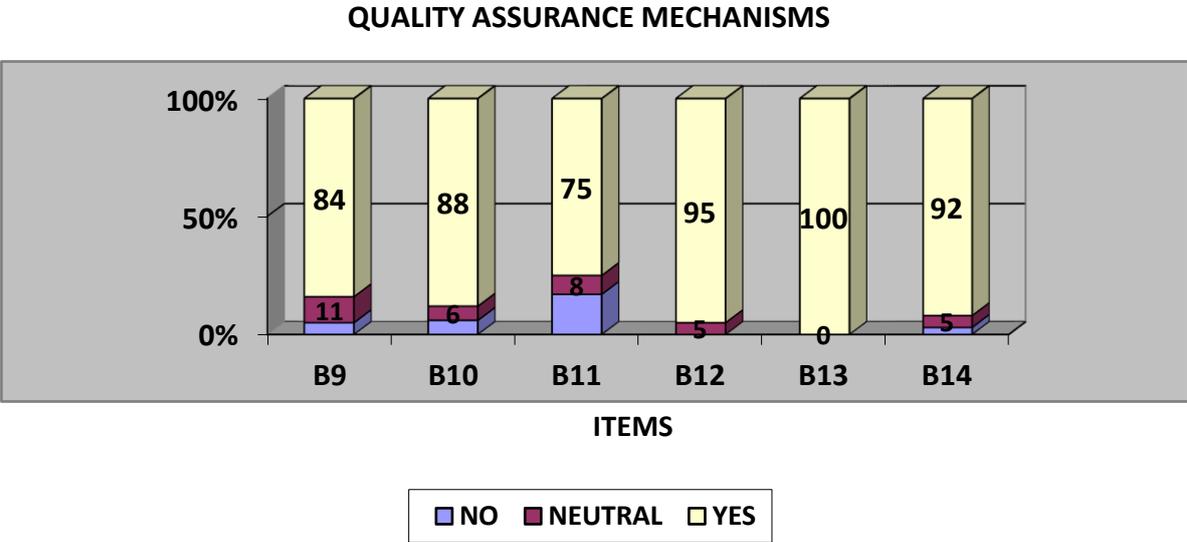
What is clear, however, is that this area is where respondents were least sure, with 23% having no idea whether they had the capacity to inform policies. This is an area of work on the part of the district and schools.

There is evidence that policies are in place that assist in quality assurance in science. The schools in this study comply in terms of their visions and management structures that enable policy dissemination and implementation. The district is actively involved in making sure schools receive and implement policies of quality assurance. The only challenge in schools is that educators are not well informed about their role in policy reviewing at both micro level (school policies) and macro level (national policies). From these results it appears that there is a need for policy training among SMT and SGB members. Policies are crucial in helping schools maintain or surpass their standards, which in turn enhances quality assurance practices. If all policies are up to date and reviewed regularly schools will function smoothly and most of the challenges that threaten the attainment of quality science education in schools will be eliminated. The findings are consistent with the GDE policies on district support to schools.

#### **5.4.3.2 Quality assurance mechanisms**

From section 5.3.2.1 it is clear that policies were put in place by the Department of Basic Education with regard to quality assurance, however, if there are no proper mechanisms to follow to implement them then the policies are as good as dead. This section has helped to identify whether mechanisms are in place and are being followed in the schools in the study. The principal and school management teams are crucial in disseminating information to the educators. The second part investigated the quality assurance mechanisms in schools, and the following questions were asked: **B9:** Does the principal consult the school management teams before finalising decisions? **B10:**

Does the school management communicate their intentions of quality assurance to all stakeholders? **B11**: Does the school have a clear direction in terms of quality assurance processes? **B12**: Are there internal monitoring mechanisms for policy implementation? **B13**: Do heads of departments (HODs) disseminate all policies to their educators? **B14**: Do the district officials support and guide the school to attain minimum standards? The results are presented graphically and shown in Figure 5.6 below. The set of questions related to mechanisms for quality assurance, with the aim of assessing whether policies were in place and whether these were communicated and had clear direction.



**Figure 5.6 Quality assurance mechanisms in schools**

The average score for the level of agreement for this section is 89.0%. The disagreement level was 5.2% and neutral was 5.8%. The responses were in the affirmative as indicated by the percentages above. This section had the second highest agreement scores in comparison with all the other sections.

**B9: Does the principal consult the school management teams before finalising decisions?**

The success of quality assurance processes in schools depends upon proper consultations with all stakeholders. The crucial ones in this case are the managers of quality assurance policies and practices, namely the SMT in schools. From the

experience of the researcher the principal's actions directly impact on the management, therefore this question was considered.

Principals in the sampled schools do have SMT meetings and consult with them before finalising decisions. Most respondents (84%) agreed that their principals consulted the school management team before finalising decisions, while 11% remained neutral and only 5% disagreed. The majority of the schools do have SMT meetings, not only for information sharing but also for consultation.

**B10: Does the school management communicate their intentions of quality assurance to all stakeholders?**

The majority (88%) of the respondents agreed that quality assurance intentions were communicated to educators through meetings as well as departmental assessment policies, among others.

The schools visited in this study all had management plans that were communicated to the entire staff. The responsibilities lie with the IQMS coordinator and the SMT to ensure implementation takes place. The management plans were in agreement with Rose's twelve steps for conducting performance measurements, as she read the list quoted below:

*“The twelve steps in conducting performance measurements are: drawing up a timetable for performance measurement; pre-evaluation meeting for summative evaluation; conducting lesson observation; post evaluation meetings and feedback on observations; resolution of differences; completion of composite score sheets; updating of PGPs [Personal Growth Plans]; completion of documents of performance measurements; making copies of signed forms, plans, reports and files; submitting original signed documents to my office for processing; capturing the summative evaluation scores into a composite schedule and submitting it to the provincial office; and finally implementation of salary and grade progression.”*

The results suggest that there is some need in some schools for communication to be done in terms of all the quality assurance practices. The majority of the respondents, however, held the view that the communications were present but to the few who did not feel the same way, there is a need for all schools to communicate clearly with all stakeholders.

**B11: Does the school have a clear direction in terms of quality assurance processes?**

The majority (75%) of the respondents agreed with the statement; 8% remained neutral and 17% did not agree with the statement. This is because the schools in the study do have policies and mechanisms in place to ensure quality science education. There are levels of monitoring that schools do mainly guided by IQMS and WSE.

**Extract 5.6 from whole-school evaluation tool 2**

<b>5.7</b>	<b>School policies and procedures</b>				
5.7.1	All required school policies and related procedures are in place	5	4	3	2
5.7.2	The school community is familiar with the school policies and procedures	5	4	3	2

Extract 5.6 above indicates that schools should have mechanisms in place about school policies, procedures and ways to familiarise all stakeholders. All the school documents revealed that all procedures were clear especially regarding IQMS and WSE. The processes in relation to quality assurance followed by schools are presented in section B10 and B15.

Quality assurance processes at macro level and micro level should have clear directions especially when stakeholders have been informed about the policies. The majority agreed with the statement because in all the schools in the study there was evidence of IQMS training as well as SAT training where conducted educators were informed. The 17 percent, however, came from the educators who are not part of the SMT. This might have been because some new educators may not have been trained or have attended workshops on the IQMS or assessment quality assurance. The HOD SMT members should see to it that all educators in their departments are trained in the various quality assurance processes.

**B12: Are there internal monitoring mechanisms for policy implementation?**

Almost all respondents (95%) held the view that there were internal monitoring mechanisms for policy implementation in their schools. The respondents' views corroborated the documents available in all the schools, which showed that mechanisms were in place where deputy principals monitored the HODs and the HODs monitored the educators. Tools were available where the educators reported to their immediate supervisors.

The mechanisms in the schools occurred in two phases, where the first phase was based on reporting and the second phase on verification. Educators were reporting to the HODs in terms of work/content coverage, quality and quantity of work. The HODs would then check and verify if what the educators were reporting on was the truth. Reports were written and given to deputy principals and district officials, who also in turn verified the contents. The district officials had schedules to visit schools and also verify the information obtained from the educators.

**B13: Do head of departments (HODs) disseminate all policies to their educators?**

All the respondents (100%) shared the view that HODs disseminated all policies to their educators. One of the duties of the HODs as part of the SMT is to disseminate and clarify policies and documents from the Department. The minutes of meetings obtained from the departments also suggest that the HODs do disseminate policies to the educators. It is the duty of HODs to disseminate information or workshop educators about the policies. The HODs can also recommend that educators attend different workshops on specific policies. All the views of the respondents were positive and indicated that there are proper channels in all the schools in this study. Policy dissemination assists schools in preparing the ground for the implementation of the policies. If all educators were informed about the quality assurance policy there might be positive results especially in the quality of teaching and learning of science in schools.

**B14: Do the district officials support and guide the school to attain minimum standards?**

The majority (92%) of the respondents agreed that the district officials supported and guided the school to attain minimum standards. Only 3% disagreed and 5% remained neutral. An analysis of the checklist or monitoring tool from the district shows that the district officials are supposed to comment on two aspects, namely the areas of good practice and recommendations for improvement. Alice further concurred with the results above:

*“From our observations during school visits we always give recommendations and then do follow-up visits to check if the educators are implementing what we suggested.”*

**Drivers based on Pivot tables**

Cross tabulation or pivot cell combinations from B9 to B14 showed that the strongest positive drivers were between B10 and B13. The second strongest drivers were between B13 and B14 as illustrated in Table 5.4 above and Table 5.5 below.

**Table 5.5 Strongest positive drivers B10 vs B13**

	Count of Gender	B13 Do heads of departments (HODs) disseminate all policies to their educators?		
		Maybe Yes 4.00	Definitely Yes 5.00	Grand Total
<b>B10 B10 Does the school management communicate their intentions of quality assurance to all stakeholders?</b>	Maybe No (2.00)		4	4
	No Idea (3.00)		4	4
	Maybe Yes (4.00)		4	4
	Definitely Yes (5.00)	1	52	53
	<b>Grand Total</b>	<b>1</b>	<b>64</b>	<b>65</b>

Table 5.5 shows the strongest driving questions that were positively answered by the respondents. Those that were definitely positive that their school management communicated their intentions of quality assurance to all stakeholders were 52 out of

53 = 98%. The same number (52 out of 64 = 81%) held the view that HODs disseminated all policies to their educators within their schools.

**Table 5.6 Positive drivers B13 vs B14**

	Count of Gender	B14 Do the district officials support and guide the school to attain minimum standards?				
		Maybe No (2.00)	No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
<b>B13 Do heads of departments (HODs) disseminate all policies to their educators?</b>	Maybe Yes (4.00)				1	1
	Definitely Yes (5.00)	2	3	12	47	64
	<b>Grand Total</b>	<b>2</b>	<b>3</b>	<b>12</b>	<b>48</b>	<b>65</b>

Table 5.6 shows that those educators that were definitely positive about district officials being active in supporting and guiding schools to attain minimum standards were 47 out of 48 = 98%. The same number (47 out of 64 = 73%) of educators positively agreed that the HODs disseminated all policies to their educators. It can be concluded that the school management communicate their intentions of quality assurance to all stakeholders; HODs disseminate all policies to their educators; and the district officials' support and guide the school to attain minimum standards.

The strongest positive driver was B10 (“Does the school management communicate their intentions of quality assurance to all stakeholders?”). This shows that the educators overwhelmingly viewed that their school management teams communicated their intentions of quality assurance to all stakeholders. It also shows that mechanisms are in place that ensure that quality assurance processes are executed perfectly in the schools in Johannesburg South.

The result for B14 indicates that the district officials do support their schools in order to maintain standards. These results correlate with theme 5 item 5.3.5, where facilitators/subject specialists visit schools and also plan quality assurance processes for assessments.

B9: In the majority of cases, the governance structure is working as it ought to. In 84% of cases, the principal consults management before taking decisions. However, there are 5% of schools where the governance structure is not in place. A further 11% of respondents were unsure of the governance mechanism, but this is not as much a red flag as in other questions. B10, B13 and B14 revealed that most schools communicate their quality assurance policies well. It is observed that the district participates in ensuring minimum quality standards. B11 was the worst in terms of responses that related to whether the quality assurance process has a clear direction. This is a red flag. The responses here suggest that some schools have ineffective policies. This ties in with what was already seen in the question concerning whether respondents felt that they had a measure of control to change the direction of a policy.

From this study it is evident that mechanisms are in place and are up and running in all the schools in the study. It was also the point of view of the district officials. These mechanisms favour quality science education in the district. The findings here concur with IQMS studies by Mahlaela (2012); Mji (2011); Nkambule (2010); Sambumbu (2010); Bisschoff et al. (2007). They all observed that IQMS mechanisms were present in all the schools they investigated although there were implementation issues.

#### **5.4.3.3 The IQMS processes**

The main purpose of IQMS is to identify the specific needs of educators, schools and district offices for support and development, to provide support for continued growth, promote accountability and monitor an institution's overall effectiveness and finally to evaluate educators' performance. The IQMS is an integrated quality management system that consists of three programmes, which are aimed at enhancing monitoring performance of the education system in South Africa. Developmental Appraisal (DA), Performance Measurement (PM) and Whole School Evaluation (WSE) are supposed to be implemented in an integrated way in order to ensure optimal effectiveness and coordination of the various programmes.

This section examined whether the processes of IQMS are followed properly so as to achieve the intended outcomes, which in this case will result in improved quality science education in schools. The third set of questions dealt with the fairness and

implementation of the IQMS process. The following questions were deemed necessary to gather the required information: **B15**: Does the school conduct IQMS as an ongoing process? **B16**: Is IQMS done in a free, fair and transparent manner? **B17**: Are all educators informed on time about the IQMS process? **B18**: Are there specific parts of the IQMS that are targeted by the school for its particular needs? **B19**: Do the performance standards in IQMS directly address the quality of teaching and learning? **B20**: The standards should be reviewed regularly to ensure that the statements are relevant to the current situation of the school.

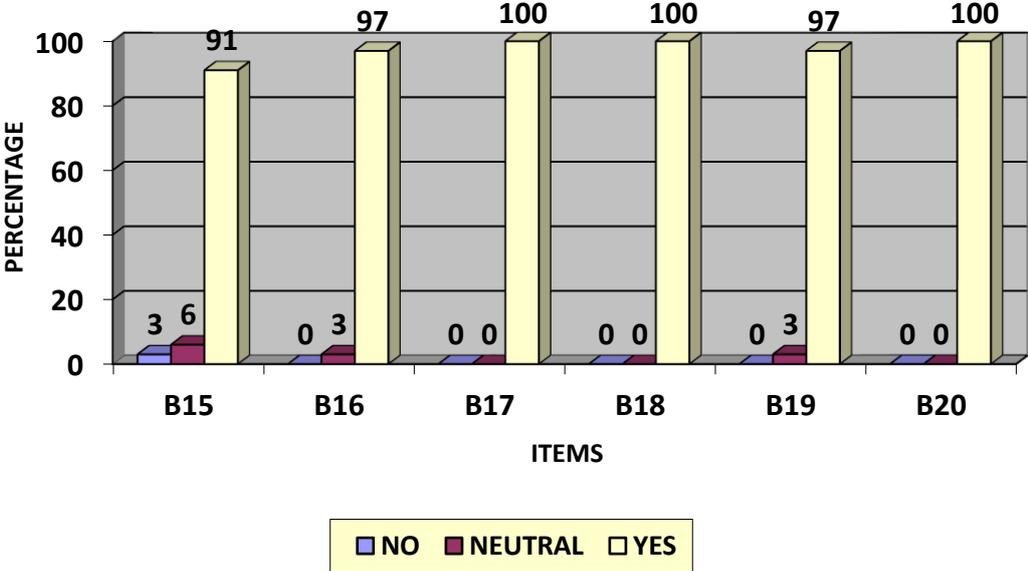


Figure 5.7 IQMS processes in schools

The average score of agreement for the IQMS processes is 97.5% and the average score for disagreement is 0.5%. Those respondents who were neutral accounted for an average of 2.0%. The responses were overwhelmingly positive, with very little signals of score for improvement. This finding is somewhat surprising given the previous results, which suggested that there was not enough consultation with respondents to ensure that the policies and procedures implemented were effective.

### **B15: Does the school conduct IQMS as an ongoing process?**

The management plans for IQMS showed that the IQMS processes were an ongoing process. This was confirmed by the views of the respondents, which indicated that the schools conducted IQMS as an ongoing process as 91% agreed and only 3% disagreed while 6% remained neutral.

The implementation processes especially of the IQMS process were summarised by respondent Rose, a district official, as follows:

*“There are eleven steps to implement IQMS and twelve steps to conduct performance measurements which I will summarise as follows: Implementation step one is electing staff development team; step two: advocacy and training of new educators on the IQMS; step three: developing implementation plan; step four: self-evaluation by educators; step five: selection of development support groups; step six: pre-evaluation discussions between educators and development support groups (DSG); step seven: conducting baseline evaluation for the new educators; step eight: post-evaluation meetings; step nine: developing personal growth plans (PGP); step ten: submission of PGPs to the DSGs; and finally: development of the school improvement plan (SIP), which is submitted to us by the schools.”* – Rose referring to a document she was reading

These processes are not a once-off thing as indicated by the steps above, but are actually cyclic in nature. Document analyses concurred with the findings as they showed timeframes for the different activities for IQMS implementation. The documents available in all schools showed that lesson observations were conducted each term by HODs and at times designated by DSGs.

### **B16: Is IQMS done in a free, fair and transparent manner?**

IQMS processes involve the establishment of DSGs, who may include peers and immediate supervisors. The fact that educators are informed in good time about dates for class visits and discussions after lesson observations, that educators evaluate

themselves and finally the DSG/HOD evaluates at the end of the cycle makes the process transparent. In the schools where the processes are followed 97% of participants expressed their conviction that the process was free and fair. There were no respondents who disagreed with the statement and those who were neutral/had no idea accounted for 3%. The findings also concur with the purpose of DA, which is to appraise individual educators in a transparent manner with a view to determining areas of strength and weakness, and to draw up programmes for individual development. These findings were further supported by Pamela, one of the district officials:

*“Each educator selects his/her own school based Developmental Support Group (DSG), who does on-site quality assurance, offers support on request of the incumbent and/or based on developmental needs identified by the DSG. It is mandatory that the immediate supervisor/Head of Department forms part of the DSG.”*

The results suggests that the processes of IQMS in the Johannesburg South schools are free and fair based on the fact that not only one person is involved in the process of scoring educators. External whole-school evaluators’/supervisors’ remarks can also be used to score educators, furthermore there are channels of resolutions if educators do not agree with the final scores given to them after lesson observations. Documents available in the schools supported the findings in this subsection.

#### **B17: Are all educators informed in time about the IQMS process?**

All the schools in the study have an IQMS coordinator who informs educators about the dates and procedures to be followed throughout the year. In school C, for example, a management plan is given to all educators at the beginning of the year where they fill in their Personal Growth Plans (PGPs). All respondents (100%) agreed that educators were informed in time. All the schools in the study had an IQMS management plan with schedules and timeframes for different activities. According to the registers available, educators attended workshops while handouts were given on the processes of IQMS during the first term or at the beginning of the year.

**B18: Are there specific parts of the IQMS that are targeted by the school for its particular needs?**

All the respondents (100%) agreed that there are specific parts of the IQMS that are targeted by the school for its particular needs. An Analysis of the IQMS instrument shows that the particular needs of the school are taken into account in both sections. The Whole School Evaluation tool covered nine focus areas, which all pointed to some specific needs of the schools.

**B19: Do the performance standards in IQMS directly address the quality of teaching and learning?**

The majority of the respondents (96%) agreed that the performance standards in IQMS directly address the quality of teaching and learning, whereas the other 4% marked “no idea/neutral” in this question. Since all educators are involved in the IQMS processes they know about the instrument and all the criteria used. Each educator as a DSG member is expected to do class visits for developmental purposes and this part involves checking the quality of teaching and learning. All the documents from IQMS scoring pages and WSE rating pages had a section that directly quality-assured teaching and learning.

**B20: The standards should be reviewed regularly to ensure that the statements are relevant to the current situation of the school.**

The views of all respondents (100%) revealed that standards should be reviewed regularly to ensure that the statements are relevant to the current situation of the school.

## Drivers based on Pivot tables

For this section B15 to B20 there were three strong positive drivers, namely B16, B17 and B19. The strongest positive relationships were between B16 and B17, followed by B16 and B19, and the third strongest was between B17 and B19. These are presented in Tables 5.7, 5.8 and 5.9.

**Table 5.7 Strongest positive drivers B16 vs B17**

B16 Is IQMS done in a free, fair and transparent manner?	Count of Gender	B17 Are all educators informed in time about the IQMS process?		
	B16	Maybe yes (4.00)	Definitely yes (5.00)	Grand Total
No Idea (3.00)			2	2
Maybe yes (4.00)			3	3
Definitely Yes (5.00)		3	57	60
<b>Grand Total</b>		<b>3</b>	<b>62</b>	<b>65</b>

Table 5.7 shows that 57 out of 60 = 95% were quite sure that IQMS in their schools is done in a free, fair and transparent manner. Almost the same number (57 out of 62 = 92%) were definitely in agreement with the statement that all educators were informed timeously about the IQMS processes. It can be inferred that in the schools in this study educators are informed timeously about the IQMS process, which is done in a free, fair and transparent manner.

**Table 5.8 Positive drivers B16 vs B19**

B16 Is IQMS done in a free, fair and transparent manner?	Count of Gender	B19 Do the performance standards in IQMS directly address the quality of teaching and learning?			
	B16	No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
No idea (3.00)		1		1	2
Maybe yes (4.00)			1	2	3
Definitely Yes (5.00)		1	3	56	60
<b>Grand Total</b>		<b>2</b>	<b>4</b>	<b>59</b>	<b>65</b>

Table 5.8 shows that 56 out of 59 = 95% were convinced that the performance standards in IQMS directly addressed the quality of teaching and learning. Those who said “definitely yes” to B16 were 56 out of 60 = 93%. The fact that 56 of the respondents shared the view shows that performance standards in IQMS directly address the quality of teaching and learning, which in turn shows that the quality of teaching and learning is central to enhancing quality in science education.

**Table 5.9 Positive drivers B17 vs B19**

	Count of Gender	B19 Do the performance standards in IQMS directly address the quality of teaching and learning?			
		No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
<b>B17</b> Are all educators informed in time about the IQMS process?	<b>B17</b>				
	<b>Maybe yes (4.00)</b>			3	3
	<b>Definitely Yes (5.00)</b>	2	4	56	62
	<b>Grand Total</b>	<b>2</b>	<b>4</b>	<b>59</b>	<b>65</b>

The third strongest positive drivers were between B17 and B19, of which 56 out of 62 = 90% were definitely positive to B17 and (56 out of 59 = 95%) viewed performance standards in IQMS as directly addressing the quality of teaching and learning. In the above analysis the items B16 and B19 were used to represent the rest of the questions for the theme of quality assurance processes.

The strongest positive driver was B19 (“Do the performance standards in IQMS directly address the quality of teaching and learning?”). This shows that the quality of teaching and learning is central to enhancing quality in science education in the schools in this study.

The study clearly shows that the IQMS processes are present and followed in all schools studied and are conducted freely as an ongoing process. Educators are quality-assured through their immediate supervisors (HODs) and colleagues (DSGs) as well as the Quality Assurance Directorate from the head office for external whole-school evaluation (WSE). The research findings point to the “Collective Agreement 8 of 2003”. The purpose of this agreement was to align the different quality management

programmes and implement an integrated quality assurance system, which includes developmental appraisal, performance management and whole-school evaluation.

The implementation of IQMS was studied extensively by Mahlaela (2012); Mji (2011); Nkambule (2010); Sambumbu (2010) and Bisschoff et al. (2007). The differences, however, are that their findings indicated that most schools were not implementing IQMS properly whereas this study revealed that IQMS is being implemented as an ongoing process.

#### **5.4.4 Quality of science education in schools**

##### **5.4.4.1 Quality of science educators**

The quality of science educators was included in this study because they have a great impact on the process of quality assurance as they are the implementers of the quality assurance policies. To improve the quality of science education educators should follow policies and appropriately assess the learners in accordance with the policy guidelines. According to Ramparsad's (2011) presentation on the curriculum framework, the educator has four main functions in curriculum delivery, namely (i) deliver lesson as per the syllabus/work schedule and mark and provide feedback to learners on class- and homework daily; (ii) report on progress towards the syllabus/work schedule fortnightly to the HOD; (iii) assess learners as per the subject assessment guidelines as per school assessment plan and (iv) provide remediation after diagnostic analysis of learner performance on assessment after each assessment.

The quality of schools in a South African context is measured by the achievement of the learners, which is directly linked to the educators' input. The third section of the questionnaire investigated the quality of science educators in the sampled schools. The fourth set of questions assessed the quality of science education. The questions asked were: **C1:** Are there any set criteria when appointing science educators? **C2.1:** Does the school prioritise experience when appointing science educators? **C2.2:** Does the school prioritise qualifications when appointing science educators? **C3:** Do science educators present quality teaching and learning in class? **C4:** Do science

educators have high expectations for their learners? **C5:** Are the educators knowledgeable about the subject/learning areas/programmes? **C6:** Do the educators employ appropriate teaching strategies to accommodate all learners? **C7:** Do the educators use teaching resources appropriately? **C8:** Do the educators manage their classes well and create a good learning environment? **C9:** Have the educators any means of evaluating the success of the lesson? **C10:** Does the school provide development initiative for science educators?

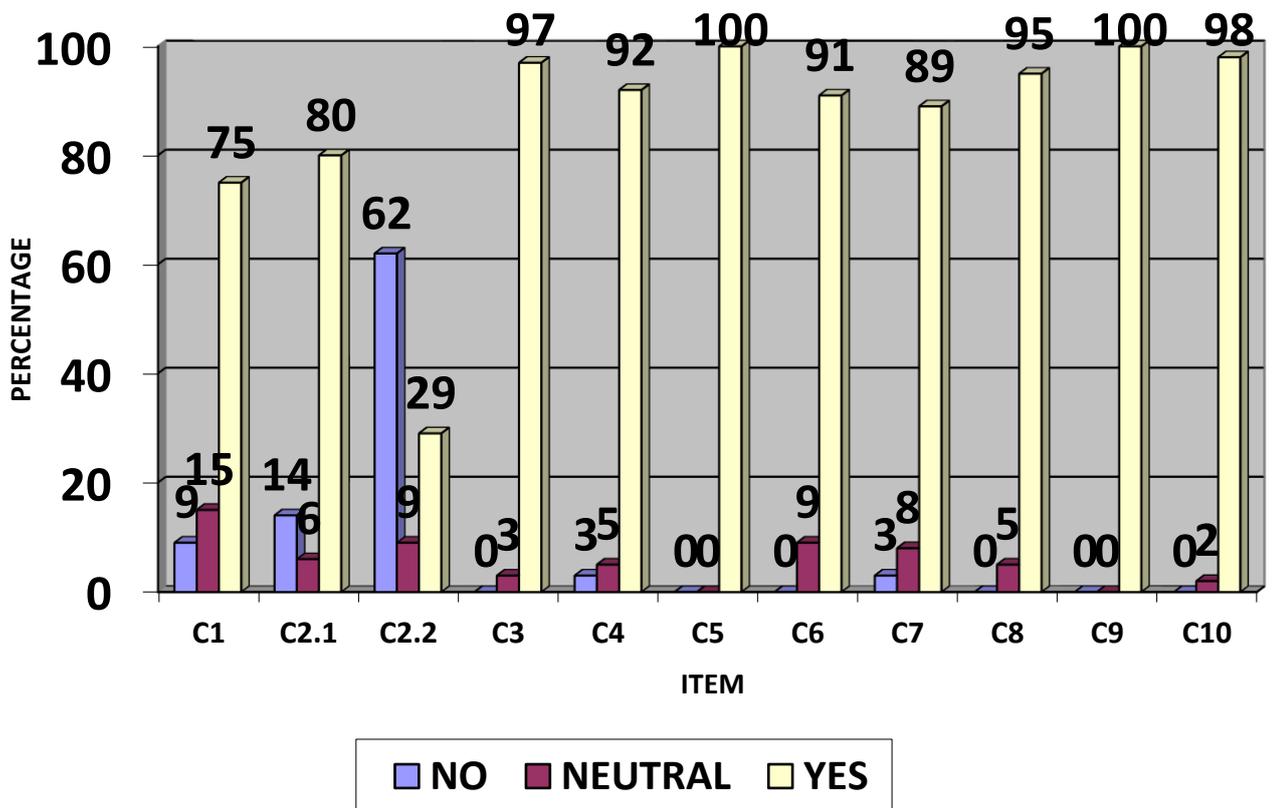


Figure 5.8 Quality of science educators

The average score for agreement with the statements above was 86%, disagreement was 8.2% and neutral was 5.8%. The findings were generally positive, meaning that educators agreed with most of the questions asked.

### **C1: Are there any set criteria when appointing science educators?**

About three-quarters (75%) of the respondents held the view that there were set criteria when appointing science educators. About 9% disagreed with the statement and 15% marked “no idea/neutral”. The Department of Education stipulates that educators can be appointed to teach Physical Sciences or Life Sciences if they have the relevant qualifications from accredited institutions. According to the Government Gazette educators should be appointed based on the approved post establishment for public schools, full-service and public special schools and have at least REQV 13 (Relative Education Qualification Value).

#### **C2.1: Does the school prioritise experience when appointing science educators?**

Just above three-quarters (80%) of the sampled educators believed that their schools prioritised experience when appointing science educators while only 14% did not agree with the statement. Most schools, however, use their discretion during interviews to get the best qualified and experienced educators to teach especially Grade 12 classes. Only a few (6%) of the respondents remained neutral.

#### **C2.2: Does the school prioritise qualifications when appointing science educators?**

A few respondents (29%) held the view that educators were appointed mainly based on their qualifications and just more than half (62%) did not believe that the school prioritised qualifications when appointing science educators. The view is in line with the PAM document, which allows educators who are newly qualified from universities to be appointed without taking experience into account.

One district official indicated that they did not have input in the selection of science educators. She explained:

*“The schools are in charge of appointments and we as facilitators we are not part of the panels. Schools appoint a panel which consists of a parent component of the SGB, principal or deputy principal, HODs, union*

*representatives, teacher representatives and so forth. In other words we have no part in that process. The only process that we used to do is recommend educators for appointment as markers in our learning areas based on experience and school pass rates as required by the policy.”*

The items from C3 to C10 were commented on based on the checklist used for whole-school evaluation as well as IQMS standards. Two of the schools had external whole-school evaluation reports that revealed that most educator scores were in the “good” and “outstanding” section, which is a confirmation that there is quality teaching and learning in those schools. Lower ratings were, however, in the areas of discipline of learners, addressing of diversity in class and goal-setting.

### **C3: Do science educators present quality teaching and learning in class?**

Almost all (97%) of the respondents agreed that science educators in their schools present quality teaching and learning in class, the other 3% remained neutral and none disagreed with the statement. DSGs and science HODs have very clear pictures of what takes place in the classrooms as they have access to the IQMS tools, educator files, learner books, lesson observations, assessment tools and records. From the information above the SMT or people assigned to conduct the whole-school evaluation should have access to the IQMS document, which actually speaks to most of the criteria and associated indicators mentioned in Extract 5.6 above.

The district officials also commented on this aspect:

*“Each educator selects his/her own school-based Developmental Support Group (DSG), who does on-site quality assurance. It is mandatory that the immediate supervisor/head of department forms part of the DSG.”*

This shows that the respondents had well-informed views on the quality of teaching and learning presented by the science educators.

The core duty of educators is to make sure learners understand concepts and be able to apply the knowledge in different circumstances. The methodologies used to achieve

this should be accompanied by conducive learning environments. Educators need to prepare for their lessons beforehand. They should also know the learners in terms of their needs based on contextual factors. The respondents to the questionnaire knew the contents of the evaluation tools as they are evaluators as DSGs, HODs during IQMS and WSE processes. This validates the fact that science educators in the schools present quality teaching and learning in their classes, which to a large extent promotes quality results among the learners.

#### **C4: Do science educators have high expectations for their learners?**

Almost all the science educators have high expectations for their learners as 92% of respondents agreed with the statement whereas only 3% disagreed and the other 5% remained neutral. From the extract (cf. 5.2 sections 1.2.1 to 1.2.4) the results suggest that educator expectations are covered, therefore the respondents would give informed views. Educator expectations are also based on the type of assessments given, e.g. mainly assessing using higher order questions or lower order questions.

Educators can act as mediators and their expectations from the learners can either improve the quality of passes or reduce the quality of passes as there may be compounded effects. It may be argued that when educators have low expectations from their learners they may compromise the quality of assessments, even the quality of lessons presented in order to come to their so called “level”. Generally there is a view that science learners are focused, well behaved and that most have achieved the required levels in mathematics and science, therefore educators may have high expectations from them. The results here corroborate the findings from the interviews:

*“Educators find it easy to teach and impart knowledge to learners who are disciplined and non-disruptive. Our science classes are much disciplined and learners are very cooperative, therefore it translates to the quality results we are currently enjoying as a school.”*

This shows that most educators believe that high expectations may also result in the improved quality of results.

**C5: Are the educators knowledgeable about the subjects/learning areas/programmes?**

All the respondents (100%) held the view that educators who teach science in all the sampled schools are knowledgeable about the subject/learning areas/programmes. The quality assurance documents used in the schools as well as IQMS and WSE documents all have sections that evaluate the knowledge of educators (see extract 5.6 sections 1.3.1 to 1.3.4).

Educators in South Africa are employed based on qualifications. All science educators in this study were highly qualified and knew their content, based on the IQMS and WSE reports. Section 1.3.1 evaluates whether educators understand their content.

**C6: Do the educators employ appropriate teaching strategies to accommodate all learners?**

The majority of the respondents (91%) held the view that the educators employed appropriate teaching strategies to accommodate all learners. A few respondents (9%) remained neutral and none disagreed with the statement. Extract 5.6 sections 1.2.4 and 1.3.2 evaluate the educator teaching strategies.

**C7: Do the educators use teaching resources appropriately?**

Science educators use teaching resources appropriately during their lesson periods, was the view of 89% of the respondents. Only a few (3%) of the respondents disagreed and the other (9%) remained neutral to the statement.

Jacob explained as follows:

*“All appointed educators should use resources appropriately and if need be they are allowed to use simulations, even do experiments, especially to struggling learners. From our monitoring all the educators follow the guidelines from teaching materials since our focus is revision.”*

**C8: Do the educators manage their classes well and create a good learning environment?**

The majority (95%) of the respondents held the view that science educators managed their classes well and created a good learning environment. The science educators, HODs of science and their DSGs had a very good picture of what happened in the classrooms. The WSE quality assurance tool looks at those aspects that the questionnaire asked about. The responses were backed up by WSE and SSE ratings.

**C9: Have the educators any means of evaluating the success of the lesson?**

All (100%) of the respondents viewed science educators as having some means of evaluating the success of their lessons. The lesson plans being used by the science educators in all the schools show a section at the end that says, "Teacher reflection". This section gives educators time to reflect on lesson progress, learner response to formative assessments or summative assessments in order to improve the next lesson. This information could be easily accessed by HODs, SMTs and DSGs from the tools used (see extract 5.6 section 1.4.5). According to the Department's assessment policies educators should use a variety of strategies to assess the effectiveness of their lessons including baseline assessment, formative assessments and summative assessments. From the documents accessed in the schools all the schools adhered to the policy on assessments.

**C10: Does the school provide development initiatives for science educators?**

An overwhelming majority (98%) of respondents held the view that their schools provided development initiatives for science educators. Document analysis backs up the results as information gathered from the PGPs is used to draw up the school improvement plan, which encompasses educator developmental needs. HODs and DSGs may also feel that educators may need to be developed in certain areas as they fill in the IQMS evaluation tool.

**Drivers based on Pivot tables**

The pivot table analysis revealed that the strongest positive relationship was between C8 and C10, followed by C9 and C10.

**Table 5.10 Strongest positive drivers C8 vs C10**

C8 Do the educators manage their classes well and create a good learning environment?	Count of Gender	C10 Does the school provide development initiatives for science educators?			
		No idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
No idea (3.00)				3	3
Maybe Yes (4.00)		1	1	3	5
Definitely Yes (5.00)			1	56	57
<b>Grand Total</b>		<b>1</b>	<b>2</b>	<b>62</b>	<b>65</b>

Table 5.10 shows that 56 out of 57 = 98% of respondents strongly believed that science educators managed their classes well and created a good learning environment. Fifty-six out of 62 = 90% of respondents also strongly believed that their schools provided science educators with development initiatives. The second strongest positive drivers showed that 52 out of 54 = 96% were definitely positive that educators had the means of evaluating the success of their lessons. This shows that the schools have micro quality assurance practices that gauge their lessons.

From the percentages in C8 (“Do the educators manage their classes well and create a good learning environment?”) this is the strongest driving question for the theme of the quality of science educators. The quality of science education in these schools is therefore a reflection of the educators’ input into science education. C1 & C2: The responses show that most schools have set criteria in selecting educators. This is reassuring, as it minimises the chances of hiring poor quality educators. However, the responses show that schools prioritise experience far more than qualifications. This may speak of a lack of qualified science educators, but may also indicate that the criteria implemented by schools are ineffective. It may be true, in the long run, that experience beats educational qualifications, but effective science educator training should make better educators. The appointment of educators is guided by the following

Acts and policies: National Education Policy Act (Act No. 27 of 1996), as amended; South African Schools Act (Act No. 84 of 1996), as amended; Labour Relations Act (Act No. 66 of 1995), as amended; Employment of Educators Act (Act No. 76 of 1998), as amended; Employment Equity Act (Act No. 55 of 1998); and ELRC Collective Agreement 2 of 2005. The requirements for educators as stated in the Revised Personnel Administration Measures (PAM) and the advertisement are applicable. An applicant with an REQV (Relative Education Qualification Value) 13 to 17 will need at least 7 years' appropriate experience to be eligible to apply for a vacancy on the level of principal. Actual educator's experience as well as other appropriate experience is taken into account for the purpose of appointment on post level 2 and not for post level 1.

The study showed that the educators who teach science are highly qualified and experienced. They apply quality teaching and follow policies and subject guidelines in executing their duties. The documents available in schools revealed that the educators receive support from the schools and district as there are mechanisms in place to identify areas of weakness and areas that need improvement. Content workshops, information sharing sessions, development workshops and subject meetings among others have all been lined up in schools and district venues to support educators. The findings here verify that there is movement towards quality science education in the district through quality personnel and support. The results here concur with Stephen (2013); Perez (2013) and Trowbridge (2004), who show that educators can effectively make use of resources to simplify subject matter. Teaching quality and educator quality to certain degrees all contribute to educator effectiveness in class, thus quality results (cf. 3.6.1.1, 5.3).

### 5.4.4.2 Quality of science learners

Schools are ranked and awarded primarily based on the achievements of the learners.

The quality of science learners was investigated in this section. Schools are required to promote learners from one grade to the next based on whether they have achieved minimum standards at that particular grade. However, the Department of Education's policy is silent on the exact criteria of selecting learners who will take up science subjects. The main requirement is a pass in mathematics given that all the requirements are met. Learners are expected to choose subjects based on their career choices. Other factors like whether learners are capable, enthusiastic and hardworking are not considered. Educators are not allowed to exclude any learners who choose science subjects as long as they meet the criteria.

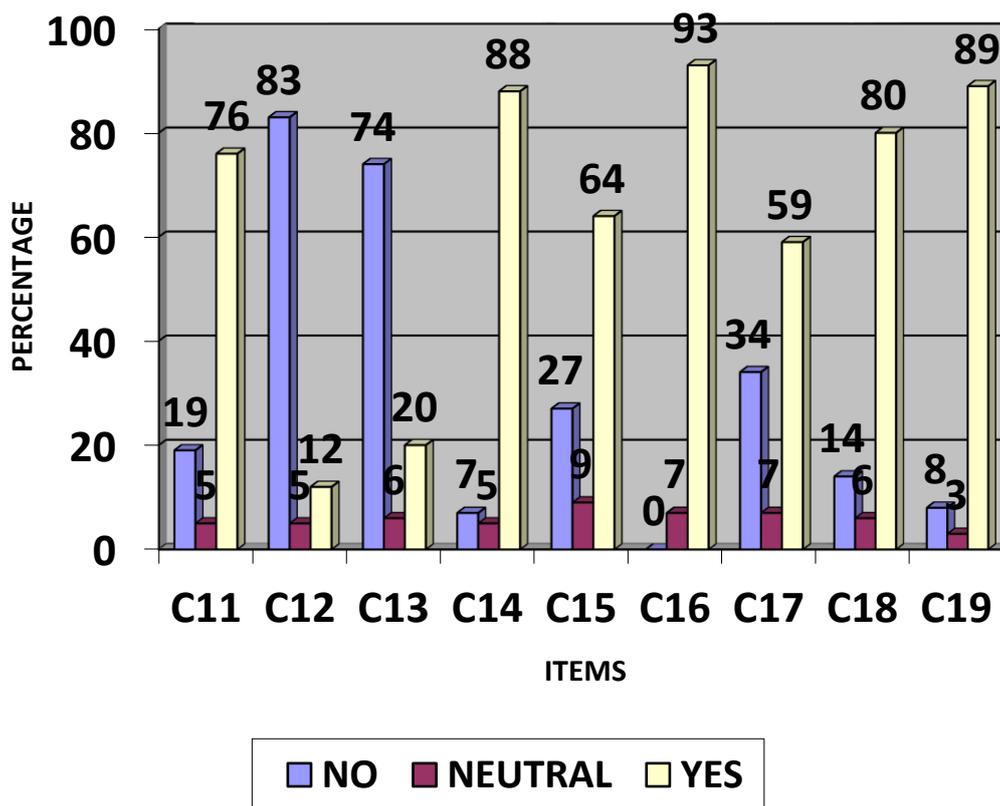


Figure 5.9 Quality of science learners

The average score of agreement is 64.6% and the score of disagreement is 29.5%. Those who were neutral are 5.9%.

**C11: Does the school have selection criteria for learners who will take up science at FET level?**

The schools have selection criteria for learners who will take up science at FET level, was the sentiment of the majority (76%) of the respondents. A handful of respondents (5%) did not agree and 19% were neutral to the question. From Grade 9 to 10 all learners are free to choose a subject as long as they meet the criterion or minimum pass mark.

**C12: Are all learners doing science capable of reaching the expected outcomes?**

The selection criterion allows learners to take subjects of their choice from Grade 10 after completing Grade 9. The current policy allows learners who obtained a level 3 (40%) and upwards in Mathematics to choose the science streams, which include Physical Sciences and Accounting. The majority (83%) of the respondents, however, disagreed with the statement that learners doing science are capable of reaching the expected outcomes. Only 12% agreed with the statement and only 5% remained neutral. These results are consistent with C12.

**C13: Do learners unnecessarily disrupt the educators when teaching?**

Three-quarters (75%) of respondents disagreed with the statement that learners unnecessarily disrupt the educators when teaching. This means that science learners at this stage do not disrupt lessons and the learners accept rules from educators. Only a few respondents (20%) agreed and the remaining 5% remained neutral. All the schools had a code of conduct and indications were that all learners were given the school rules and class educators explained them and the consequences of breaking them. If 20% of educators viewed learners as disrupting educators when teaching then it would be a cause for concern. The moment lessons are disrupted it means goals may not be achieved, learner concentration may be negatively affected and this may impact on the quality of the lessons.

**C14: Do learners come to class on time and ready to learn?**

Almost 9 out of 10 (88%) of the respondents held the view that learners came to class on time and were ready to learn. Only 7% disagreed with the statement and the remaining 5% were neutral. This question was two-folded. In those schools where the learners remained in their classrooms there was no problem of late coming to class. In schools where learners moved from class to class or where learners moved to the laboratories where educators were stationed the view was that learners came to class late.

**C15: Do all learners respect the educators and accept authority?**

More than half (64%) believed that all learners respected the educators and accepted authority. Almost a quarter (27%) did not agree with the statement and the other 9% remained neutral. In all schools the code of conduct was available and learners were expected to respect their educators, visitors, parents and fellow learners. The fact that 27% of the educators held the view that learners do not respect educators and accept authority is worrisome. Proper learning involves mutual respect, which would enable learners to learn and grasp concepts easily.

**C16: Do learners know what is expected of them in class?**

An overwhelming majority of the respondents (93%) had the view that learners knew what was expected of them in class. It was, however, surprising that 7% of the respondents did not have an idea whether learners knew what they were expected to do in class. The reason is that in all the schools studied learners are given the code of conduct and in some classes classroom rules and expectations are clearly written on charts.

When educators begin their lessons the goals/objectives of the lesson should be clear to the learners so that educator and learner take the learning experiences towards these goals or objectives. If all the learners know what is expected in class it means that the learners that do not respect or accept authority from the educators are defiant learners.

### **C17: Do all learners participate during lesson times?**

From the responses above half (59%) agreed that learners participated during lesson times. One of the requirements for effective teaching and learning is that learners should be actively engaged in and participate during lessons. It is clear that not all learners participate during lesson times as indicated by 34% of the respondents and this has a bearing on the quality of science education.

The respondents who are HODs and DSGs had chances to observe other educators teaching and due to the fact that they also teach their own learners, they have a clear picture of their learners. Of respondents 34% observed that some learners did not participate during lessons, which may lead to learners not understanding certain aspects of the content, and consequently achieving poor results.

### **C18: Is there effective teaching and learning progress in science classes?**

All the science educators and HODs agreed that there was effective teaching and learning progress in science classes. This accounted for 80% of the respondents. The remaining 6% did not have direct contact with teaching and learning in science classes and thus remained neutral. Only 14% disagreed with the statement and these results agreed with the results in C17. Effective teaching and learning is to a large extent indicated by the quality of the results produced by learners. Effective teaching and learning means taking into consideration educator input and learner experiences in the class. From this section it is apparent that educators contribute to effective teaching and learning, but that learners who are disruptive, defiant and disrespectful and do not participate during lessons contribute negatively to what happens in class.

### **C19: Do the learners require extrinsic motivation to do their work?**

Just above four-fifths (89%) of the respondents believed that the learners required extrinsic motivation to do their work. Only a few (8%) held the view that learners were intrinsically motivated. Only 3% remained neutral to the statement. The documents analysed showed that there a number of motivation sessions were planned for science learners in almost all the schools. Science educators indicated that in some of the

cases learners became serious about their work after being motivated in one way or another.

The district officials also noted that motivation was one way of improving the quality of science education in schools.

*“That’s also part of our job (motivation). We also go to different schools to motivate them. At times we recommend notable motivational speakers in the scientific fields to motivate our learners. The other way we motivate is by recommending to educators to engage in educational tours to various institutions like universities, chemical and manufacturing plants, mines, botanical gardens and so forth.”*

Subject specialists or district officials in the district have been supporting learners by encouraging them to have focused studies towards certain goals. The schools visited had planned excursions especially in Life Sciences and career-oriented excursions in conjunction with Life Orientation departments.

Alice emphasised the importance of motivation through excursions:

*“The moment learners are exposed to the real world situations they are motivated much better than when we just lecture to them. They may not attach any value to what they are learning until they have experienced it out there.”*

### **Drivers based on Pivot tables**

There are two strong positive drivers identified in this section or theme on quality of science learners. The strongest positive statements from the pivot cell analysis was between C16 and C19 and the second strongest was between C18 and C19.

**Table 5.11 Strongest positive drivers C16 vs C19**

	Count of Gender	C19 Do the learners require extrinsic motivation to do their work?					
		Definitely No (1.00)	Maybe No (2.00)	No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
C16 Do learners know what is expected of them in class?	No Idea (3.00)			2	1	2	5
	Maybe Yes (4.00)	1	1		1	9	12
	Definitely Yes (5.00)	2	1		2	43	48
	Grand Total	3	2	2	4	54	65

The responses by the educators revealed that 43 out of 48 = 90% expressed the view that learners knew what was expected of them in class. The same educators (43 out of 54 = 80%) also held the view that learners required extrinsic motivation to do their work. It can be concluded that even when learners know what is expected of them in their classes still they require extrinsic motivation to do their work. The second strongest positive driver revealed that 39 out of 43 educators (=91%) strongly supported the statement that there was effective teaching and learning progress in science classes. These same educators (39 out of 54 = 72%) also pointed out that learners required extrinsic motivation to do their work. The views therefore reveal that effective teaching and learning in science classes should be accompanied by extrinsic motivation in order to promote quality science education.

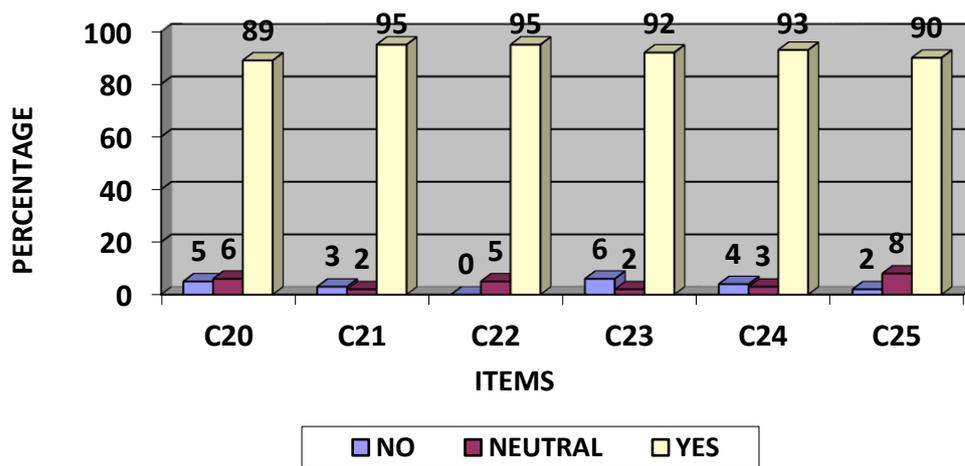
This section is one of the lowest in terms of agreement levels with the questions. This shows that the quality of learners who take up science subjects is a bit questionable. Learners choose to do science subjects based on meeting requirements and not based on whether they will manage. This has contributed to learners repeating a grade or changing subjects because their overall marks especially in mathematics and physical sciences would be low. This may be a big contributory factor to the poor quality of results experienced in some South African schools. The results indicate that some of the learners do not respect educators and that a substantial number of learners do

require extrinsic motivation in order to do their work or study hard. This observation concurs with Ebenebe (1998) and Phurutse (2005), who conclude that poor subject selection, large classes etc. contribute to learner indiscipline and lesson disruptions. According to Ezezobor (1983), Ebenebe (1998), Wisker and Brown (1996) and Kotirde and Yunos (2014) course selection should ensure that high quality learners be promoted to the next grade in order to obtain quality results (cf. 3.6.1.2).

#### **5.4.4.3 Quality of assessments**

Effective teaching and learning involves proper assessments ranging from baseline to formative and summative assessments. These assessments, whether internally or externally set, gives an indication of whether learners grasp the concepts being taught. The quality of the assessments given, however, has a direct impact on the quality of results at the exit points like Grade 12. It is therefore crucial to have quality assurance mechanisms at that level to maintain acceptable standards or improve the quality of science education.

This section put the spotlight on the quality of assessments given by science educators and the processes they undergo in schools. The fifth set of questions dealt with the assessment procedures followed by schools in assessing learners. Most respondents indicated that schools had effective assessment tools for learners. With reference to the theoretical framework and literature the following questions were considered necessary to determine the quality of assessments in the schools. **C20:** Do the educators assess learners in such a way to make their teaching to be effective? **C21:** Do educators make good use of homework by giving feedback to learners? **C22:** Are the learners informed on the types and dates of all assessments? **C23:** Do all learners submit their assessment tasks on due dates? **C24:** Are all the tasks given undergoing necessary quality assurance processes like pre-moderation and post-moderation? And **C25:** Does the school have an active school assessment team (SAT)? The results are shown in Figure 5.10.



**Figure 5.10 Quality of assessments**

The average score of agreement is 92.4%; disagreement is 3.3% and neutral 4.3%. The whole-school evaluation tool covered some of the aspects considered in this research.

**C20: Do the educators assess learners in such a way to make their teaching to be effective?**

More than three-quarters (89%) of the respondents held the view that science educators in their schools assessed learners in a way to make their teaching to be effective. Only 6% disagreed and 5% were neutral in this regard. The WSE evaluation tool covers most of the quality assurance aspects on assessment in this study. It is the view of the researcher that assessment is one key area in the teaching and learning of science where every educator should teach and assess in a variety of ways. Baseline assessment or pre-tests usually inform educators as to what learners know and which areas are lacking. This help educators to plan future lessons accordingly. Formative assessment can begin during teaching time, where educators ask oral questions, written short answers, explanations of diagrams etc. In this way educators get instant feedback from learners whether they understand the scientific aspects being taught, which then helps educators to continue as planned or change methodology or re-teach concepts. Summative assessment and/or post-tests can be done after a lesson, or weekly, fortnightly, monthly or when a topic is covered to check whether there was effective teaching and learning. From the views of the 6% percent who disagreed it

means there might be some need for assessment training in schools and for educators to refer to the subject assessment policies. Since the majority of 89% agreed, this means that science educators do refer to policies on assessment and therefore assess learners effectively. Effective assessments also means all cognitive levels according to Bloom's taxonomy are assessed, which leads to quality passes in science. If all the other variables are excluded effective assessments may lead to quality science results. When there are quality assurance mechanisms in place for assessments quality results may be expected in the district.

### **C21: Do educators make good use of homework by giving feedback to learners?**

The majority of the educators (95%) expressed the view that educators made good use of homework by giving feedback to learners. Of the rest almost 2% were neutral and the remaining 3% did not agree with the statement. The subject policies used in all schools stipulated that learners should be given homework and educators have to monitor and assist learners where they do not understand.

Section 1.8.3 looks at the quality and quantity of homework given and section 1.5.1 looks at feedback to learners. Those schools that conduct the annual school evaluation have a very good picture of how science educators make good use of and gave feedback on homework. Homework is one way that complements classwork and helps learners to interact with what they have learnt in class. Since science periods per lesson are limited to an hour or less per day means learners still need more time to read on their own and try to understand the concepts they have been taught in class. Homework therefore comes in handy and further assists educators to establish whether learners grasped the concepts taught or not. Intervention, remediation and the correction of misconceptions can then begin the moment educators receive feedback from the learners. Parental involvement in teaching and learning can increase through homework as they may assist or monitor their children/wards. Since the quality assurance checklist also evaluates homework quality and quantity this results in educators and HODs reflecting and improving on their practices, therefore steps are taken to attain quality results.

## **C22: Are the learners informed of the types and dates of all assessments?**

Most of the respondents (95%) held the view that the learners were informed of the types and dates of all assessments. All the schools that participated in this study had management plans, which included the issuing of assessment plans to learners at the beginning of the year. The learner books sampled contained the assessment plans on the first pages. Proposed dates, actual dates, the type of assessment as well as mark allocations were indicated in learners' books.

The CAPS document stipulates that learners should be informed of the types of assessment especially the formal school-based assessment tasks (SBA) and examinations. When presented to learners this information may help them to focus and plan accordingly. Learners who are intrinsically motivated can take initiatives to study for such tasks and when educators motivate learners all may prepare in advance for such assessments. Science educators give their learners these documents, which means learners are not disadvantaged in that regard, thus the foundation for quality performance is laid in these schools. The results are consistent with section B, where educators are given policy documents and are supported by HODs and the district teams.

## **C23: Do all learners submit their assessment tasks on the due dates?**

The types of response given by the educators clearly show that not all learners submit their assessment tasks on the due dates as 6% disagreed with the statement while 92% agreed. Informal communications with some of the educators revealed that some learners do not submit their assignments on the due date, but the tasks that are to be done during the lessons are submitted on time. These include experiments.

A variety of assessments are given to learners. Some, like projects and research tasks, may require learners to take some time before submitting them to the educators. Due dates are provided and some reminders are given or stages of the projects are indicated. It is evident from the views of the 6% that a number of learners do not submit these tasks on the due dates. Some of the reasons may be that educators may not have thorough follow-up mechanisms or may not give reminders to the learners. The

other reasons may be that the learners do not understand clearly what to do, or have a lack of resources or are complacent. Most science learners were described in section 3 as learners who are “generally compliant”, therefore the submission of tasks may not be a huge challenge to them. This section is also in agreement with C22, where learners are informed about the assessments and dates. This helps both learners and educators to manage their time efficiently.

**C24: Are all the tasks given undergoing the necessary quality assurance processes like pre-moderation and post-moderation?**

The respondents who held the view that tasks given underwent the necessary quality assurance processes like pre-moderation and post-moderation were 93%. Only 4% remained neutral and 3% disagreed with the statement.

**Extract 5.7 Post-moderation tool for experiments**

<b>Circle the marks in black on the mark sheets of the learners whose experiments were moderated MARKING OF SCRIPTS (EXPERIMENTS)</b>	<b>Yes</b>	<b>No</b>
• Are all scripts marked?		
• Were the scripts intensively marked?		
• Was marking done according to the memo?		
• Is the number of ticks equal to the marks allocated in each question?		
• Is the total number of marks awarded equal to the number of ticks?		
• Do the marks entered on the mark sheet correspond with the marks on the answer script?		
<b>COMMENT BRIEFLY ON THE QUALITY OF MARKING</b>		
➤ Which aspects of the experiment were poorly done?		
➤ Remedial work /Intervention planned?		
Is there an impression that the learners were well prepared for the EXPERIMENT? If the answer is no, state reasons.		
Recommendations:		
_____		
Moderator's name: _____ Signature: _____		

It is clear that all necessary quality assurance processes are taking place in all the schools in this study. There were a variety of checklists in the schools some of which were generic, however, those for Life Sciences and Physical Sciences were customised and specific to the learning areas. The assessment documents checked showed that there were both pre-moderation and post-moderation tools available for all school-based assessments (SBA). This is a good move towards quality education as quality assessments are an indication of quality work. The majority of the respondents held the view that pre-moderation and post-moderation were taking place in schools, which is a very good indicator of the quality of assessments given. Workshops on setting quality papers among science HODs and educators in the District was done, according to Alice:

*“Workshops on setting quality papers and moderation processes were done, first to our cluster HODs, then educators. Main focus was on following CAPS document as well as complying with Bloom’s taxonomy percentages per difficulty level.”*

The results in this section confirm the qualitative results on pre- and post-moderation in section 3. This clearly shows that the schools in this district are moving towards quality science education by following the policies on the quality assurance of assessments.

#### **C25: Does the school have an active School Assessment Team (SAT)?**

Most of the respondents (90%) expressed the opinion that their schools had active School Assessment Teams (SAT). Only 2% disagreed and the rest (8%) remained neutral. Various structures were established by the GDE under the NPAQ (2007) to facilitate the quality assurance of assessment in schools. There are three main levels, namely provincial assessment teams (PAT), district assessment teams (DAT) and school assessment teams (SAT).

The response from Primrose reveals the links between PAT, DAT and SAT in the following statements:

*“The provincial assessment teams have been instrumental in the improvement of quality of science especially in Gauteng. They have been setting quality common papers in Maths, Physical Sciences, Life Sciences and Accounting that would have been standardised and follow relevant policies like the CAPS policy on assessment.”*

In this case provincial assessment teams are actively involved in enhancing the quality of science education in the schools. At district level there are also activities that ensure quality assessments are administered, as Primrose further explained:

*“In cases where the provincial papers are not available the districts would do the same process where quality papers are set and quality-assured through moderation by experts. To enhance quality the facilitators as part of the district assessment teams would call meetings with educators known as memo discussions or standardisation meetings, where the questions are discussed further and possible answers proposed, accepted or rejected. The main purpose, however, would be to make sure that all educators in the cluster mark papers in a standardised same manner.”*

These statements show that mechanisms are in place that support schools and make sure that SATs are furnished with quality assessments and that quality assurance processes are followed in schools. Alice agreed with Primrose and cited the important duties of SAT:

*“School assessment teams plan the smooth running of exams, set guidelines based on school assessment and CAPS policies. One coordinator attends meetings at the district or various venues where information is disseminated from PAT or DAT to the SATs for implementation in schools.”*

School assessment teams give guidance and direction to the whole-school about assessments. The team proposes management plans in terms of the date the papers should be set, quality-assured, docketed, packaged, stored and examination or test dates. Quality assurance processes like pre-moderation, post-moderation and marking

timelines in accordance with policy are also given by the SAT. Almost all respondents held the view that the SAT in their schools was actively involved in their duties. The results in this section corresponds with the qualitative results in section 3, where HODs, district subject specialists and appointed moderators actively moderate tasks given in the schools.

**Drivers based on Pivot tables**

The strongest positive drivers identified from all cross-combinations for C20 to C25 showed that C22 and C24 cross-tabulations had the highest number of educators who were definite in their positive responses. This is illustrated in Table 5.12 below.

**Table 5.12 Strongest positive drivers C22 vs C24**

		<b>C24 Are all the tasks given undergoing the necessary quality assurance processes like pre-moderation and post-moderation?</b>						
		<b>Count of Gender</b>						
<b>C22</b>	<b>Are the learners informed of the types and dates of all assessments?</b>	<b>Definitely No (1.00)</b>	<b>Maybe No (2.00)</b>	<b>No Idea (3.00)</b>	<b>Maybe Yes (4.00)</b>	<b>Definitely Yes (5.00)</b>	<b>Grand Total</b>	
		<b>No Idea (3.00)</b>			1	2		3
		<b>Maybe Yes (4.00)</b>				3	2	5
		<b>Definitely Yes (5.00)</b>	1	1	1	7	47	57
		<b>Grand Total</b>	1	1	2	12	49	65

Table 5.12 shows that 47 out of 57 = 83% of the educators strongly agreed that learners were informed beforehand of the types and dates of all assessments. The 47 educators also held the view that all the tasks given to learners underwent the necessary quality assurance processes, which included pre-moderation and post-moderation. The results show that when all tasks undergo the necessary quality assurance processes learners will also be informed timeously of the types and dates of assessments.

The second strongest positive drivers were between C23 and C24, of which 46 out of 53 = 87% educators held the view that all learners submitted their assessment tasks on the due dates. The same 46 out of 49 = 94% educators expressed the view that all the tasks given underwent the necessary quality assurance processes like pre-moderation and post-moderation. It can be inferred that when learners submit their tasks on the due dates it can assist the quality assurance processes like post-moderation.

The strongest positive driver that emerged was C24 (“Are all the tasks given undergoing the necessary quality assurance process like pre-moderation and post-moderation?”). The study revealed that assessments given and the quality assurance practices are present and followed in the schools in the sample. The only challenging aspect about the views of the educators was learners not adhering to timeframes for the submission of assignments. The provincial, district and schools assessment teams, as well as Umalusi, are all actively involved in quality-assuring the assessments in schools. Impressive mechanisms and thorough follow-up mechanisms are in place. All these point to quality science assessment which can be matched to international standards. The findings agree with theme 4 from qualitative results 5.3.2.2, which also suggests that assessment quality assurance practices like pre-moderation and post-moderation take place at various stages in all schools in this study.

#### **5.4.5 Factors impeding quality science education**

The attainment of quality science education can be hindered by not quality-assuring all threats that may arise. UNICEF (2002a) identifies five categories of barriers to quality education, namely household barriers, policy barriers, infrastructure barriers, community beliefs and practices, and educational barriers. From the TQM theory there is a need to identify loopholes through fact-based decision-making, thus continual improvement would be promoted. The challenges identified according to the systems theory will help understand change, giving a guide in developing new quality assurance tools no matter how complex. This section investigated the support systems present in schools and the resources available which either enable or hamper quality science teaching and learning in the schools in the study.

### 5.4.5.1 Support systems and learning and teaching support materials (LTSM)

According to Tait (1995:232) a learner support system includes the range of activities which complement the mass-produced learning resources, contact or face-to-face support mechanisms. This study looked at physical and human resource support with a bias towards practical activities as they support enquiry-based teaching and learning. The sixth set of questions dealt with physical resources, human resources, support systems and equipment. The first two responses that dealt with physical and human resources were very negative, showing that the schools were under-resourced and that this was impacting negatively on the quality of science education. The set of questions included: **D1**: Does the school have well-equipped science laboratories? **D2**: Are there any laboratory technicians/assistants in the school? **D3**: Is there a need for laboratory technicians in the school? **D4**: Does the lack of resources limit the teaching and learning of science? **D5**: Does the availability of science laboratory/science kits improve teaching styles and the performance of learners in science? And **D6**: Do science experiments help learners to improve the quality of science learning? Figure 5.13 below summarises the responses from the respondents.

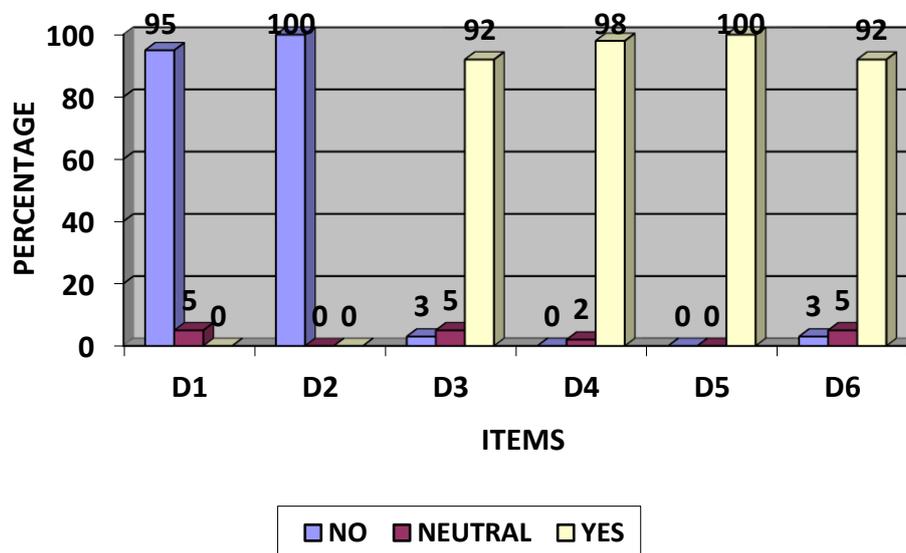


Figure 5.11 Support systems and LTSM

The average score of agreement is 63.7%, disagreement is 33.5% and neutral 2.8%. The low average score was contributed by the questions from D1 and D2.

### **D1: Does the school have well-equipped science laboratories?**

The majority (95%) of respondents held the view that the schools science laboratories were not well equipped. This is consistent with research studies by Manqele (2012); Mji and Makgato (2006:254); Howie (2003:2) and Legotlo et al. (2002:115), who consistently prove that lack of resources is a common problem in most South African public schools.

Practical activities are very important to the extent that educators who do not do them may be charged. Practical activities reinforce learners' knowledge and help them concretise what the educators are teaching. Practical activities and experiments help learners to discover things on their own, which is part of learner-centred teaching and learning.

*“In terms of infrastructure like laboratories there are a few schools that are well equipped but the majority of the schools do not have any. Due to large numbers of learners some of the schools turned the laboratories into classes. We, however, encourage educators to be innovative and make use of science kits which were distributed to all the schools. The laboratory kits are like mini laboratories which contain most equipment and chemicals which mainly allow educators to do demonstrations to learners. The other alternative is booking learners to go to Sci-Bono and conduct their experiments and practical activities. Educators are also advised to communicate with neighbouring schools so that they assist each other or contact us for help.”*

Well-equipped laboratories enable learners to operate, manipulate and become confident in the use of the equipment, thus enhancing learning experiences in science. Science disciplines are evidence-based or empirical in nature and learners need to experiment and do practical activities which assist them to concretise information. Individual work with the use of equipment as in a physics topic like electricity may be more beneficial than working in groups or seeing demonstrations by the educator. Only one school in this study had a well-equipped laboratory. The majority of the schools

had laboratories that were ill-equipped and two schools did not even have a laboratory building. The views of a staggering 95% of the respondents backed up the qualitative findings in section 3. These findings show that science learners in these schools may be disadvantaged and may not reach their maximum potential in hands-on science activities, thus compromising the quality of science achievement. Most application and synthesis questions or higher order questions in Physical Sciences are based on experiments and practical activities. If learners have not been exposed fully and properly to such experiences the desired quality may not be reached.

### **D2: Are there any laboratory technicians/assistants in the school?**

All the respondents (100%) knew that there were no laboratory technicians/assistants in their schools. This means that the educators have to prepare all equipment and chemicals before embarking on conducting the practical activities, then administer the practical activities and finally clean up. It is a burden to most educators as it diminishes their time for teaching. None of the schools had laboratory technicians, including the one school that was well equipped. This implies that science educators have to plan, set up an equipment, monitor, administer and clean equipment at the end of the lesson. Apart from this all the science educators had a full workload in terms of teaching time in accordance with policy or the PAM document. However, this policy does not take into consideration the fact that science educators need more time to prepare practical activities in comparison with other learning areas. The presence of laboratory technicians/assistants or the reduction of teaching periods for science educators may greatly reduce stress and burn-out among science educators. These findings are in line with section 3 and item D3 as well as the literature on educator burnout.

### **D3: Is there a need for laboratory technicians in the school?**

Almost all the respondents (92%) expressed the view that schools required laboratory technicians to assist science educators. This is in line with Archer (2006), who maintains that laboratory work is one of the most challenging aspects of science teaching when compared to some other subjects because it requires careful planning and considerable expertise on the part of the science educator (Archer, 2006:X1, 38). One district official also concurred with the findings above:

*“Absolutely I agree as most of our educators are burdened by a lot of work. Laboratory technicians’ duties usually are to prepare practical activities, prepare workstations and clean materials as well as to maintain equipment and taking stock. These duties are all done by science educators if the science lab is available.”*

Item D3 results are in line with item D2, therefore the respondents’ views showed that if schools have laboratories there is a great need for laboratory assistant personnel or technicians. The absence of these key personnel is a threat to quality science education attainment in the District.

**D4: Does a lack of resources limit the teaching and learning of science?**

All the educators (98%) believed that a lack of resources limited the teaching and learning of science. These views are in line with views in D1 and the literature search. It is clear that there is a direct proportionality between resources and the quality of education. Two of the schools did not have laboratory facilities and they relied heavily on demonstrations by the educators. Resources in science are key in enhancing performance for the learners. If these resources are lacking learners will not experience quality education due to the nature of science learning experiences.

**D5: Does the availability of science laboratory/science kits improve teaching styles and the performance of learners in science?**

All the educators (100%) revealed that the availability of science laboratory/science kits improves teaching styles and the performance of learners in science. The statement was also supported by one district official:

*“The laboratory kits are like mini laboratories which contain most equipment and chemicals which mainly allow educators to do demonstrations to learners.”*

It is evident that the majority of the schools in this district are under-resourced. Some do not even have laboratories, therefore science kits will greatly help learners. It emerged here that educators can improve their teaching styles and enhance the performance of learners by using science laboratory kits.

**D6: Do science experiments help learners to improve the quality of science learning?**

Most of the respondents (92%) agreed that science experiments helped learners to improve the quality of science learning. The results correspond with the findings of Motlhabane (2015) if learners and educators use enquiry-based methods (see D20):

*“In most practical-related science lessons, the focus is on completing the experimental procedure as directed by the teacher. However, the scientific discourse among learners themselves and teacher–learner discourse about scientific processes, scientific enquiry and the nature of science should play an important role in the teaching and learning of science. This means the incorporation of enquiry-based activities aimed at sparking debates about scientific concepts.”*

Jacob implied that experiments usually help learners especially when they are struggling in understanding concepts:

*“... educators use resources appropriately and if need be they are allowed to use simulations, even do experiments especially for struggling learners.”*

Learners learn and understand concepts differently. Hands-on activities like experiments and practical activities definitely assist learners as they merge theory and practice. Bloom’s taxonomy of higher order questions also involves practical activities, and this will enhance the quality of science education.

## Drivers based on Pivot tables

This section had strong positive drivers D4 and D5, and strong negative drivers D1 and D2. They are shown in the two tables below.

**Table 5.13 Strongest positive drivers D4 and D5**

D4 Does lack of resources limit teaching and learning of science?	Count of Gender	D5 Does the availability of science laboratory/science kits improve teaching styles and performance of learners in science?		
		Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
No Idea (3.00)		1		1
Maybe Yes (4.00)			4	4
Definitely Yes (5.00)			60	60
<b>Grand Total</b>		<b>1</b>	<b>64</b>	<b>65</b>

Table 5.13 shows that 100% (60 out of 60) educators agreed that the lack of resources limited the teaching and learning of science. Sixty (60 out of 64 = 94%) were definitely positive that the availability of science laboratory/science kits improved teaching styles and the performance of learners in science. The views show that lack of resources limit teaching and learning. In order to rectify this, science laboratory kits should be requested to improve educator teaching and learner performance in science.

**Table 5.14 Strongest negative drivers D1 vs D2**

D1 Does the school have well equipped science laboratories?	Count of Gender	D2 Are there any laboratory technicians/assistants in the school?		
		Definitely No (1.00)	Maybe No (2.00)	Grand Total
Definitely No (1.00)		49	1	50
Maybe No (2.00)		12		12
No Idea (3.00)		1	2	3
<b>Grand Total</b>		<b>62</b>	<b>3</b>	<b>65</b>

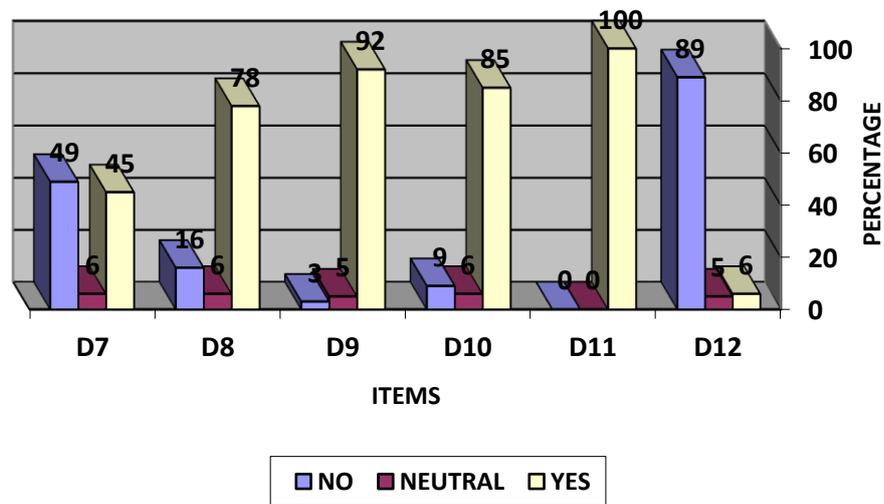
Table 5.14 shows that 49 out of 50 = 98% of the educators strongly agreed that their schools did not have well-equipped laboratories, while 49 out of 62 = 79% also said that there were no laboratory technicians or assistants in their schools. The views show that educators know that their schools' laboratories are not well equipped and the absence of laboratory technicians in the schools could make it worse.

D1 and D2 responses show that schools are not well resourced in terms of equipment and technicians, with none of the responses being positive. This is very alarming. A part of science training requires laboratory work and experiments. The lack of these surely impedes the success of learners. D3 and D4 responses further confirm that the lack of resources limits the success of educators. D5 and D6 show that the lack of resources also impact on the style and quality of science education. This section reveals that all the schools investigated are in one way or the other under-resourced in terms of laboratories, equipment and laboratory technicians. There is a general consensus that the limited resources or absence of resources impacts negatively on the quality of science education. If science learners are exposed to practical activities more frequently the quality of science education will also improve.

#### **5.4.5.2 Contact time and educator workload**

Contact time is the time that educators are directly teaching the learners. If this time is poorly managed or if there are no quality assurance measures quality would be compromised. Grayson (2010:10) asserts that educators are overloaded with paperwork, therefore contact time is reduced and educators cannot cover all content as per work schedules. The quantity and complexity of educator work are regarded as a big challenge among educators leading to stress and exhaustion and compromising the quality of education (Starnman & Miller, 1992). The seventh set of questions were based on the above findings and concentrated on the timeframes and workload of educators and how this may affect results. **D7**: Are the lesson periods long enough to cover all prepared daily work by educators? **D8**: Do learners finish all given work during the prescribed period? **D9**: Are educators overwhelmed by administrative paperwork in your school? **D10**: Do science educators require fewer periods so as to prepare for practical work or experiments? **D11**: Are there any quality assurance mechanisms that check the quantity and quality of work given by educators? **D12**: Are the timeframes

given for work coverage realistic and attainable? Figure 5.1.4 below summarises the findings.



**Figure 5.12 Contact time and educator workload**

A set of questions that relate to lesson period timeframes, learner time management, educator preparation time and educator paperwork were asked in the questionnaire. The average score for agreement with the statements was 67.7% and the average score for disagreement was 27.6%. The average score for the neutral response was 4.7%. Negative responses were given on lesson period timeframes and work coverage timeframes.

**D7: Are the lesson periods long enough to cover all prepared daily work by educators?**

Almost half (49%) of the respondents held the view that the lesson periods in their schools were long enough to cover all prepared daily work by educators. Only 6% remained neutral and the remainder (45%) disagreed with the statement. The majority of these were science educators. Science educators in this case required more time for the learners to grasp concepts, hence the extra classes arranged in all the schools in the study. This might also mean that some educators over plan their lessons or the learners may be slow to grasp the concepts being taught. Further analysis identified the majority of respondents who said periods were not long enough as the science

educators. The findings concur with Grayson (2010) and ELRC (2005), who point out that educators have many duties that compromise their contact time.

**D8: Do learners finish all given work during the prescribed period?**

Of the respondents 78% agreed that learners finished all given work during the prescribed period and 16% disagreed with the statement. The conflicting views from D7 suggest that the time allocated is enough for learners, but time management is a challenge to the educators. Science educators adjust their lesson preparations in such a way that the learners should be able to finish given tasks. A comparison of educator lesson preparations and GDE lesson plans showed that educators adjusted their lesson plans to suit their learners. These findings are in line with Maile (2013), Grayson (2010) and ELRC (2005).

**D9: Are educators overwhelmed by administrative paperwork in your school?**

A number of studies confirmed that educators and HODs were overloaded with work. As a result educators are overwhelmed with paperwork causing them not to effectively assess learners according to assessment policies. On the other hand HODs cannot effectively take on quality assurance tasks (Chavalala, 2015; Ngobeni, 2011). Chavalala (2015:121) established that HODs were also overloaded as they took up professional and managerial duties. D9 concurs with the findings of the other studies conducted as 92% of the respondents agreed with the statement that science educators are overloaded with work. The findings further confirm the research findings by Starnman and Miller (1992).

**D10: Do science educators require fewer periods so as to prepare for practical work or experiments?**

An overwhelming majority of the respondents (85%) agreed that science educators required fewer periods so as to prepare for practical work or experiments. The results for this subsection supports the findings in 5.3.3 (D3). Only a few respondents (9%) disagreed with the statement and only 6% remained neutral. Most science educators spend a lot of time preparing practical activities and administering them. This is

consistent with D2 and D3, wherein no schools in the study had laboratory technicians. A decrease in the number of teaching periods per science educator will definitely assist educators in the preparation of practical activities and experiments. The results above also concur with the qualitative findings in section 3.3. The results confirm Naylor (2001), and Starnman and Miller (1992), who reported that educators faced exhaustion due to overload.

**D11: Are there any quality assurance mechanisms that check the quantity and quality of the work given by educators?**

Documents analysed in all the schools revealed that quality assurance mechanisms checked the quantity and quality of work given by educators. All the respondents (100%) agreed with the statement. The main tool used is the content coverage tool, which requires educators to fill in the topics. This was available in all the sampled schools. The other HODs had their own templates together with the template supplied by the GDE. The district officials were in agreement with the findings above as they visit schools to verify content coverage and the quality of assessments.

**D12: Are the timeframes given for work coverage realistic and attainable?**

The timeframes given for work coverage are not realistic and attainable as 89% disagreed with the statement and only 6% agreed. In two of the schools sampled the educator work coverage was a week behind in Grade 10 (school 1), two days behind in Grade 11 (school 4) and those who were at par or ahead had been conducting extra classes especially Grade 12 (school 2 and 3). An analysis of the work schedules in both Life Sciences and Physical Sciences showed that they did not take into account certain special days like sports day, Valentine's Day, heritage day etc. which were present in the entire school's year plan. In some instances the work schedule dates overlapped with the weeks the schools were to write internal tests like the June examinations. The lost time was the responsibility of the individual educators, who should then plan for extra classes and holiday classes to cover all aspects required.

## Drivers based on Pivot tables

A cross-combination of all the items from D7 to D12 shows two scenarios, where the strongest positive drivers are between the D10 and D11 pair, and the strongest negative drivers between the D7 and D12 pair.

**Table 5.15 Strongest positive drivers D10 vs D11**

	Count of Gender	D11: Are there any quality assurance mechanisms that check the quantity and quality of work given by educators?		
		Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
D10 Do science educators require fewer periods so as to prepare for practical work or experiments?				
	Maybe No (2.00)		6	6
	No Idea (3.00)		4	4
	Maybe Yes (4.00)	2	26	28
	Definitely Yes (5.00)	3	24	27
	<b>Grand Total</b>	<b>5</b>	<b>60</b>	<b>65</b>

The respondents that were quite certain that science educators required fewer periods so as to prepare for practical work were only 24, however, a combination of “maybe yes and definitely yes” resulted in 51 out of 55 = 93%. Educators that held the view that there were quality assurance mechanisms that checked the quantity and quality of work given by educators were 51 out of 60 = 85%. An overall analysis of the D10 and D11 pair, although weak, shows that quality assurance mechanisms in place should provide for fewer periods for science educators.

**Table 5.16 Strongest negative drivers D7 vs D12**

	Count of Gender	D12				
		Are the timeframes given for work coverage realistic and attainable?				
		Definitely No (1.00)	Maybe No (2.00)	No Idea (3.00)	Maybe Yes (4.00)	Grand Total
<b>D7</b> Are the lesson periods long enough to cover all prepared daily work by educators?	Definitely No (1.00)	14	7		1	22
	Maybe No (2.00)	6	4			10
	No Idea (3.00)	1		3		4
	Maybe Yes (4.00)	12	8			20
	Definitely Yes (5.00)	5	1		3	9
	<b>Grand Total</b>	<b>38</b>	<b>20</b>	<b>3</b>	<b>4</b>	<b>65</b>

Of all the pivotal table pair combinations the strongest negative driver was the D7, D12 pair. Not even one educator was definitely positive to D12 of which 14+7 were negative, meaning that the time given for work coverage in science is not realistic and attainable. The same 14 believed that the lesson periods were not long enough for educators to cover all prepared work.

D7 responses show that lesson periods are too short to cover the prepared work. This is likely to affect both educators and learners negatively. Some evidence has shown that having longer periods of the same subject may be better than having a large number of subjects for short periods (a type of economies of scale). D8 responses show that most learners are able to finish the work on time, but some are incapable given the short periods. D9, D10 and D12 results show that not only are periods short, but educators are swamped by administrative work, and do not have enough time to focus on preparing lessons. There is simply not enough time to cover all the work. Part of the solution may thus be to make periods longer to build momentum, instead of having fragmented lessons. D11 responses show that there are quality assessment measures to at least ensure that education is at a good standard, despite the high workload.

The strongest positive driver was that there are quality assurance mechanisms that check the quantity and quality of work given by educators. It can be inferred that, for quality science education to be achieved, there is a need for balancing the quantity and quality of work that educators give to learners. This study responses indicate that school science educators are overloaded and also that lesson periods and timeframes are not friendly. This impacts on the quality of their delivery. Science educators are multi-tasking and science HODs are also engaged in administrative duties, which may compromise their quality assurance duties.

#### 5.4.5.3 Effects of language on the quality of science education

The eighth set of questions examined the influence of the medium of instruction on outcome. Results were mixed. Language issues definitely affect the quality of results, therefore the following questions were asked to establish the extent to which language hampers the attainment of quality results. D13: Learners have a limited understanding of academic language; D14: The home language of learners who underachieve is usually not English; D15: Learners have difficulties understanding scientific technical terms; D16: Learners find it difficult to listen to and understand English due to its phonological/pronunciation system, which differs from that of their home language; and D17: Learners understand scientific concepts better if taught in more than one language.

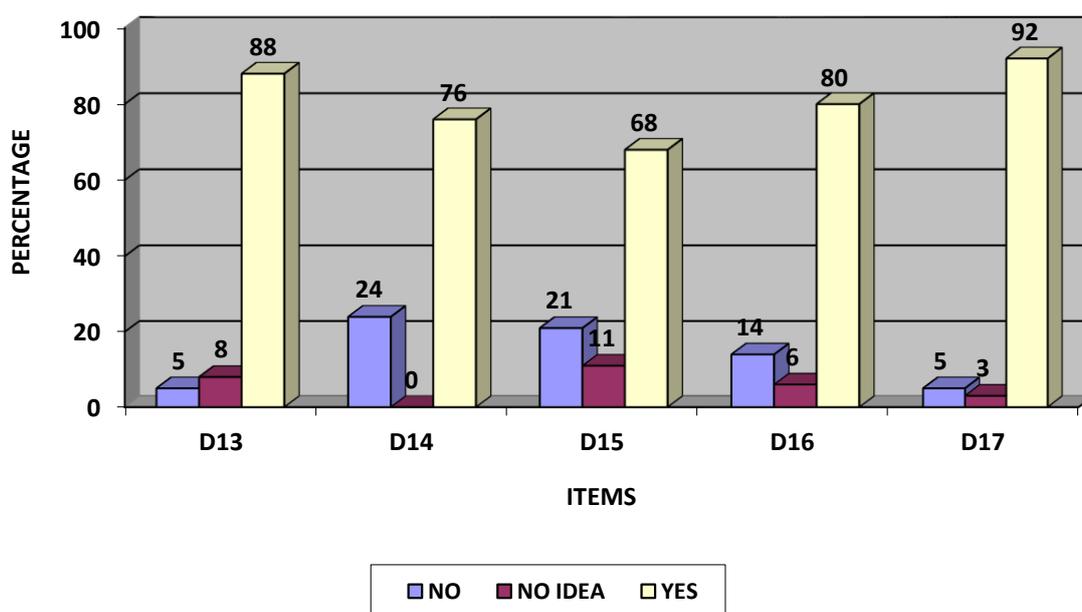


Figure 5.13 Language in science teaching and learning

The average score of agreement with the statements is 80.7%, the average score of disagreement is 13.7% and the average of the neutral responses was 5.6%.

#### **D13: Learners have limited academic language understanding**

The majority of the respondents (88%) agreed that learners had a limited understanding of academic language, whereas 5% disagreed and only 8% remained neutral. Since academic language understanding and skills are crucial in the teaching of science, learners with a limited understanding in the language of teaching and learning would compromise the quality of the results. The 5% that disagreed may be as a result of learners whose home language is English, who may be assumed to understand academic language.

#### **D14: The home language of learners who underachieve is usually not English**

Most of the respondents (76%) disagreed with the statement that in the case of learners who underachieve, the home language is usually not English. A few (24%) of the respondents agreed and none remained neutral. The majority in this case disagreed with the statement because those learners who achieve academically are not only those whose home language is English. There is need to further investigate the influence of home language and language of teaching and learning.

#### **D15: Learners have difficulties understanding scientific technical terms**

The second statement most educators (68%) agreed with was that “learners have difficulties understanding scientific technical terms”. Only 21% disagreed with the statement. Scientific terms are used in Physical Sciences and Life Sciences. If learners do not understand them it may result in poor quality of results as most of the sections examined require an understanding of the technical terms. To grasp scientific concepts requires an understanding of technical terms.

**D16: Learners find it difficult to listen to and understand English due to its phonological/pronunciation system which differs from that of their home language**

The majority of the respondents (80%) agreed that learners found it difficult to listen and understand English due to its phonological/pronunciation system, which differs from their home language. A few (14%) of the educators disagreed and 6% remained neutral. It is of the utmost importance for learners to understand the language of teaching and learning science, in this case English. The findings above raise a red flag since in the case of the majority of learners in the schools in the study the home language is not English but African languages. The above views mean that developing a scientific register in the African languages in South Africa should be considered as the majority of the learners in the study are not English home language speakers.

**D17: Learners understand scientific concepts better if taught in more than one language.**

The majority (92%) of the respondents held the view that learners understood scientific concepts better if taught in more than one language. Five percent of the respondents disagreed and only 3% remained neutral. The findings concur with the study conducted by Zisanhi (2013). Teaching concepts in different languages or code-switching benefit the learners as they would be able to process some information in their home language.

**Drivers based on Pivot tables**

The pivot pair combinations for all possible outcomes was generated and analysed and the strongest positive pairs were D13, D17 and D14, D17.

**Table 5.17 Strongest positive drivers D13 vs D17**

	Count of Gender	D17 Learners understand scientific concepts better if taught in more than one language.				
		Maybe No (2.00)	No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
<b>D13: Learners have limited academic language understanding.</b>	Maybe No (2.00)			1	2	3
	No Idea (3.00)	1	1		3	5
	Maybe Yes (4.00)		1	3	31	35
	Definitely Yes (5.00)	2		2	18	22
	<b>Grand Total</b>	<b>3</b>	<b>2</b>	<b>6</b>	<b>54</b>	<b>65</b>

Table 5.17 shows that the 18 respondents who viewed learners as having limited academic language understanding also said that learners should be exposed to more than one language in order to understand scientific concepts. The strongest driving question therefore is D17, which had a total of 31 + 18 out of 54 = 91% positive responses. The second strongest positive driving pair was D14, D17, where the 17 educators who viewed learners as underachieving when English is not their home language also felt that learners understand scientific concepts better if taught in more than one language. The strongest driving question was also D17, with 25 + 17 out of 54 = 78%.

D13 and D15 responses showed that understanding academic language was a challenge to most learners. This may be linked to the previous findings about workload. Perhaps educators simply do not have enough time to prepare a simplified version of the material or to explain topics more descriptively given the short periods. The D14 responses showed that language has an effect on outcome, where those who use English as their home language perform better. This is not the full story, however, since 24% indicated that not having English as a home language does not give a disadvantage academically. D16 and D17 responses here suggest that most learners would benefit from being taught in more than one language, as this would aid their understanding.

This section revealed that academic language understanding was a challenge to most learners. This may be linked to the previous findings about workload, where educators did not have enough time to prepare a simplified version of the material or to explain topics more descriptively given the short periods. The responses showed that language has an effect on outcome, where those who have English as their home language perform better. However, there are indications that not having English as a home language does not lead to a disadvantage academically. The results further suggest that most learners would benefit from being taught in more than one language or use of code switching, as this would aid their understanding.

#### 5.4.5.4 Enquiry-based teaching and learning of science

According to Xanthoudaki (2010) quality science learning should adopt an enquiry-based teaching and learning approach, which involves observing, questioning, hypothesising, investigating, interpreting, communicating and evaluating acquired knowledge. Science learners who were given opportunities to engage in thinking, insights and problem solving performed much better than learners who were in classes where the conventional chalk and talk routine was followed (Muwanga-Zake, 2008; Taylor, 2006; Mji & Makgato, 2006; Madibeng, 2006). From the literature search and the theoretical framework it was deemed necessary to consider the following questions in the questionnaires. D18: Do science learners use “monological” interactions: one-way kind of reasoning (discussions and explanations)? D19: Do science learners use dialogical interactions, i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon)? D20: Do learners experiment with new situations beyond the classroom? D21: Do educators actively give feedback to learners in communication, accuracy of knowledge, skills and thought process?

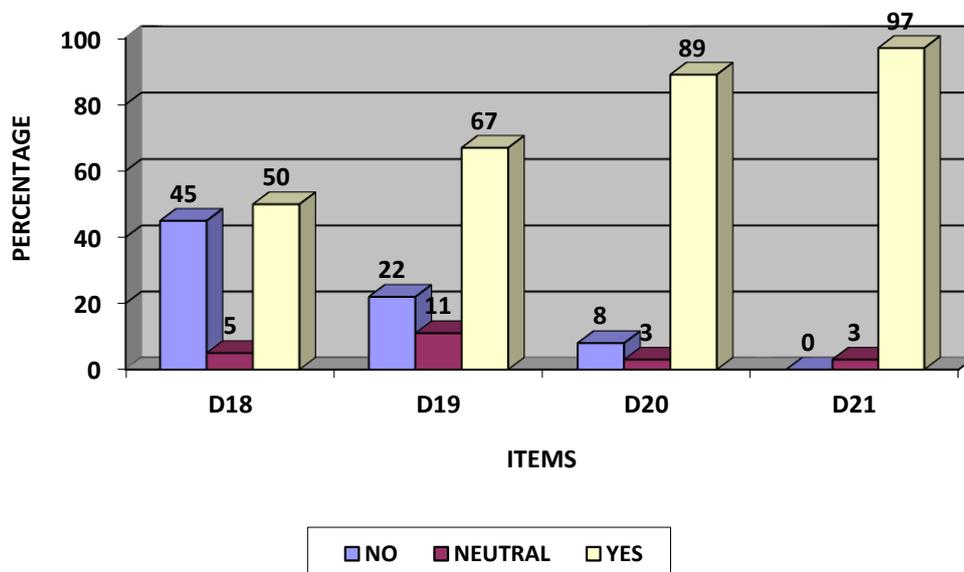


Figure 5.14 Enquiry-based teaching and learning

The average score of agreement with the statements was 75.8% and the average score of disagreement was 18.7%. The average score for neutral was 5.5%. D18 had

a much greater disagreement percentage than the rest of the questions, which were very positive.

**D18: Do science learners use “monological” interactions: one-way kind of reasoning (discussions and explanations)?**

Half of the respondents (50%) agreed that learners used “monological” interactions. Almost an equal number (45%) disagreed with the statement and 5% indicated that they had no idea and remained neutral. These findings are consistent with C11 and C12, where learners’ selection is based on learners’ choices and some learners are not able to reach the expected goals or outcomes. In such situations these same learners may display or use monological interactions instead of dialogical interactions. The closeness of the results in terms of the views of educators simply indicate that the classes have mixed learners.

**D19: Do science learners use dialogical interactions, i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon)?**

More than half (67%) of the respondents disagreed with the statement that science learners used dialogical interactions, i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon) in their science lessons. Only 11% remained neutral and 22% disagreed with the statement. The above views confirm the views in D18, where the majority of learners are viewed as using monological interactions.

**D20: Learners experiment with new situations beyond the classroom**

The majority (89%) of the respondents agreed and 8% disagreed with the statement that learners experiment with new situations beyond the classroom. Only 3% remained neutral. In this case the results are in agreement with documents/learner books, which suggested that learners experimented with new situations, e.g. higher order questions with new scenarios were answered satisfactorily, like momentum questions in Grade 11 Physical Sciences in school 3. There were assignments and projects planned by educators that required the learners to experiment with new situations.

## **D21: Educators actively give feedback to learners in communication, accuracy of knowledge, skills and thought process**

Some of the books sampled revealed that educators actively gave feedback to learners in communication, accuracy of knowledge, skills and thought process. These were the sentiments of 97% of the respondents, with no-one disagreeing and the remaining 3% were neutral. The results show that educators who make use of practical activities also engage in enquiry-based learning.

According to Alice:

*“Practical activities are very important to the extent that educators who do not do them may be charged. Practical activities reinforce learners’ knowledge and help them concretise what the educators are teaching. Practical activities and experiments help learners to discover things on their own, which is part of learner-centred teaching and learning.”*

Lesson plans from the science educators revealed that practical activities as well as enquiry-based techniques were used. The educators in the sampled schools actively engaged in enquiry-based teaching, but the views of the majority of educators revealed that learners did not reach the expected levels in enquiry-based learning. Enquiry-based teaching and learning is also quality-assured by HODs, DSGs and supervisors during the WSE process. Documents indicate that the educators actively engage their learners in learning, therefore quality science teaching and learning should follow.

### **Drivers based on Pivot tables**

All pivot table pair combinations were generated and analysed and the strongest positive driving pair identified was the D19, D21 pair.

**Table 5.18 Strongest positive drivers D19 vs D21**

	Count of Gender	<b>D21 Educators actively give feedback to learners in communication, accuracy of knowledge, skills and thought process.</b>			
<b>D19: Do science learners use dialogical interactions i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon)?</b>		<b>No Idea (3.00)</b>	<b>Maybe Yes (4.00)</b>	<b>Definitely Yes (5.00)</b>	<b>Grand Total</b>
	<b>Definitely No 1.00</b>			1	1
	<b>Maybe No(2.00)</b>		5	8	13
	<b>No Idea (3.00)</b>	1	3	3	7
	<b>Maybe Yes (4.00)</b>		14	6	20
	<b>Definitely Yes (5.00)</b>	1	6	17	24
	<b>Grand Total</b>		<b>2</b>	<b>28</b>	<b>35</b>

This theme was the weakest pair among all the other themes. The reason may be that the educators did not understand question D19 clearly, since the greater number said “maybe yes”. Seventeen (17 out of 35 = 49%) were quite certain that science learners used dialogical interactions, i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon). The same seventeen educators (17 out of 24 = 71%) had the view that educators actively gave feedback to learners in communication, accuracy of knowledge, skills and thought process.

#### **5.4.5.5 Motivation and informal science learning**

The motivation of both learners and educators boost their morale and satisfaction, therefore there is a move towards quality education (NAAC, 2007). Learning science in an informal environment offers a structured definition of learning as it is accompanied by excitement, remembrance, exploration, participation and self-identification (SETAC, 2014).

The ninth set of questions examined the integration of informal learning into the learning programme. The following questions guided by the theoretical framework and literature were asked: D22: Does the school have a policy on excursions and the

integration of formal and informal learning?; D23: Are the learners always motivated by the stakeholders to study hard?; D24: Does the school have workshops to motivate the learners?; D25: Are educators motivated by financial rewards to do extra work?; D26: Does the school have any planned educational excursions?; D27: Are the lessons planned in such a way that learners are directed to do research on their own? D28: Are parents actively involved in their children’s learning? The responses to the questions are shown in Figure 5.15 below.

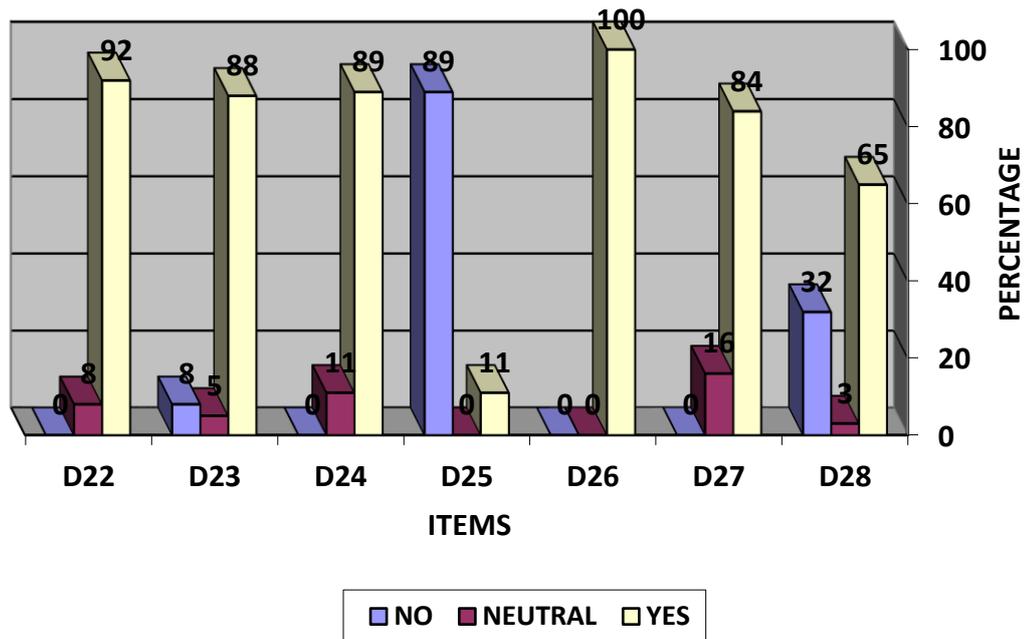


Figure 5.15 Motivation, formal and informal learning of science

The average score for agreement is 75.6%, disagreement is 18.3% and neutral is 6.1%.

**D22: Does the school have a policy on excursions and the integration of formal and informal learning?**

The majority of the respondents (92%) did know that their school had a policy on excursions and that science educators’ integrated formal and informal learning. Only a few (8%) were neutral and none objected to the statement. Alice agreed with the statement:

*“The other way we motivate is by recommending educators to engage in educational tours to various institutions like universities, chemical, manufacturing, mines, botanical gardens and so forth.”*

The findings here concur with SETAC (2014), CAIC (2010) and Xanthoudaki (2010), who emphasise the fostering of a formal and informal learning environment (cf. 3.6.2.5, 5.3.).

### **D23: Are the learners always motivated by the stakeholders to study hard?**

It is clear that learners are always motivated by the stakeholders to study hard as revealed by 88% of the respondents agreeing with the statement.

The researcher witnessed the Johannesburg South district director and the science facilitators intensifying their motivation sessions to learners in 2016 under the banner, “I am a winner”. One motivation session by a science facilitator was based on Power Point presentations and a talk on “striving towards excellence”.

The response by Alice clearly shows that they motivate learners:

*“That’s also part of our job, we also go to different schools to motivate them. At times we recommend notable motivational speakers in the scientific fields to motivate our learners. The other way we motivate is by recommending educators to engage in educational tours to various institutions like universities, chemical, manufacturing, mines, botanical gardens and so forth. The moment learners are exposed to the real world situations they are motivated much better than when we just lecture to them. They may not attach any value to what they are learning until they have experienced it out there.”*

Motivation was shown to help learners to focus on their studies (Woolfolk, 2013; Vos et al., 2007; Muwanga-Zake, 2008).

**D24: Does the school have workshops to motivate the learners?**

Motivation sessions were also organised by the individual schools where notable motivational speakers were invited to speak during assembly periods. This was backed up by 89% of the respondents who agreed that their school had workshops to motivate the learners. There were indications that Life Orientation educators and HODs worked in collaboration with other learning areas and coordinated most motivations and career guidance excursions.

*“We recommend notable motivational speakers in the scientific fields to motivate our learners.”*

Motivation sessions to learners was one priority area used by the schools and district to help learners focus on their studies.

**D25: Educators are motivated by financial rewards to do extra work**

The majority of the educators (89%) disagreed with the statement that educators are motivated by financial rewards to do extra work. Investigations by the researcher revealed that science educators in the schools in the study gave extra classes to cover the content and be ahead of work schedules, as well as revision classes or remediation. In almost all the cases educators were not given extra money except stipend money for fuel/transport. A series of workshops were conducted by the district director to motivate the educators in the district to do extra work. A whole week in 2016 was dedicated by the district director to motivating the different educators in different learning areas.

**D26: Does the school have any planned educational excursions?**

All the schools in the study had planned excursions according to their year plans. Life Sciences had more excursions planned than Physical Sciences in all the schools sampled. Most of the excursions planned were for the lower grades. The responses revealed that the majority (100%) held the view that educational excursions were

planned in their schools. No one was neutral and no one disagreed with the statement. The findings concurred with Alice's statement:

*"The other way we motivate is by recommending educators to engage in educational tours to various institutions like universities, chemical, manufacturing, mines, botanical gardens and so forth."*

The year planner calendars of all the schools showed that they had planned educational tours for the year. The findings confirmed D22, revealing that school policies on excursions were also implemented.

**D27: Are the lessons planned in such a way that learners are directed to do research on their own?**

The lessons by science educators are planned in such a way that learners are directed to do research on their own was the view of 84% of the respondents. The other 16% remained neutral and no-one disagreed with the statement. The results were also backed up by the educator lesson plans and learner books, where homework as well as research tasks was given regularly to learners.

**D28: Are parents actively involved in their children's learning?**

More than half (65%) of the respondents held the view that parents were actively involved in their children's learning. Only 33% believed that parents were not involved in the learning processes of the learners. The 33% is a huge number, which is consistent with the findings by Mathaba (2014:173), which revealed that the lack of parental involvement in schools was a contributory factor impeding teaching and learning. Respondents in Mathaba's study expressed the view that parents did not cooperate with educators, which led to learners not doing their tasks.

D22, D23, D24, D26 and D27 responses show that the schools do well in integrating informal learning into the learning programme, and show the initiative to keep learners engaged outside the classroom. D28 responses were mixed, with the majority of respondents saying that the learning programme encouraged parents to be involved

in the learning experience. However, some 32% of responses were of the opposite opinion.

This section’s responses show that the schools do well in integrating informal learning into the learning programme, and have initiatives to keep learners engaged outside the classroom. Motivation plays an important role in assisting science learners to informally and formally focus on their studies. The results corroborate the findings from the interviews with deputy principals and district officials (cf. 5.4.5). The findings however, shows that parents are not actively involved in the learning experience of their children.

### Drivers based on Pivot tables

The use of pivot tables or cross-tabulation analysis of all items from D22 to D28 revealed that the respondents’ positive responses that could represent the theme are items D24 and D26, as shown in Tables 5.19 and 5.20.

**Table 5.19 Strongest positive drivers D24 vs D26**

D24 Does the school have workshops to motivate the learners?	Count of Gender	D26 Does the school have any planned educational excursions?		
		Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
No Idea (3.00)			7	7
Maybe Yes (4.00)		1	9	10
Definitely Yes (5.00)		4	44	48
<b>Grand Total</b>		<b>5</b>	<b>60</b>	<b>65</b>

Table 5.19 shows that respondents that were definite in their responses for D24 and D26 were 44 out of 48 = 92% and 44 out of 60 = 73% respectively. The strongest positive driving question is therefore D24. The educators indicated that their schools conducted workshops to motivate learners. The second strongest drivers revealed that 35 out of 37 = 95% and 35 out of 60 = 58% positively agreed with D22 and D26 respectively. D22, D24 and D26 as factors that result in these positive responses can therefore be used to represent the theme of informal learning and the motivation of learners. It can be concluded that the policy on excursions and the integration of formal

and informal learning, workshops to motivate learners and the planning of educational excursions can impact positively on the quality of science education in schools.

#### 5.4.6 Impact of quality assurance on quality of science education

The final section examined the impact of the quality assurance policies and practices on the quality of science education in the district.

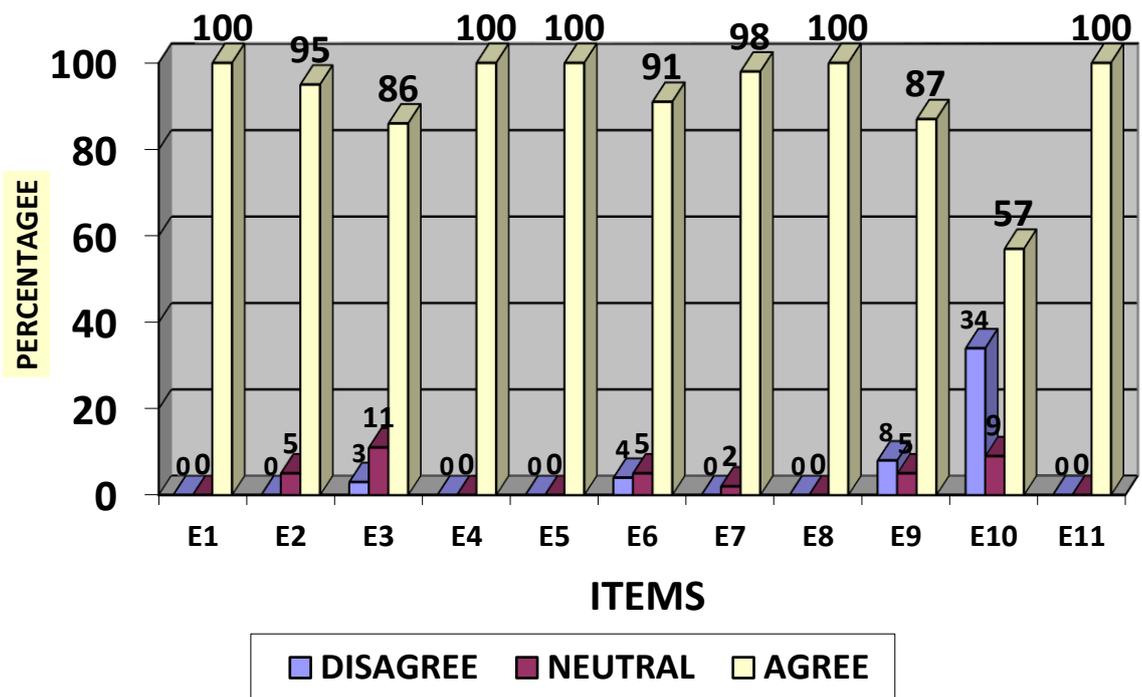


Figure 5.16 Impact of quality assurance processes

The average score of agreement is 92.2%, disagreement 4.4% neutral 3.4%.

#### E1: Are the policies and mechanisms helping the school to attain its aims?

The policies and mechanisms help the school to attain its aims, were the views of the majority (100%) of the respondents whereas none disagreed. The responses are in agreement with section B1-B12, where policies were established that there were present in all the schools. Mechanisms are also in place in the district and this is in agreement with section B13-B18, where there are mechanisms to ensure quality teaching and learning in schools.

The overall aim of schools is not only to teach learners to pass the examinations but to transform them holistically to become valuable citizens who add value to the nation and globally. It is clear from this study that policies and mechanisms in the Johannesburg South District are present and definitely helping schools to move towards attaining their aims and goals. The respondents, as active participants in either the disseminating of policies or the implementation of the policies, have a very good picture and view of whether schools are benefiting, leading to all agreeing with the statement.

## **E2: Quality assurance processes have enhanced the quality of science in the school**

Most of the respondents (95%) held the view that quality assurance processes enhanced the quality of science teaching in their schools. No respondents disagreed with the statement and those who were neutral were 5%.

### **Extract 5.8 Monitoring and reporting duties (Head of Department)**

<b>Who?</b>	<b>What</b>	<b>When? Frequency</b>
HOD	1. Check teacher preparedness to deliver lesson as per the syllabus/work schedule	Weekly
	2. Report on progress towards the syllabus/work schedule in subjects being managed	Monthly to the deputy principal
	3. Monitor implementation of subject assessment plans and track learner performance and ensure remediation	After each assessment in subjects as per the school assessment plan
	4. Ensure internal moderation of assessment	Moderated assessment before assessment is administered and after marking a sample of learner work moderated
	5. Monitor a sample of learner workbooks and homework to validate against syllabus/works schedule completion in subjects in all grades	Rotate fortnightly between subjects being supervised – all subjects and grades to be monitored in a month.
	6. Conduct subject meetings – to provide direction to educators	Twice a term – to be formally conducted and minutes recorded.

The above extract shows the quality assurance processes expected to be followed at the level of the HOD (Ramparsad, 2011:8).

Educators need to be prepared to deliver quality lessons. This is usually done via lesson plans, where educators plan for the entire duration of the lesson before entering a class. The GDE has prepared lessons that educators can interact with and they then contextualise or make them suit their teaching styles. The documents obtained by the researcher showed that all schools have these lesson plans and in addition they make and fill in lesson preparation templates that show exactly what they will teach and activities they will give to the learners. Educator and HOD signatures were evident on the lesson plans, showing that there is internal monitoring. The HOD master files also revealed that the HOD received curriculum coverage reports and verifying using learner books. Pre-moderation and post-moderation reports for both Physical Sciences and Life Sciences were present in all the sampled schools. The reports by the district officials also showed that they monitored the educators in schools. This information is readily available for self-school evaluation and external whole-school evaluation. Reports from these evaluation tools indicated that all the schools visited were actively involved in the quality assurance processes. Such practices, according to the respondents' views, would definitely enhance the quality of science in the schools.

### **E3: Quality assurance processes have led to infrastructure development in the school**

The respondents that agreed with the statement that quality assurance processes had led to infrastructure development in the schools were 86%, whereas only 11% disagreed and 3% were neutral. The WSE process informs the needs of the school also in regard to infrastructure and recommendations sent to the district and then head office. The results revealed that the developments in infrastructure were there, but the issue of laboratories was not present in two poor quintile 1 schools. The school improvement plan should also include the infrastructure improvement, where the recommendations are sent to the relevant departments dealing with structures. Inspection of the infrastructure in the schools shows that the quintile 5 and quintile 4 schools have laboratories which are well-maintained though not well-equipped except one. The poor schools in quintile 1 and 2 had no laboratories at all. Since the SSE and WSE are done every year it means the schools have sent requests and recommendations every year. Educators in the poor school have the view that nothing is being done because their infrastructure remains the same year in and year out and

they still don't have laboratories. On the other hand most of the schools have seen the infrastructure development or school maintenance in progress after sending school improvement plans. The WSE tool has a section on quality-assuring infrastructure, therefore the views of the 86% are in agreement with the statement. The results in E3 are in agreement with the documents available in schools as well as the interview results.

#### **E4: IQMS has led to professional staff development training**

All respondents (100%) believed that the process of IQMS led to professional staff development training in their school and none did not agree with the statement. The sentiments of all the respondents were shared by the district official Rose:

*“Our role in Performance Management and Development is developing educators on the interpretation of the policy i.e. Collective Agreement 8 of 2003 (IQMS). Specific development is conducted by the Teacher Development Unit, where they check according to school improvement plan their specific needs on all educators. In-service training is organised, relating to the specific need of educators, personnel staff, all involved in the school.”*

Documents from all the schools in this study revealed that the SIP included areas of staff development requirements.

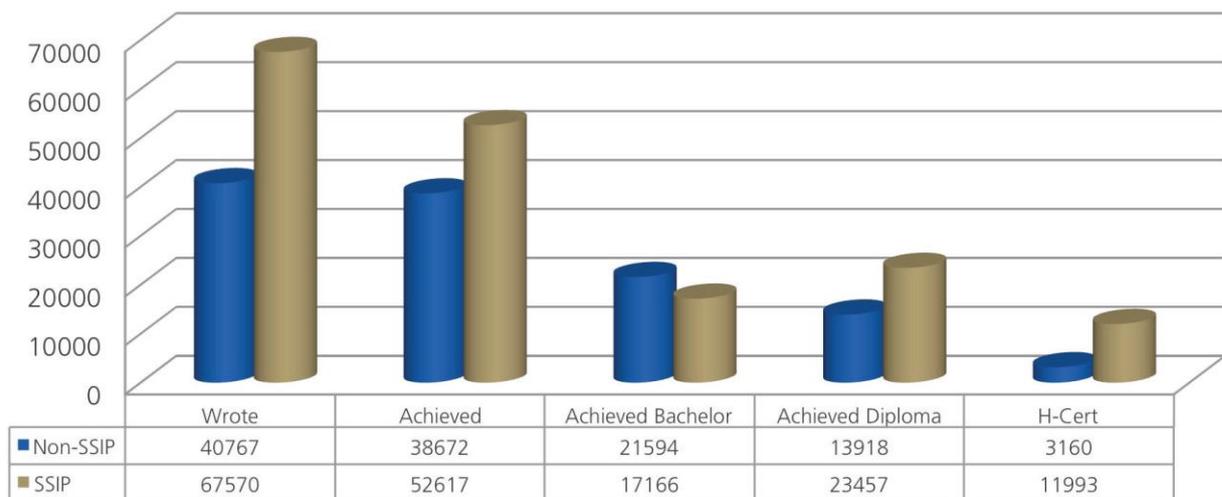
#### **E5: IQMS process has helped in improving the quality of science in the school**

All respondents (100%) agreed that the IQMS process has helped in improving the quality of science education in their schools. The responses clearly showed that the current quality assurance mechanisms are enhancing education in the district. The quality assurance processes based on IQMS were present in all the schools in this study. The results concur with findings from qualitative responses theme 6 where all quality assurance practices enhanced science quality.

## 6: District officials monitoring and supporting programmes have enhanced the quality of science education

Just above three-quarters (91%) of the respondents agreed that district officials monitoring and supporting programmes enhanced the quality of science education in their schools. Less than a quarter (4%) of the respondents disagreed with the statement and 5% remained neutral. One of the support programmes initiated by the GDE and all the schools in the sample was part of the SSIP programme where both Physical Sciences and Life Sciences were taught to Grade 12 learners. The results above concur with the comparison of SSIP and non-SSIP schools below. (The Secondary School Improvement Programme or SSIP is a project designed by the Sci-Bono Discovery Centre that seeks to improve Grade 12 results in the province of Gauteng, South Africa.)

### 2015 Comparison of SSIP schools and non-SSIP schools



**Figure 5.17 GDE 2015 NSC results analysis**

Figure 5.19 shows that the overall number of learners who achieved in SSIP schools were more (52 617) than those in non-SSIP schools, who were only 38 672 in 2015. These results suggest that there is an improvement when it comes to schools that participated in the SSIP classes initiated by the GDE.

*“It is pleasing to note that the gap between the schools under the SSIP programme is narrowing compared to the non SSIP schools. The quality of passes is also improving, with the 2015 group contributing more than 40 000 candidates that can pursue their academic career in bachelor or diploma studies” (GDE, 2015:52).*

**E7: Recommendations from district inspection teams are usually implemented**

98% of the respondents agreed that recommendations from district inspection teams were usually implemented. The district officials emphasised that they visited schools and made recommendations. The schools were given timeframes to implement the strategies or recommendations.

**E8: The district officials/inspection teams provide guidance and support following the school visits**

All the respondents (100%) agreed that the district officials/inspection teams provided guidance and support following the school visits. The views of the respondents were backed up by the documents available in schools. Following school visits the facilitators/subject specialists commented and recommended on their findings. From the framework for curriculum support and programme accountability (Ramparsad, 2011:12) the duties and reporting system of district support teams are shown in extract 5.4 below.

**Extract 5.9 Monitoring and reporting duties (District official)**

<b>Who?</b>	<b>What?</b>	<b>When?/ Frequency</b>
CES Curriculum	1. Report to district director on the status of all schools in the cluster in terms of support provided to schools on curriculum matters for syllabus/work schedule completion and implementation of school assessment plans	Monthly – summary report to district director Quarterly reports to programme directors at Head Office
	2. Provide quantitative and qualitative report to district director on the curriculum structures particularly subject meetings, assessment structures and support provided	Monthly - Summary report to district director

	to schools in general and as per request from IDSOs	Quarterly reports to programme directors at Head Office
	3. Conduct meetings with school principals in the district to provide direction on curriculum and assessment matters	Twice a term – to be formally conducted and minutes recorded
	4. Monitor learner performance targets and support school intervention programmes	Quarterly
	5. Ensure district participation in relevant support structures to interface with HO	As per curriculum calendar

The duties of the subject advisors are outlined above. They are helpful in supporting the schools to a great extent. It is the researcher's view that, if the job descriptions above are strictly followed, then quality education will be achieved.

### **E9: The SGB members are involved in enhancing the quality of science education in the school**

The role of the SGB in quality assurance is seen as significant as 87% agreed with the statement that the SGB members were involved in enhancing the quality of science education in the school. A smaller number (8%) disagreed with the statement and only 5% were neutral. The SGBs in South Africa have a number of roles, namely: Developing the mission statement of the school; adopting a code of conduct for learners at the school; determining the school's admission policy; determining the school's language policy; adopting a constitution for the SGB; determining times of the school day consistent with any applicable conditions of employment of staff at the school; determining the school fee (note: not applicable to no-fee schools); determining any other voluntary contributions (e.g. fees for excursions); recommendations to the Provincial Department of Education and the appointment of educators at the school, subject to the Employment of Educators Act (DBE, 2014). In this study the contributions of SGBs in enhancing the quality of science education were in the areas of determining the school's language policy, school day, recommendations for appointment of educators and other voluntary contributions. The schools review their language policies and changes are initiated by the demographics of the school, for instance four of the schools introduced African languages in lower grades. The language of teaching and learning (LoLT) of the schools is also determined by the SGBs, in which case the language of teaching and learning science in most schools was English. The school

day in all the schools for all learners remained the same except for Grade 12 learners. Documents gathered in all the schools in the study revealed that there were extra classes for Grade 12 learners, in some instances early in the morning from 07:00 to 07:45 and some from 15:00 to 17:00 as well as classes on Saturday and Sunday. In school A and D the SGB parent component volunteered to come to schools and monitor learners' reading periods from 15:00 to 17:00.

### **E10: Recommendations by the SGB are taken seriously by the educators**

The second question regarding the role of the SGB in quality assurance matters was further not agreed with by 34%. More than half (57%) agreed that recommendations by the SGB were taken seriously by the educators. One of the duties of the principal is to conduct meetings with the SGB and parents to provide feedback on academic achievements. According to the curriculum management model this should take place once a quarter. This is the period when the SGB put across their inputs and recommendations for improvement. The reason for the results above is twofold: it might be that most educators do not know the roles of the SGB personnel or they may be relations of educators and the SGB is not cemented as the two areas of professionalism and governance are separated and their integration is not fully understood.

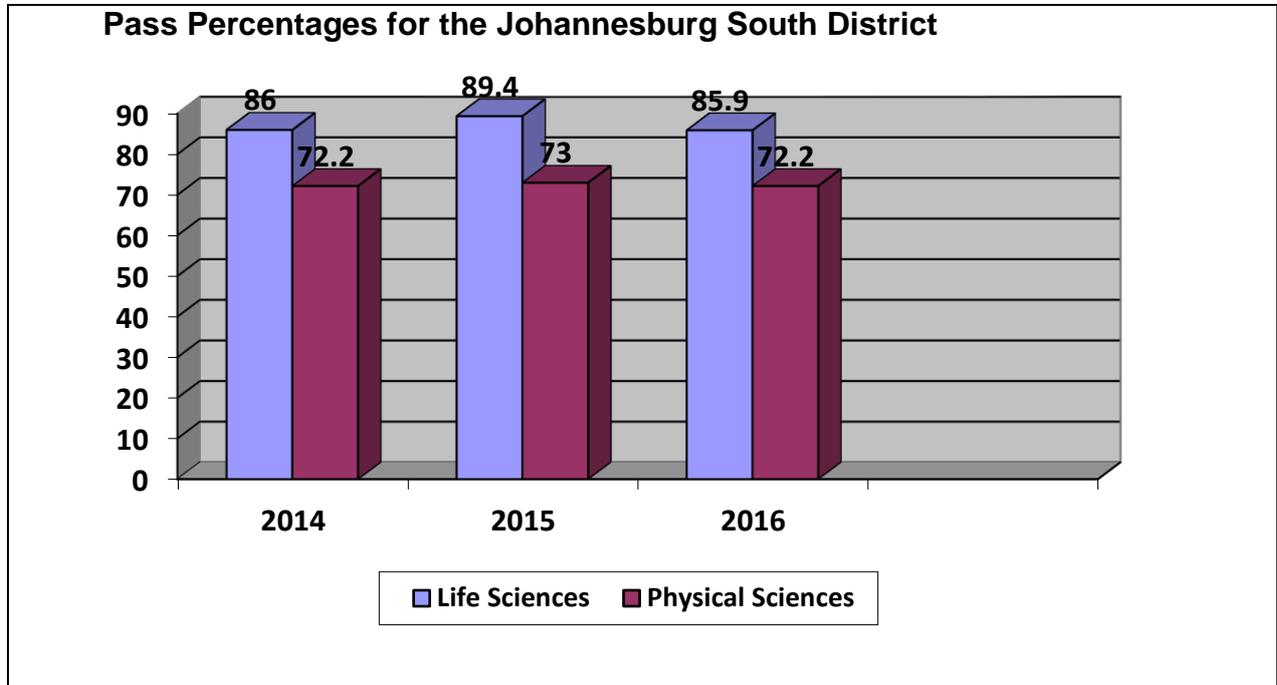
### **E11: The benefits of quality assurance processes are long term**

All the respondents agreed that the benefits of quality assurance processes were long term. The interview respondents also agreed with this statement as indicated by Alice:

*“Historically our results used to be poor but because of the systematic way of quality assurance introduced by the Department our results have been steadily increasing year after year.*

*“Yes of course educators understand the importance of quality delivery at schools. I can safely say that our quality assurance practices have helped to improve the quality of science education in our district.”*

The results suggest that the consistently high pass rates, i.e. above national pass rates in both Life Sciences and Physical Sciences, in the district are linked to the quality assurance practices that had been taking place in the district for some time.



**Figure 5.18 Johannesburg South results analysis**

Figure 5.20 shows that the Johannesburg South district has maintained high overall pass rates in both Life Sciences and Physical sciences over a three-year period from 2014 to 2016. Life Sciences had percentages consistently above 85% and in 2015 the district had the highest percentage (89.37%) in Life Sciences in Gauteng and the whole country. Physical Sciences over the three-year period maintained pass rates above 70%, which was above the national average pass rate.

*“In order to uphold quality standards at the matric exit level the South African question papers were benchmarked and comparable in standards to some of the best international assessment bodies, viz. the Scottish Qualification Authority, the Cambridge International Examinations, and the Board of Studies New South Wales” (Motshekga, 2013).*

It can be concluded that the improvement in quality passes in Johannesburg South are credible since the standards of question papers used are comparable to international standards, according to the Minister of Basic Education.

### Drivers based on Pivot tables

All possible combinations of pivot tables from E1 to E11 were analysed. The strongest positive drivers identified were the E5 and E8 pair, which is presented in Table 5.20. The second strongest positive driver was E8, E9 pair and is shown in Table 5.21 below.

**Table 5.20 Strongest positive drivers E5 vs E8**

	Count of Gender	E8 The district officials/inspection teams provide guidance and support following the school visits		
		Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
<b>E5 IQMS process has helped in improving the quality of science education in the school.</b>	<b>Maybe Yes (4.00)</b>	1	10	11
	<b>Definitely Yes (5.00)</b>	2	52	54
	<b>Grand Total</b>	<b>3</b>	<b>62</b>	<b>65</b>

Table 5.20 shows that the strongest positive drivers were between the E5, E8 pair. The educators who viewed that IQMS processes helped in improving the quality of science education in the schools were 52 out of 54 = 96%. The same 52 educators (52 out of 62 = 84%) also viewed with certainty that the district officials provided guidance and support following their school visits. It can be concluded that district officials' guidance and support in schools especially on IQMS processes has helped to improve the quality of science education in the schools in this study.

**Table 5.21 Second strongest drivers E8 vs E9**

	Count of Gender	E9 The SGB members are involved in enhancing the quality of science education in the school.					
		Definitely No (1.00)	Maybe No (2.00)	No Idea (3.00)	Maybe Yes (4.00)	Definitely Yes (5.00)	Grand Total
<b>E8 The district officials/ inspection teams provide guidance and support following the school visits</b>	Maybe Yes (4.00)			2		1	3
	Definitely Yes (5.00)	2	3	1	7	49	62
	Grand Total	2	3	3	7	50	65

The pivot tables' analysis for section E revealed that item E5 ("IQMS process has helped in improving the quality of science in the school") was the strongest positive driver for the theme on the impact of quality assurance. The second strongest positive drivers for the theme were between E8 ("The district officials/inspection teams provide guidance and support following the school visits") and E9. Forty nine (49 out of 62 = 79%) respondents were definitely positive to E8 and the same 49 (49 out of 50 = 98%) also viewed with certainty that the SGB members were involved in enhancing the quality of science education in their schools. The pivot table therefore suggests that if district officials provide support to schools and work together with SGB members, the quality of science education would be enhanced.

The final section clearly revealed that in the Johannesburg South district the quality assurance processes have impacted positively on the quality of science results. The impact of quality assurance policies and mechanisms have helped positively on the quality of science education in the district and schools in the study. E1 and E2 show that the policies, mechanisms and processes of quality assurance have helped or enhanced the quality of science education. E4 and E5 results suggest that the quality assurance practices, like IQMS and WSE, have helped the schools in improving the quality of educators through support and therefore the quality of results in the schools. E6 to E9 revealed that the district officials and school governing body (SGB) members are also actively involved in enhancing the quality of science through policy formulation, dissemination and follow-up. E3 and E10 suggest that infrastructure development has not materialised through quality assurance. SGB members' recommendations are not taken seriously or implemented by educators and this may

affect the quality of implementation of some quality assurance processes. E11 revealed that the quality assurance processes in place in the district have long-term effects on the quality of science education. The findings in this section are in agreement with the results from qualitative researchers, where educators agreed that generally there is a positive impact. Where quality assurance processes are available and followed thoroughly then quality results are obtained.

#### **5.4.7 INFERENCEAL STATISTICS**

The main objective of inferential statistics was to determine the main quality assurance drivers of quality passes within the quality assurance context. In this study the following inferential steps were done: identification of strongest drivers per theme using pivot tables; univariate Gini statistics to measure the uniformity of distribution of the strongest drivers; multivariate analysis of variables satisfying univariate analysis; stepwise regression analysis to select a combination of quality assurance variables that strive to give optimal quality science passes.

##### **5.4.7.1 Univariate Gini statistics analysis**

Individual variables were explored using a measure of statistical dispersion developed by Gini (1936), called the Gini coefficient. The higher the coefficient value, the higher the ability of predicting the target variable. Migut, Jakubowski and Stout (2013) suggest that coefficients below 5 may be excluded. In this study, however, a cut-off of 4 was used due to the limited covariates used. The covariates that passed the Gini statistics were assessed for proportional hazard (PH) assumption where the graphs obtained resulted in parallel lines as the predictors were proportional. One target variable was chosen for analysis, which was the quality pass rates in Life Sciences for 2016. These were matched against the strongest variables identified using pivot tables. The results are shown below.

**Table 5.22 Univariate Gini statistics analysis**

Variable*e	Gini Statistics for Target/Dependent variable (Quality passes)	Accepted
B2	11.22	Yes
C8	8.18	Yes
B10	7.68	Yes
D19	7.35	Yes
D4	7.19	Yes
D24	5.58	Yes
B16	5.36	Yes
D10	4.42	Yes
C24	2.71	No
E5	1.71	No
C16	0.61	No

The Gini statistics value is an indicator that the variable can satisfactorily predict the target variable, which is quality passes in science. All values below 4 are weaker predictors and were therefore discarded for the purposes of analysis.

**5.4.7.2 Multivariate analysis**

Univariate analysis results came up with covariates that could be advanced to multivariate analysis. The multivariate analysis was conducted to select covariates that would satisfy the variance inflation factor (VIF), thus could fit into the final regression model.

**Table 5.24 Multivariate variable values**

_NAME_	B2	B10	B16	C8	C16	C24	D4	D10	D19	D24	E5
B2	1										
B10	0.294097	1									
B16	-0.05637	0.473922	1								
C8	0.147007	0.297172	0.226056	1							
C16	0.029439	0.025776	0.228907	0.066231	1						
C24	0.096106	-0.01181	-0.076	-0.08011	0.206596	1					
D4	0.139272	0.255384	-0.07398	-0.09564	0.219593	0.113291	1				
D10	0.126913	0.141094	0.050768	0.100891	0.020018	0.087946	0.051046	1			
D19	0.211882	0.00875	-0.10855	-0.02796	-0.1291	0.395519	0.150536	0.101788	1		
D24	-0.04196	-0.10419	-0.14958	-0.00293	-0.0046	-0.04553	0.121156	-0.1255	0.128434	1	
E5	0.106668	0.189759	0.290952	0.096792	0.218761	0.114838	0.240588	-0.00628	-0.00107	0.05751	1

All the variables were below 0.4 except B10 vs B16. This shows that the variables were independent and were not influenced by the other variables, therefore the univariate analysis values can be taken as they are.

#### 5.4.7.3 Testing for autocorrelation using variance inflation factor

Multicollinearity among covariates was assessed using the variance inflation factor (VIF). It is recommended that multicollinearity among covariates should be done before conducting the final multivariate regression analysis (Mansfield & Helms, 1982). VIF helped to determine the statistical relationship between the variables that satisfied the multivariate analysis.

**Table 5.25 Variance inflation factors**

Variable	Variance Inflation Factor	Comment
<b>Intercept</b>		<b>Acceptable</b>
B2	1.256486	Yes
C8	1.184017	Yes
B10	1.854579	Yes
D19	1.397816	Yes
D4	1.419507	Yes
D24	1.106169	Yes
B16	1.786603	Yes
D10	1.062234	Yes
C24	1.362433	Yes
E5	1.242804	Yes
C16	1.343793	Yes

Highly correlated covariates have high VIF values and are not favourable for model development, therefore values lying above 5 should be excluded from further analysis (Migut et al., 2013). All the variables were below 5, therefore they were acceptable, meaning that they were not highly correlated, therefore they could all be used in the stepwise regression stage.

**5.4.7.4 Model-building stepwise regression analysis**

Stepwise regression was finally used to obtain subsets of covariates that can fit into a quality science pass rates model with regard to quality assurance. The first step involved manually selecting categories that can be used as baseline instead of using automatic selection. The category combinations with the largest population were used as the baseline for each event as shown in Table 5.26. The second step was the stepwise regression and finally the AIC plot.

**Table 5.26 Quality pass rate model baseline determination**

Variables	B2	C8	B10	D19	D4	D24	B16	D10	COUNT	Priority	Selected
Levels	5	5	5	5	5	5	5	4	6	1	Yes
	5	5	5	5	5	5	5	5	6	1	No
	5	5	5	4	5	5	5	4	4	2	No
	5	5	5	2	5	5	5	4	2	3	No
	5	5	5	2	5	3	5	4	2	3	No
	5	5	5	2	5	4	5	4	2	3	No

The first priority 1 with a count of 6 was selected to be used as the baseline for the model. All the variables except D10 which used a baseline of 5 were used, whereas D10 used a baseline of 4.

**Table 5.27 Stepwise regression - variable importance**

Step	Variables effect entered	DF	Number in model	Score Chi-square	Probability Chi-square P-values
1	D19	4	1	241.8414	0.0001
2	B16	2	2	90.6708	0.0001
3	C8	2	3	69.0022	0.0001
4	D10	3	4	62.8654	0.0001
5	D24	2	5	40.4668	0.0001
6	B2	2	6	26.0688	0.0001
7	D4	2	7	29.5045	0.0001
8	B10	3	8	15.7567	0.0013

Table 5.27 shows that D19 emerged as the most important variable with a chi-square score of 241.84, followed by B16, with a chi-square score of 90.67. All the other covariates were statistically significant as they met the 0.05 significance level. Further

analysis of measures of goodness of fit was done in order to exclude any variables that do not improve the model performance.

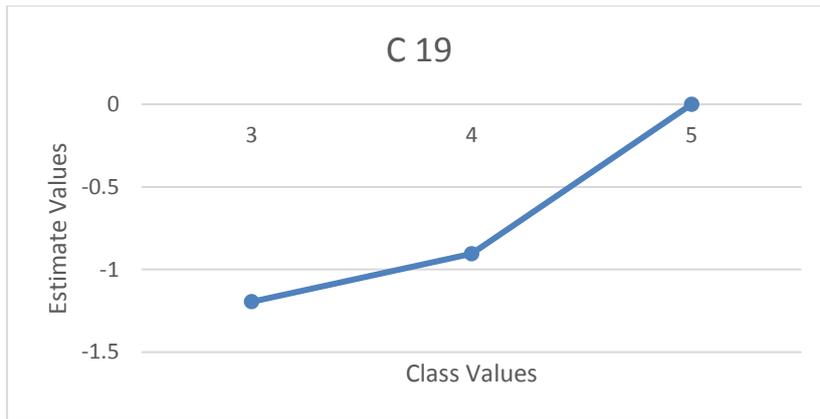
### Quality pass rate model selection criteria

Every step through stepwise regression involved the selection of one of the three models, namely the Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SBC) and -2 Log-likelihood. These are used as goodness of fit measures that compare one model to another. The lower the goodness of fit, the better the model. In this case AIC was used as the best model. All variables added after the graph levelled off did not improve the model performance. In this case D4 and B10 were excluded from further analysis because they levelled off at the point after the 6th step in Table 5.27.

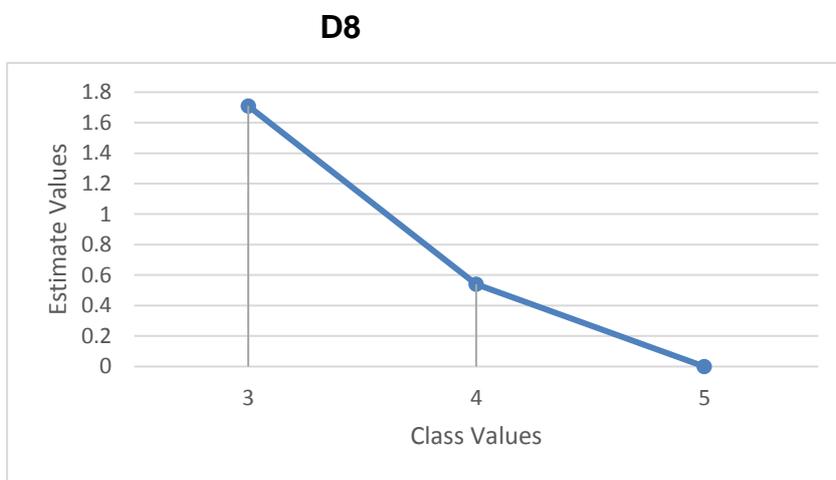
**Table 5.28 Logistic stepwise regression – Quality pass rate model**

Variable	Class Value	DF	Estimate Value	Std Err	Wald Chi-square	Probability Chi-square
Intercept		1	2.367982612	0.076325811	962.5298	0.0000
B2	3	1	2.194838359	0.517045911	18.0197	0.0000
B2 Baseline	5		0			
C8	3	1	1.709637407	0.515267924	11.0088	0.0009
C8	4	1	0.539640618	0.134892327	16.0042	0.0001
C8 Baseline	5		0			
D19	3	1	-1.195199371	0.090337774	175.0419	0.0000
D19	4	1	-0.904962252	0.096842995	87.3222	0.0000
D19 Baseline	5		0			
D24	4	1	-0.365757517	0.092192721	15.7396	0.0001
D24 Baseline	5		0			
B16	4	1	-1.064304204	0.140784519	57.1507	0.0000
B16 Baseline	5		0			

AIC plots for all the remaining variables rendered graphs that do not level off, as shown in Figure 5.19 and 5.20, therefore no covariates were removed based on the AIC selection criterion.



**Figure 5.19 AIC Plot for D19**



**Figure 5.20 AIC plot for D8**

Figures 5.19 and 5.20 show that both curves are smooth and do not level off, therefore the AIC model satisfactorily measures the goodness of fit. Table 5.25 can therefore be presented as it is after excluding D4 and B10 since all the remaining variables satisfied the regression model.

#### **5.4.8 SUMMARY OF INFERENCE STATISTICS**

The themes that were significant and very strong in predicting quality science education with regards to quality assurance are listed below in their order. The model seeks to reveal the variables that can be prioritised when it comes to quality assuring areas that can significantly contribute towards quality passes in Science.

- **ENQUIRY-BASED TEACHING AND LEARNING OF SCIENCE**

D19 (“Do science learners use dialogical interactions, i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon?)”) The enquiry-based teaching and learning of science theme emerged as the most important variable in multivariate analysis and fourth strongest indicator for attainment of quality science results in the univariate analysis. The methodological aspects of teaching and learning should therefore be prioritised and considered essential in all quality assurance developments. Any quality assurance tool to be developed should therefore prioritise the enquiry-based teaching and learning of science.

- **IQMS PROCESSES**

The second most important variable in the multivariate regression was B16: (“Is IQMS done in a free, fair and transparent manner?”). This suggests that the quality assurance processes of IQMS when conducted in a free, fair and transparent manner, can lead to the achievement of quality science passes.

- **QUALITY OF EDUCATORS**

The third most important variable in the multivariate analysis and the second highest Gini coefficient value in univariate analysis of 8.18 was for C8 (“Do the educators manage their classes well and create a good learning environment?”), which became the second strongest predictor for quality science results. This suggests that educators’ classroom management and the creation of a conducive learning environment has a direct impact on the quality of science results. This third theme is of paramount importance in achieving quality science passes.

- **QUALITY ASSURANCE MECHANISMS**

B10 was the fourth most important quality assurance variable under the theme of quality assurance mechanisms. B10 (“Does the school management communicate their intentions of quality assurance to all stakeholders?”) with a univariate Gini value of 7.68, suggesting that the SMT has an important role to communicate with all

stakeholders who are the custodians of quality assurance practices. If all quality assurance mechanisms are put in place and intentions for quality assurance are shared with all stakeholders then quality science passes will be achieved.

- **MOTIVATION AND INFORMAL SCIENCE LEARNING**

The fifth most important variable in the multivariate analysis and sixth in the univariate analysis with a Gini coefficient value of 5.58 was D24 (“Does the school have workshops to motivate the learners?”). The motivation of learners therefore plays a major role in obtaining quality results in science education.

- **QUALITY ASSURANCE POLICIES**

The results show that B2 (“Does the school have any policies regarding quality assurance?”) had the strongest Gini value of 11.22 in univariate analysis, therefore in this study it can be regarded as one of the best quality assurance variables that can predict or influence science results in the schools. This shows that the theme on policies of quality assurance are essential and have the greatest impact on the quality of science results. Quality assurance policies should therefore be readily available. Schools should contribute to developing unique context-based quality assurance policies that will help improving the quality of science education.

- **LTSM AND RESOURCES**

D4 (“Does a lack of resources limit the teaching and learning of science?”) had a Gini value of 7.19 in the univariate analysis. This suggests that if resources or LTSM are quality-assured it may result in resources becoming available and being maintained, thus helping learners achieve quality science results. This variable was only significant in the univariate analysis and not in the multivariate regression analysis.

- **CONTACT TIME AND EDUCATOR WORKLOAD**

In the univariate analysis D10 was the last acceptable value above the cut-off value of 3 (“Do science educators require less periods so as to prepare for practical work or

experiments?”). There is a need to reduce the workload of science educators so that they may have a positive impact on the quality of science results. D10 was, however, not significant in the multivariate analysis.

The following variables C24, E5 and C16 were not significant from the univariate analysis, therefore they could not be analysed further.

## **5.5 CONCLUSION**

Chapter 5 presented the findings of the study from the Johannesburg South district cluster 2. The interview data, documents and questionnaire data were all analysed concurrently and presented. The schools that participated in the study had a lot of good practices in terms of quality assurance procedures according to prescribed policies. All the schools used the same type of tools for quality assurance, namely IQMS and WSE. The quality assurance tools that differed were the ones that the HODs were using. Some had extra aspects whereas some HODs did not have any other tools to quality-assure their educators in terms of assessments. Policies were readily available in all the schools and mechanisms to implement them were also available. A number of challenges were identified, such as educator overload, lack of fully equipped laboratories, lack of laboratory technicians/assistants, and lack of full parental support in curriculum issues, among others. The results suggest that the quality assurance mechanisms in place in the district have helped to improve the quality of results in the district. The quality pass rate model developed using stepwise regression in quantitative analysis revealed that quality passes in science were influenced mainly by the following ; Enquiry based teaching and learning, IQMS processes, Quality of educators, Quality assurance mechanisms, Motivation and informal science learning, Quality assurance policies, LTSM and resources, Contact time and educator workload respectively.

## **CHAPTER 6**

### **SUMMARY, RECOMMENDATIONS AND CONCLUSIONS**

#### **6.1 INTRODUCTION**

The main focus of this study was to investigate the role of quality assurance in science education and the factors impeding the quality of science education using one South African district in Gauteng. The aim was achieved through the following objectives: to examine what mechanisms have been put in place in the South African education system to instil quality science education; to understand how secondary schools manage quality assurance in science education; to identify the factors that negatively affect the quality of science education in secondary schools; and to explore how quality assurance influences the quality of science education in secondary schools in the Johannesburg South district. The summary of the chapters is given in section 6.2, the findings and answers to the research questions are described in section 6.3; reflections on the research design and methodology are given in section 6.4; recommendations of the study are made in section 6.5; the conclusions drawn in section 6.6 and the limitations of the study are presented in section 6.7.

#### **6.2 SUMMARY OF THE CHAPTERS**

##### **6.2.1 Chapter 1**

The main focus was to identify the gaps in quality assurance in the South African education system. Since quality assurance is relatively new in education there is not much information on the quality assurance of science in public secondary schools. This chapter motivated why there is a need to explore and gain a better understanding of the science quality assurance processes in Johannesburg South. The thrust towards quality science education was investigated as well as the challenges hindering its attainment. The influence of quality assurance mechanisms on science quality was explored. In summary, the chapter covered the introduction, background, problem statement, limitations, delimitations, ethical considerations and chapter organisation. The significance of and the motivation for conducting the study were discussed.

### **6.2.2 Chapter 2**

This chapter concentrated on the reflections of authors and scholars regarding the role of quality assurance in education. The chapter started by conceptualising and explaining the meanings of the terms central to the study, which is quality assurance and quality science education. The chapter also looked at the implementation of quality assurance policies and shortcomings.

### **6.2.3 Chapter 3**

This chapter further reviewed the literature specifically on the challenges faced by science education in a South African context. Particular attention was paid to the steps South Africa has taken towards achieving quality science education as well as the negative factors contributing to poor science results. Quality assurance in science education was also critically examined.

### **6.2.4 Chapter 4**

Chapter 4 described the research design and methodology employed in the study. The motivation for conducting the study was also explained. Population, sampling, sampling techniques, data collection instruments, data analysis and reliability and validity modalities were also discussed. Three approaches were employed in collecting data, namely interviews, questionnaires and viewing of documents.

### **6.2.5 Chapter 5**

Chapter 5 focused on the presentation, analysis and interpretation of the findings. A brief description of the setting and the participants was provided. Participants' responses to interview questions and the questionnaires, as well as their views on the role of quality assurance in the quality of science education, were presented, analysed and interpreted. Chapter 5 was devoted to the interpretation of the data and findings from the surveys. The interpretation of the research findings was discussed in accordance with the specific objectives and theoretical framework.

## **6.2.6 Chapter 7**

Finally Chapter 7 presented a proposed quality assurance framework that would ensure the achievement of quality science education. The proposed framework was based on the literature review as well as empirical evidence from the study.

## **6.3 THE FINDINGS AND RECCOMENDATIONS TO THE RESEARCH QUESTIONS**

The following questions were considered essential to evaluate the role of quality assurances in determining the quality of science teaching and learning in the selected schools:

### **6.3.1 What mechanisms have been put in place in the South African education system to instil quality science education?**

In order to answer the question quality assurance policies, mechanisms and processes were considered in detail. Educators and district officials who are directly or indirectly linked to policy dissemination, monitoring and implementation in science education were purposefully selected. In the schools questionnaires were handed out and at the district interviews were conducted. Furthermore, documents used for quality assurance in the district and from schools were analysed. IQMS was identified as the main quality assurance mechanism in place, including whole-school evaluation (cf. 5.3.2.2). Quality assurance of assessments was also identified from school level to national level (cf. 5.3). Policies emerged as the greatest theme that influences the quality of science results in the schools (cf. 5.3.2.7). The following policy development mechanisms emerged in the study and are summarised as macro level and micro level policy developments. Practices at a smaller scale or micro level have an impact on the overall system and in this study, the overall quality of science education in South Africa.

## **FINDINGS**

### **6.3.1.1 Macro level policy developments**

#### **(i) National and provincial mandates**

The national mandates inform the policies to be in place. These mandates have a direct or indirect impact on education, hence on the quality thereof. The national mandates that inform South African quality assurance systems include the following: National Development Policy (NDP) 2030, Medium Term Strategic Framework (MTSF); Action Plan to 2019: Towards the Realisation of Schooling 2030 and the National Strategy for Learner Attainment (NSLA) Framework. Other national bodies like SAQA and Umalusi are directly linked with basic education and inform quality assurance policies and practices in schools. The district and school officials' planning, implementation and monitoring of CAPS is guided by the National Curriculum Statement Grades R-12 as published in Government Gazette No 34600 of 12 September 2012 (NCS), which comprises: National Curriculum and Assessment Policy Statements for all the approved subjects for Grades R-12 (CAPS); National Protocol for Assessment Grades R-12 (NPA) and National Policy Pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R-12 (N4PR). The quality assurance processes are also guided by the National Policy on Whole-school Evaluation, Government Gazette no 22512 (WSE). The Gauteng provincial government has its mandates that hang on the national mandates and these are referred as the GDE plans, pillars and levers. These include: Transformation, modernisation and reindustrialisation (TMR) 10-pillar plan; five development corridors; GDEs 10 key pillars and reorganisation of schools. All these policy developments have a bearing on the quality assurance practice trajectories introduced by the Department of Education as revealed in this study (cf. 2.4, 5.3.2.2.i, 5.3.2.1, 5.4.3.3).

### **6.3.1.2 Micro level policy developments**

#### **(i) District quality assurance processes**

The districts were placed by the national government to support schools. The district improvement plan (DIP) was developed after collecting and analysing all school improvement plans (SIP and AIPIP). Some of the duties of district support teams entail the monitoring of curriculum coverage, and the quality and quantity of work given by educators in schools. The districts support schools and ensure that both SSE and external WSE are conducted in schools in accordance with the policies of the day. Regarding the quality assurance of assessment there are policies that guide

assessment pre-moderation and post-moderation at school, district, provincial and national levels. The policies and quality assurance policies used at micro level include IQMS, which encompasses whole-school evaluation. The policy on whole-school evaluation covers most areas that require quality assurance in the schools as it consists of nine focus areas (cf. 5.3.2.4, 5.3.2.5.iv).

## **(ii) Schools quality assurance processes**

The schools are identified as the centre for most quality assurance practices that have a direct impact on the quality of science education. The IQMS and WSE policies guide all quality assurance practices in schools. The other processes that ensure quality pedagogy, teaching and learning emanate from assessment quality assurance practices. The HODs in schools played a major role in ensuring that all assessments were quality assured to match standards in place (cf. 5.3.2.1, 5.3.2.5).

## **RECOMMENDATIONS**

- National and provincial mandates should be reviewed being informed from current practices
- Quality assurance practices in education should be guided by national policies at the same time the current practices should also inform the national policies for refinement
- IQMS and WSE should be strictly followed in all schools through district support so as to enhance quality science education.

### **6.3.2 How do secondary schools manage quality assurance in science education?**

The question was answered mainly via questionnaires given to educators and SMT members in the schools as well as interviews with district officials. IQMS processes, assessment practices, HOD management and district monitoring were gathered from questionnaires, interviews and documents. The main areas of quality assurance practices in schools were based on the following: external supervision through WSE; internal school self-evaluation through SSE and IQMS; examinations and tests

(assessment quality assurance, evaluations at school and national level). The management of these quality assurance practices were linked to provincial, district, school and departmental management plans (cf. 5.3.2.2.ii, 5.4.2.3).

## **FINDINGS**

### **6.3.2.1 Provincial management**

The quality assurance directorate of the GDE head office was directly involved in WSE management, where schools were selected based on their criteria. Schools were then selected and informed about external WSE via the district. Provincial examinations were common in science, where provincial moderation was done on assessments. Umalusi emerged as the quality assurance body that ensures that standards are met at various levels of assessment. Provincial assessment teams had a direct impact on the quality of assessments as most final papers written in Physical Sciences and Life Sciences were set at provincial level. The year-end examinations were set nationally and were quality-assured by Umalusi (cf. 5.3.2.2, 5.3.2.5.ii).

### **6.3.2.2 District management**

Senior education specialists (SES) managements from district assessment teams (DAT), subject specialists (facilitators), quality assurance, teacher development support teams, are all involved in the setting up of management plans for schools. The district was actively involved in supporting schools although some areas needed strengthening in order to improve the quality assurance systems in place (cf. 5.3.2.4, 5.3.2.5.iii).

### **6.3.2.3 School management teams (SMTs)**

SMTs see to the smooth running of schools by making sure that ideal conditions for teaching and learning are available through the lens of IQMS, SSE and WSE. The

SMTs are also part of the SAT committees, which ensure policies on assessments are adhered to. Policy dissemination and monitoring are done by the SMTs together with the district officials (cf. 5.3.2.5.ii, 5.3.2.5.iv).

#### **6.3.2.4 School departmental management**

The heads of departments (HODs) at school level have a number of duties that are in line with quality assurance principles. The ultimate goal is ensuring that standards are maintained. Their duties include the following: departmental planning; ensuring effective teaching and learning by educators and learners; coordinating, evaluating and assessing all departmental activities; gathering all information required for reporting from educators to the principal, district officials and stakeholders; quality-assuring all the assessments, whether formal or informal; disseminating information and policies; ensuring implementation and compliance to ensure effective quality teaching and learning; and conducting departmental meetings (cf. 5.3.2.5.ii, 5.3.2.5.iii).

### **RECOMMENDATIONS**

- More standardised provincial assessments in all grades would help improve quality of science education.
- There should be more training for the SMT and HODs on assessment quality assurance.
- Workshops and training on quality teaching and learning focusing on enquiry based teaching and learning in science should be prioritised.

#### **6.3.3 What are the factors impeding the quality of science education in secondary schools?**

It is the researcher's view that quality assurance instruments should be dynamic and context-based. When they are designed the challenges faced by different communities should be taken into consideration. Science education faces unique challenges, therefore it was necessary to investigate some of the factors that impede the attainment of quality science education. The factors discussed below were investigated.

## **FINDINGS**

### **6.3.3.1 Quality of science educators**

The quality of science educators emerged as the second strongest variable that influences the quality of science passes (cf. 5.4.4.1). This study revealed that the science educators employed in all the schools investigated were not a threat to quality science education. The responses showed that most schools have set criteria in selecting educators. This is reassuring as it minimises the chances of hiring poor quality educators. However, the responses show that schools prioritise experience far more than qualifications. This may speak of a lack of qualified science educators, but may also indicate that the criteria implemented by schools are ineffective. It may be true in the long run that experience beats educational qualifications, but effective science training should make better educators (cf. 5.4.4.1).

### **6.3.3.2 Quality of science learners**

This subsection was one of the lowest in terms of agreement levels regarding the questions. Learners who take science subjects are not well informed in terms of their capabilities. Learners choose to do science subjects based on meeting certain requirements and not based on whether they will manage. This has contributed to learners repeating a grade or changing subjects because their overall marks, especially in Mathematics and Physical Sciences, would be low. This may be an important contributory factor to the poor quality of results experienced in some South African schools. Some of the learners do not respect educators or are disobedient to educator instructions. A substantial number of learners do require extrinsic motivation in order to do their work or study hard (cf. 5.3.2.2.vii, 5.3.2.6.ii, 5.4.4.2).

### **6.3.3.3 Laboratories and laboratory assistants/technicians**

The responses showed that schools are not well resourced in terms of both equipment and technicians, with none of the responses being positive. This is very alarming because part of science training requires laboratory work and experiments. The lack

of these surely impedes the success of learners. The respondents further confirmed that the lack of resources limits the success of educators' lesson delivery. The lack of resources also impacts on the style and quality of science education (cf. 5.3.2.2.vi, 5.3.2.6.i, 5.4.3.3, 5.4.5.1).

#### **6.3.3.4 Support systems and learner/teacher support materials (LTSM)**

This section clearly showed that all the schools investigated were under-resourced regarding both infrastructure and laboratory equipment. In all the schools, textbooks were available as well as tablets and smart boards for Grade 12 learners. There was a huge disparity between Grade 12 and the lower grades in all schools regarding information and communications technology (ICT) provisions. There was a general consensus that the limited resources or absence of resources impacts negatively on the quality of science education. There was a view that if science learners are exposed to practical activities more frequently the quality of science education will also improve (cf. 5.3.2.2.v, 5.4.3.3, 5.4.5.1).

#### **6.3.3.5 Contact time and educator workload**

The responses indicated that school science educators are overloaded, lesson periods are packed and content coverage timeframes were not friendly, thus impacting negatively on the quality of their delivery. Science educators were multi-tasking as they needed to prepare for lessons as well as practical activities. Science HODs were also engaged in administrative tasks, which compromised their quality assurance duties (cf. 5.3.2.6.iv, 5.4.5.2).

#### **6.3.3.6 Language in science teaching**

This section revealed that understanding academic language was a challenge to most learners. This could be linked to the previous findings about workload, where educators did not have enough time to prepare a simplified version of the material or to explain

topics more descriptively given the short lesson periods. The responses showed that language has an effect on the outcome, where learners using English as their home language perform better. However, there are indications that not having English as a home language does not give a disadvantage academically. The results further suggested that most learners would benefit from being taught in more than one language or the use of code switching, as this would aid their understanding (cf. 5.4.5.3, 5.3.2.6.iii).

#### **6.3.3.7 Enquiry-based teaching and learning of science**

This theme emerged as the strongest indicator that influences the quality of science education (cf. 5.4.7.1). Lesson plans and WSE reports from the supervisors revealed that practical activities as well as enquiry-based techniques were used extensively by science educators. Educators in the sampled schools actively engaged in enquiry-based teaching, but the views of the majority of educators revealed that learners did not reach the expected levels in enquiry-based learning. However, in some of the schools measures were not in place to assist learners who do not adhere to enquiry-based learning (cf. 5.3.2.2.iv, 5.4.5.4).

#### **6.3.3.8 Science assessment**

This section revealed that assessments given and quality assurance practices are present and followed in the schools involved in the study. The only challenging aspect from the views of the educators was learners not adhering to timeframes for the submission of assignments. The provincial, district and schools assessment teams, as well as Umalusi, are all actively involved in quality-assuring the assessments in schools. Impressive mechanisms and thorough follow-up mechanisms are in place at district and national level. All these point to quality science assessment that can be matched to international standards (cf. 5.3.2.5, 5.4.4.3).

#### **6.3.3.9 Motivation, formal and informal learning of science**

This theme appeared to be significant regarding its impact on the quality of science education (cf. 5.4.7.1). The study revealed that science educators in the schools were

self-motivated as they did extra classes to cover content to be ahead of work schedules, as well as classes for revision or remediation. Workshops were conducted by district officials to motivate both educators and learners. A whole week in 2016 was dedicated by the district director to motivating educators in different learning areas. Schools also invited motivational speakers to motivate the learners, mainly during assembly times.

This responses in this section show that the schools do well in integrating informal learning into the learning programme, and have initiatives to keep learners engaged outside the classroom (cf. 5.3.2.6.v, 5.4.5.5).

## **RECOMMENDATIONS**

- **Parental involvement**

There is a great need to provide the necessary support to parents so that they can support and monitor their children's education. Improving science education requires the implementation of support systems and rigorous follow-up mechanisms for educators, learners, management and all stakeholders. There is a need to train educators in ways they can assist parents in becoming involved in the academic work of their children.

- **Quality of science educators**

The quality of educators should not be compromised. Quality should be linked to the effectiveness of the educators, which lies in teaching quality as opposed to teacher quality. Elements of teaching are more indicative of teacher effectiveness than elements of educators among educators in the study conducted by Perez (2013:iv). Educator content knowledge and learner academic performance have been correlated as educators play a central role in the effective dispensation of the curriculum. There is ample evidence from research showing that learners who are taught by unqualified educators will produce poor results.

- **Quality of science learners**

Learners should be guided to choose science subjects only if they have the potential to do well instead of having them struggle and being unable proceed to institutions of higher education. Those who insist on doing science-related fields should be directed to FET colleges to do practical courses. There is a need for specialist support for learners by therapists and educational psychologists in order to help with discipline, social issues, subject selection etc. so that educators can focus on teaching.

- **Laboratories and laboratory assistants/technicians**

All schools that have laboratories should at least have a science laboratory technician or assistant who takes care of equipment, prepare and sets up practical activities beforehand and clean equipment after practical activities or experiments. The presence of laboratory technicians would relieve the burden of work of science educators.

- **Support systems and learner/teacher support materials (LTSM)**

In order to improve the quality of science education the strengthening of quality assurance in resource management and the provisioning of learner and teacher support materials (LTSM) should be a priority. Laboratories should be well equipped so that learners may become fully involved in enquiry-based learning through laboratory work.

- **Contact time and educator workload**

The science educator's workload should be reduced to allow more time for preparation especially in cases where there are no laboratory technicians. Increasing laboratories, laboratory equipment and labour-saving devices as well as introducing laboratory technicians would decrease the educator overload.

- **Language in science teaching**

Learners should be competent in the language of science instruction to be able to grasp most scientific concepts. Technical and nontechnical terms of science should be taught by science educators in collaboration with language educators like English and Afrikaans, which already have scientific registers in South Africa.

- **Enquiry-based teaching and learning of science**

Educators should be free to explore different teaching styles, at the same time allowing learners to interact with scientific knowledge guided by enquiry-based teaching and learning principles. Science educators should employ all other methods that take into account learner-centred approaches which encourage internally persuasive dialogue by posing authentic questions, follow-up questions that appreciate learner answers, challenging the learners on a suitable level, and giving room for reflection by the learner and/or among learners. Educators should employ scientific debate as a tool to build the essential qualities of a scientific mind and a critical stance.

- **Science assessment**

Quality assurance processes should be more rigorous at school level since most quality assurance processes use only formal assessments and not informal assessments. Science HODs in schools should quality-assure all formal and informal assessments, which include laboratory, practical and experimental work.

- **Motivation of science learners and educators**

Motivation should play an important role in assisting science learners to focus and refocus on their studies. Parents should be holistically involved in the learning experience of their children, which should include parents motivating their children.

- **Formal and informal learning of science**

Educators should give adequate informal tasks to learners and should increase the formal-informal learning experiences of the learners. Quality assurance tools should have sections that include both formal and informal learning experiences offered by schools in science.

#### **6.3.4 How does quality assurance influence the quality of science education in South African secondary schools?**

### **FINDINGS**

Both qualitative and quantitative data revealed that quality assurance practices influence the quality of science education in a number of ways. The study revealed that in the Johannesburg South district the quality assurance processes have improved the quality of science results. Quality assurance policies, mechanisms and processes have made a positive contribution to the quality of science education in the district and schools in this study. The results suggested that quality assurance practices like IQMS, WSE, helped the schools to improve the quality of educators through support and thus the quality of science education in the schools. The district officials and SGB members were involved in enhancing the quality of science education through policy formulation, dissemination and follow-up. However, in some of the schools infrastructure development has not materialised through quality assurance. SGB members' recommendations were not taken seriously by schools and this may have negatively affected the implementation of some quality assurance processes. Finally, the study revealed that the quality assurance processes in place in the district have long-term effects on the quality of science education (cf. 5.4). Quality assurance practice had an influence on inputs, e.g. on the provision of resources as it informs infrastructural development. In Johannesburg South district quality assurance resulted in the provision of infrastructure (cf. 5.5.4 E3, 5.4). Quality assurance furthermore affected instructional processes like pedagogy, the teaching and learning of science, district supervision, assessment processes, SGB functions and parental influence on science education. There was evidence that quality assurance processes had an influence on outputs, products or outcomes, which included improved results, more disciplined

learners, educator development, improved quality of assessments, reaching goals and fulfilling visions (cf. 5.3.2.2.vi, 5.3.2.7, 5.4.5).

## **RECOMMENDATIONS**

- Policy formulation, dissemination and follow-up should be enhanced in all schools in order to have more positive science results.
- Quality assurance policies should target all inputs, processes and outputs that directly or indirectly affect quality of science education.
- Lack of infrastructure should be addressed especially laboratories as they have a direct impact on the quality of science.

## **6.4 REFLECTIONS ON THE THEORETICAL FRAMEWORK, RESEARCH DESIGN AND METHODOLOGY**

### **6.4.1 Theoretical framework: Total quality management (TQM) theory**

The theory of TQM in relation to Deming's fourteen principles was partly revealed in this study. Some of the fourteen principles when modified would provide the guiding principles for educational reformation and reconstruction was the view of a number of educationists (Hayward & Steyn, 2001; Mehrotra, 2010; Cotton, 2001). The TQM principles were shown to help achieve educational aims and objectives (Mehrotra, 2010; Westcott, 2013; cf. 2.2.1). TQM was integrated with the principles of quality management, which are customer focused, total employee involvement, process centred, integrated system, strategic and systematic approach, continual improvement, fact-based decision-making and communications. All these principles were incorporated into this study (cf. 2.2.1.2).

### **6.4.2 Research design and methodology**

The pragmatist ideology was used which promoted a mixed research method. The study attempted to fit together the insights provided by qualitative and quantitative research and this was successfully executed. Pragmatism offers an epistemological

justification and logic that use the combination of methods and ideas that give tentative answers to research questions for mixing the approaches. This mixed methods research considered multiple viewpoints, perspectives, positions and standpoints regarding qualitative and quantitative research. The merging of the qualitative and quantitative aspects was not a major challenge as their results concurred and corroborated each other in many areas.

## **6.5 CONCLUSIONS FROM THE RESEARCH**

In order to investigate the role of quality assurance in science education and the factors impeding the quality of science education it was necessary to look into the details of the mechanisms in place, management by district and schools, factors impeding quality science and finally the influence of quality assurance processes on the quality of science education.

### **6.5.1 Mechanisms in place to instil quality science education**

The policies put in place by the South African Department of Education favours quality assurance at different levels, namely departmental level (HOD), school level (deputy principals/principals), district level (senior education specialists) and national level (head office and Umalusi). In this study policies emerged as a variable that had the greatest impact on the quality of science education.

### **6.5.2 Management of quality assurance in science education**

Quality assurance was managed at different levels, including provincial, district and school level. The management of the quality assurance processes enhanced the quality of science education to a greater extent in the district. Quality assurance processes were managed well at school, district and provincial levels.

### **6.5.3 Factors impeding the quality of science education**

The following factors emerged as impeding the quality of science education: the absence of a comprehensive quality assurance system focusing on science education; a lack of laboratories; unavailability of laboratory technicians; learners who learn science in a language they are not proficient in; absence of policy enforcing collaboration of formal and informal science learning (5.3.2, 5.4.3, 5.4.4).

### **6.5.4 Influence of quality assurance on the quality of science education**

Both qualitative and quantitative data revealed that quality assurance practices influence the quality of science education in a number of ways. The study revealed that in the Johannesburg South district the quality assurance processes have impacted positively on the quality of science results, quality of educators and quality of assessments. Quality assurance policies and mechanisms have helped positively to improve the quality of science education in the district and schools in this study. Quality assurance practices, however, did not influence infrastructural resource provisioning in some of the schools in this study (cf. 5.3.2.2.vi, 5.3.2.7, 5.4.5).

## **6.6 THE LIMITATIONS OF THE STUDY**

The research study consisted of a small sample seen from the qualitative research angle. Purposeful sampling was used to select deputy principals, science educators and district officials for both interviews and questionnaire responses. The respondents were chosen based on their willingness to participate, expertise and experience in quality assurance practices at school and district level. The research study sought the perspective of participants who are the quality assurance implementers in the schools. The research was purposefully limited to the Johannesburg South district in the Gauteng province.

## **6.7 SUGGESTIONS FOR AREAS OF FURTHER RESEARCH**

- Further research could be conducted on the impact of quality assurance on instructional and infrastructural resources. This should include the essence of

quality assurance in educational administration and ways to enhance the effectiveness of the learning and teaching environment by monitoring and evaluating all aspects of teaching and learning.

- The same study can be conducted at a national level to gain a clearer picture of the impact of quality assurance processes on the quality of science education.
- A study could be conducted on how school partnership with parents and communities can enhance quality assurance processes.

## **6.8 CONCLUSION**

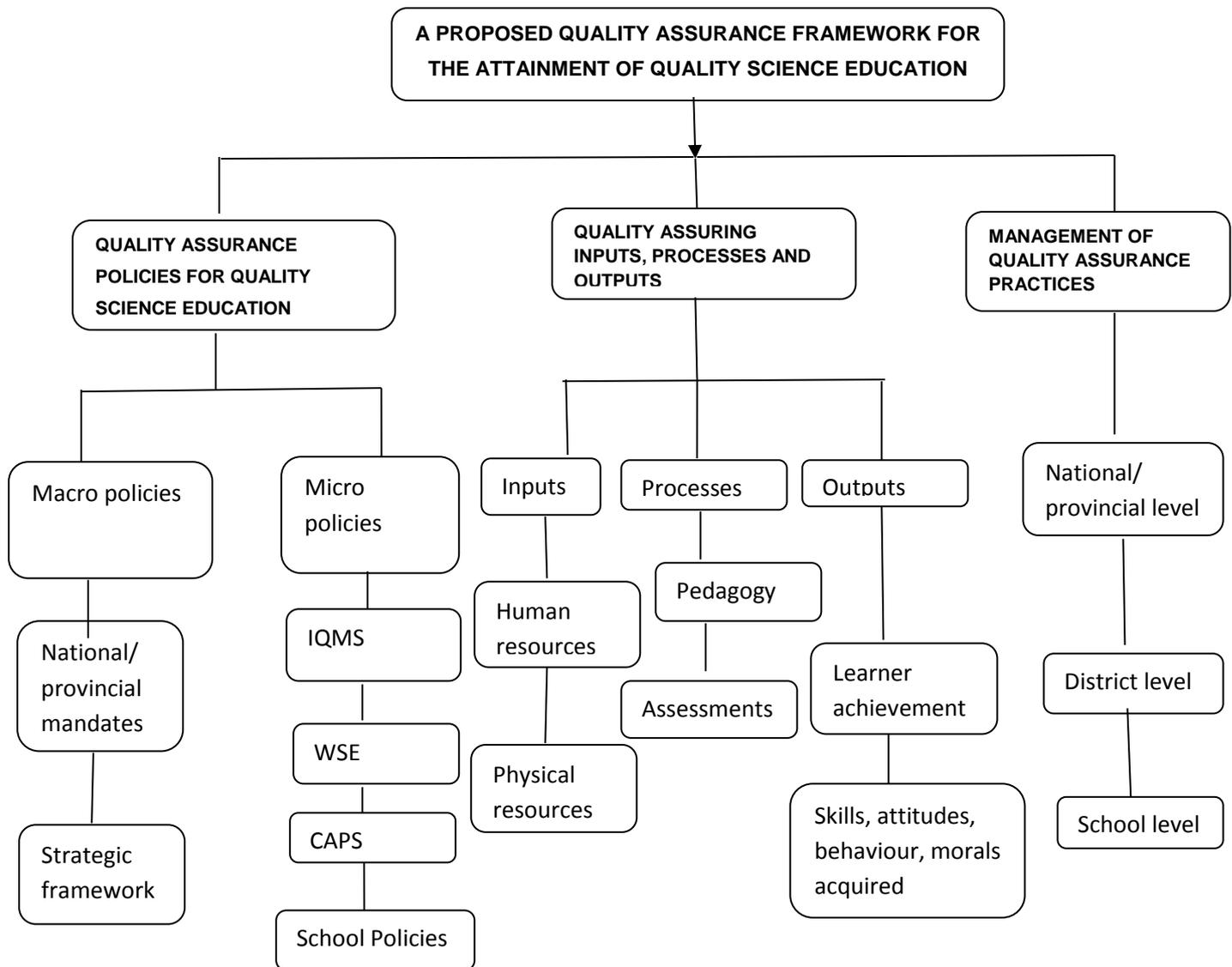
This chapter summarised the findings from both literature search and empirical evidence where the impact of quality assurance practices has been studied. The sub-questions were presented in such a way that the findings and recommendations were laid out clearly in accordance with the objective of the study. Following from the literature review and empirical studies, the next chapter proposes a quality assurance framework that ensures the achievement of quality science education in South Africa.

# **CHAPTER 7**

## **A PROPOSED QUALITY ASSURANCE FRAMEWORK FOR THE ATTAINMENT OF QUALITY SCIENCE EDUCATION**

### **7.1 INTRODUCTION**

Chapter 6 focused on the summary, findings and recommendations emanating from both the literature study and the empirical investigation. This chapter formulates and proposes a quality assurance framework for science education that may be used by quality assurance bodies, the Department of Education, provinces, districts and schools in different districts. The proposed quality assurance framework can be used by quality assurance bodies and all stakeholders that are concerned with science education and its impact. Results from literature and both qualitative and quantitative research were merged to come up with the proposed framework Figure 7.1 summarises the proposed framework, the detailed proposals of which are explained in the rest of the chapter.



**Figure 7.1 A proposed quality assurance framework for the attainment of quality science education**

## **7.2 QUALITY ASSURANCE POLICIES FOR QUALITY SCIENCE EDUCATION**

This doctoral study regarding a quality assurance framework proposes that any quality assurance practice in education should be done in consultation with national mandates, provincial mandates and strategic frameworks at macro levels. The policies that are implemented at the ground level or in the schools in this study are referred to as micro level policies.

## **7.2.1 Macro level policy mandates and frameworks**

### **7.2.1.1 National mandates**

Every nation has goals and mandates that strive to move the country in a certain agreed upon trajectory. The first mandate to be considered when developing the quality assurance framework should be the Constitution of South Africa, 1996 (Act 108 of 1996). This constitutional mandate requires education to be transformed and democratised in accordance with the values of human dignity, equality, human rights and freedom, non-racism and non-sexism. It guarantees basic education for all, since everyone has the right to basic education. Education is one of the wheels that drive a country in a direction that can make the citizens productive or non-productive. In the South African context the other national mandates are the NDP 2030; Medium Term Strategic Framework (MTSF) and Action Plan to 2019: Towards the realisation of schooling 2013 (cf. 3.5.2).

### **7.2.1.2 Provincial mandates**

Schools are located in different provinces and the needs of these provinces differ depending on a number of factors like the availability of resources, financial status etc. Provincial and sectorial mandates should therefore be considered in order to have balanced quality assurance mechanisms that are context-bound. Gauteng as a unique province has its mandates hanging on GDE plans, pillars and levers, which include the following: Transformation, Modernisation and Reindustrialisation (TMR) 10-pillar plan; five development corridors; Gauteng Department of Education's 10 key pillars; and the Reorganisation of Schools (ROS) (cf. 3.5.2).

### **7.2.1.3 Strategic frameworks**

The current medium-term strategic framework (MTSF) of the Department of Basic Education speaks to quality assurance areas that need to be in place. The proposed framework in this thesis takes cognisance of the following six MTSF sub-outcomes:

Improved quality teaching and learning through development, supply and effective utilisation of educators; improved quality teaching and learning through the provision of adequate, quality infrastructure and LTSM; improving assessment for learning to ensure quality and efficiency in academic achievement; expanded access to ECD and improvement of the quality of Grade R, with support for pre-Grade R provision; strengthening accountability and improving management at school, community and district level; partnerships for educational reform and improved quality. The quality assurance tools proposed in this study should incorporate the MTSF sub-outcomes listed above (cf. 3.5.3.2).

## **7.2.2 Micro level quality assurance policies**

### **7.2.2.1 IQMS**

The integrated quality management system in South Africa has been at the helm of quality assurance in schools inclusive of its three programmes, PM, DA and WSE. IQMS needs to be more rigorous and become more specific to the science education areas since it is one area that determines the availability of science-oriented professionals for the country. Effective quality assurance mechanisms require the setting of standards both externally and internally in the schools while involving all stakeholders, who include educators, learners, parents and communities. There should be a shift from prescribing standards by consulting widely so that schools come up with unique standards that suit the school's contextual factors. The standards accordingly should inform all inputs, processes and output/outcomes of the school. In this way accountability will fall upon all stakeholders who designed and set the standards and therefore likelihood of success is greater (cf. 2.3.2, 5.3.2.1, 5.4.3).

### **7.2.2.2 WSE**

The quality assurance processes in South Africa should be guided by the National Policy on Whole School Evaluation, Government Gazette no 22512 (WSE). Whole-school evaluation should evaluate the overall effectiveness of a school as well as the quality of teaching and learning in the schools. This quality assurance initiative should measure the work of individual educators for developmental purposes. WSE should be

an effective monitoring and evaluation process that is vital to the improvement of the quality and standards of performance in schools. All key indicators in quality assurance should be covered in the WSE policy of South Africa. Some key indicators are the following: quality learning environments; quality content; what learners gain; processes that support quality; and outcomes from the learning environment. WSE should help in the identification of the area that requires support, therefore it should act as a tool that strengthens accountability and assists schools to become more functional, leading to improved quality (cf. 2.11, 5.3.2.2, 5.4.3).

### **7.2.2.3 NCS and CAPS**

The quality assurance of assessments in the sciences learning areas in South Africa should be guided by the NCS and CAPS policy. The planning, implementation and monitoring of CAPS by district and school officials are guided by the National Curriculum Statement Grades R-12 as published in the Government Gazette No 34600 of 12 September 2012 (NCS) which comprises the following: National Curriculum and Assessment Policy Statements for all the approved subjects for Grades R-12 (CAPS); National Protocol for Assessment Grades R-12 (NPA) and National Policy Pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R-12 (N4PR) (cf. 3.5.2.7)

### **7.2.2.4 School quality assurance policy developments**

The success of any policy is determined by the people who receive and implement it. The learners, educators, parents and SGBs should all be involved in the formulation of the quality assurance of the different areas especially at school level. It is the view of the researcher that, when policies are developed by the stakeholders who will implement them, it becomes easier for them to accept and implement their own context-based policies. All quality assurance policies developed at micro level should also inform and interact with policies developed at macro level (cf. 2.5.2).

### **7.3 QUALITY ASSURING INPUTS, PROCESSES AND OUTPUTS**

This doctoral study proposes that quality assurance processes and mechanisms should quality-assure specific areas holistically. A number of indicators can be used to quality-assure schools, which include: learning resource inputs; instructional process; educators' capacities development; effective management; monitoring and evaluation; and quality learning outcome, among others. The areas to quality-assure that emerged in this study included all related educational inputs, educational processes and educational outputs. It is the view of the researcher that if all science education inputs, processes and outputs are quality-assured at different phases, then there would be movement towards quality science education (cf. 3.6).

#### **7.3.1 Human resource inputs**

##### **7.3.1.1 Educators**

Highly qualified and well-trained science educators should be sought by schools in order to enhance quality science education. In the South African context this should be guided by the Employment of Educators Act, 76 of 1998; South African Council of Educators Act, 31 of 2000 (SACE); the Education Labour Relations Council (ELRC), which contains the legislative framework regulating the operations of education in South Africa; and the South African Schools Act, no. 84 of 1996 (SASA), which defines educator appointments. Quality science educators should fulfil their purpose of simplifying the subject matter so that it can be accessible to learners (cf. 3.6.1.1). They should enhance an internally persuasive dialogue by posing authentic questions, follow-up questions that appreciate learner answers, challenge the learner on a suitable level, and give room for reflection by the learner and/or among learners. Educators should employ scientific debate as a tool to build the essential qualities of a scientific mind and a critical stance. Questioning of misconceptions through building hypotheses which can be tested via investigations should be included in the quality assurance tools (cf. 3.6.1.1).

### **7.3.1.2 Laboratory technicians**

The science educator's workload should be reduced to allow more time for preparation especially in cases where there are no laboratory technicians. Increasing laboratories, laboratory equipment and labour-saving devices as well as introducing laboratory technicians would decrease educator overload. In the proposed framework all schools that have laboratories should at least have a science laboratory technician or assistant who takes care of equipment, prepares and sets up practical activities beforehand and cleans equipment after practical activities or experiments (cf.3.6.1.3).

### **7.3.1.3 Educator assistants needed to reduce educator workload**

Due to the overwhelming sense that educators are overburdened with paperwork and laboratory work for science educators it would be ideal that educator assistants be employed in schools in order to help educators concentrate on delivering content and engaging in enquiry-based teaching and learning activities. Science educators in the schools studied were overloaded, lesson periods were packed, and content coverage timeframes were not friendly, which impacted negatively on the quality of their delivery. Science educators were multi-tasking as they needed to prepare for lessons as well as practical activities. Science HODs were also engaged in administrative duties, which compromised their quality assurance duties (cf. 3.6.1.3, 3.6.1.5).

## **7.3.2 Physical and support resource inputs**

### **7.3.2.1 LTSM**

In order to improve the quality of science education resource management and the provision of learner and teacher support materials (LTSM) need to be strengthened. A learner support system should encompass a range of activities, which complement the mass product learning materials such as the electronic support subsystem, published material and contact or face-to face support mechanisms. Learner support should include any form of help, assistance and guidance given to learners who experience barriers to learning to enable them to overcome their barriers. The support offered should be of a low intensive, moderate or high intensive level depending on the needs

of the learners. Learner/teacher support materials (LTSM) include all teaching and learning aids such as chalkboards, posters, charts, audiotapes, projectors, computers and textbooks. Learner support should include all activities that enhance the capacity of a school to cater for diversity and ensure effective learning and teaching for all learners (cf. 3.6.1.4, 5.4.5.1).

### **7.3.2.2 Infrastructure**

Effective quality science education can be achieved if schools ensure that all science-related school infrastructure is maintained and become fully equipped. A perfect climate conducive to the teaching and learning of science is created when infrastructure like laboratories is built, maintained and well equipped. The provision of such infrastructural resources should be accompanied by the corresponding quality assurance tools that will help to maintain minimum standards and improve where necessary. Educators can improve their teaching styles and enhance the performance of learners through laboratory work like experiments and practical activities (cf. 5.4.5.4). In the absence of these, science laboratory kits should become mandatory (cf. 3.6.1.3).

### **7.3.2.3 Laboratories and laboratory resources/equipment**

In order for teaching and learning to become more positive, interesting, varied and more effective there should be frequent and selective use of resources. The study further showed that the reason for the inability to teach science practically was that some educators could not operate certain apparatus that was already in the schools. Resource increases in schools should be accompanied by appropriate training on the part of educators so that they would be able to operate all science equipment and use chemical resources appropriately to enhance learning, thus improving results in science. Effective and rigorous quality assurance mechanisms and tools should be used by school management, HODs and supervisors (cf. 3.6.1.3).

### **7.3.3 Pedagogical and instructional processes for quality science education**

#### **7.3.3.1 Enquiry-based teaching and learning**

Educators should be free to explore different teaching styles while at the same time allow learners to interact with scientific knowledge guided by enquiry-based teaching and learning principles. Quality teaching and learning should entail the use of multiple methods informed by contextual factors. Educators should be rated based on different teaching techniques and methodologies used as informed by the type of assessment tasks that will be given to learners (cf. 3.6.2.2, 5.4.5.4).

#### **7.3.3.2 Laboratory work, experiments**

Educators should plan practical activities in such a way that they overcome even the language barrier in science learning and can assist second or third language learners of the language used in instruction. If learners are engaged in well-planned, organised and highly specific practical activities, they will understand scientific concepts much better. Since scientific enquiry and the nature of science play an important role in the teaching and learning of science, educators should incorporate activities aimed at sparking debates about scientific concepts (cf. 3.6.2.2).

#### **7.3.3.3 Language of science teaching and learning**

The language of teaching and learning has an effect on the achievement of learners in science. Learners using English as their home language perform better when examinations are set in the same language. Most learners in South Africa would achieve quality results if they became fluent in the language of teaching and learning. Learners may also benefit if taught in more than one language or when code switching is used by educators (cf. 3.6.2.1).

#### **7.3.3.4 Motivation**

Motivation plays an important role in assisting science learners to focus and refocus on their studies. Motivation of both learners and educators boosts their morale and

satisfaction, therefore a move towards quality education. The provinces, districts and schools should engage in professional motivation sessions for both educators and learners in order to help them refocus on their duties, roles, expectations and goals in the global education system (cf. 3.6.2.4).

#### **7.3.3.5 Informal and formal learning of science**

Schools should integrate formal and informal learning experiences. They should quality-assure the learning programme and have initiatives to keep learners engaged outside the classroom. Learning science in an informal environment offers a structured form of learning as it is accompanied by excitement, remembrance, exploration, participation and self-identification. Informal science education and learning should take place in many different places and through a wide variety of ways like film, broadcast media, science centres, museums, zoos, aquariums, botanical gardens, nature centres, gaming and science journalism. The proposed quality assurance framework should include the extent to which informal science learning is incorporated into the teaching and learning of science (cf. 3.6.2.5).

#### **7.3.3.6 Science assessments**

Quality assessment should be central to good teaching. It is inevitably a key component in learning environments that facilitate learners' understanding of the science content. Since assessment plays a key role in the teaching and learning of science, it is important that science educators understand and use high quality assessment processes. Assessment should be carried out to support learning. There should be less emphasis on other purposes of assessment that include the following: educator content monitoring; grouping learners to make teaching and learning more manageable; selecting learners for particular purposes, determining how effective a teacher or a school is; deciding on the allocation of additional or scarce resources; and to judging how well a region, nation or educational system is performing. In order to achieve high quality science education, the focus should be on prioritising the learners' learning and assessments that support learning above other assessments. To be valid an assessment should match the purpose or aim of the activities being assessed and the outcomes of the assessment should match the same purposes or aims. Effective

assessments in science education should encompass a variety of types of assessment for learning (cf. 3.6.2.3). This study therefore proposes that the quality assurance tools should rate whether assessments are supporting learners' learning through matching goals, purposes and aims with the proposed outcomes.

### **7.3.4 Towards quality output**

#### **7.3.4.1 Quality of science learners**

The focus of quality assurance should also be shifted to the quality of learners enrolled in the science subjects. The learners should be capable learners, self-motivated and willing to be part of an enquiry-based learning class. Learners as products of the system should realise how important their role is in the education system in terms of working together with all stakeholders to achieve common goals. Learners play a pivotal role in order the achievement of quality results, hence at the entry point of the educational system learners should be expected to be of high quality in terms of morals and meeting the expected standard of the level or class in which they are to be enrolled for an academic purpose (cf. 3.6.1.2). Quality assurance can be used to help redirect learners to different learning areas that they are passionate about and capable of achieving. There is a need of transparency and being realistic about their options. Parents and learners need to take informed decisions in terms of subject selection from GET into FET level. Such data-backed decisions would reduce learners who repeat and change subjects in certain grades and ultimately the quality of science education would improve (cf. 3.6.1.2).

#### **7.3.4.2 Learner achievement**

Learner achievement should not solely depend on the final pass percentages in different learning areas but should also consider all areas of skills, attitudes and morals that can be used to enhance communities and the world as a whole. Extra-curricular activities should be given priority in all schools and learners who excel in these areas should be rewarded and nurtured towards the realisation of these fields. It is the view of this researcher that all learners should be taught at least one technical subject that will equip them with skills to be used in adult life instead of only academic subjects.

Quality assurance tools should then quality-assure all these areas and criteria for learner achievement should be modified based on technical skills, values, attitudes, sport etc. gained in the course of their secondary schooling (cf. 2.11.6).

#### **7.3.4.3 Parents' involvement in quality assurance**

The South African Schools Act 84 of 1996 (SASA) stipulates that parents are equal partners in education. In order to improve the quality of education in schools, parents should be involved in both governance and academic policy issues. In academic issues parents should assist learners with homework, motivate learners to participate in extramural activities and guide them in behaviour and social interactions. Parental involvement in teaching helps learners with improved self-esteem, attendance and social behaviour, among other things. Educators should be trained in how to involve the parents in ways to support their children's learning and strive for healthy and active relationships with parents in order to achieve quality science education. Corresponding quality assurance tools should be designed in order to rate schools on how parents enhance the quality of science education (cf. 2.11.9, 2.12).

#### **7.3.4.4 SGB on quality issues**

The SGB as one of the stakeholders in the education system in South Africa, should have a direct say in the formulation of quality assurance policies and mechanisms. The South African Schools Act 84 of 1996 (SASA) encourages a collaborative relationship between the SGB, parents, the school and the principal to provide quality education. The Act stipulates that schools must have a governing body that is representative of all stakeholders in keeping with the policy of democratic governance and the commitment to include parents as equal partners in education (cf. 2.12).

#### **7.3.4.5 Skills, attitudes, behaviour, morals acquired**

Quality science learners should be able to reflect on science processes, have an interest in knowing how the scientific phenomenon works, fully observe the phenomenon, make hypotheses, reason and verify phenomena through empirical

investigation. When attained these skills can be used later in all areas of life and not only to pursue different scientific careers.

## **7.4 MANAGEMENT OF QUALITY ASSURANCE PRACTICES**

### **7.4.1 Provincial level**

#### **7.4.1.1 Provincial WSE**

The quality assurance directorate from the education head office should be directly involved in WSE management. Schools should be selected based on certain criteria like choosing poorly performing schools as well as those performing above the rest. In South Africa the Office for Standards in Education (OFSTED) is an external evaluation institution linked to the Department of Education and responsible for evaluating the performance of schools as part of WSE. The supervisors should be personnel who have experience within the education system, preferably principals and subject specialists who are well versed in curriculum matters, supervision, policy, governance issues etc. The current supervisors of WSE are former principals and deputy principals who are familiar with the nine focus areas.

#### **7.4.1.2 Provincial moderation**

The quality assurance of assessment should include the pre-moderation and post-moderation of assessment to ensure that standards are met. Provincial examinations were common in science, where provincial moderation was done on assessments. Umalusi emerged as the quality assurance body that ensures standards are met at various levels of assessment. Provincial assessment teams (PAT) had a direct impact on the quality of assessments as most final papers written in Physical Sciences and Life Sciences were set at provincial level. The teams should ensure the implementation of policy and regulations to counter the abuse of assessment as a means of exclusion. PAT should ensure that assessment is based on CAPS principles. The implementation of the assessment policy and guidelines facilitate multi-level and multi-functional assessment practices and sound assessment practices that are fair, valid and reliable at provincial level (cf. 2.8.1.1).

## **7.4.2 District level**

### **7.4.2.1 IQMS and WSE implementation**

The system currently being implemented is called the Integrated Quality Management System (IQMS). District officials should be involved in SSE as part of the internal school team evaluation. Subject specialists from the districts can be used to evaluate schools, monitor educators' performance and support educators in their work. Developmental appraisal should appraise individual educators in a transparent manner with a view to determining areas of strengths and weaknesses that can be used to draw up programmes for individual development. Performance measurement (PM) should evaluate individual educators for salary progression, grade progression, affirmation of appointments and incentives. Whole-school evaluation (WSE) evaluates the overall effectiveness of a school as well as the quality of teaching and learning. This quality assurance initiative measures the work of individual educators. The district should propose strategies to ensure that IQMS monitors form the district monitor and support schools in all nine focus areas (cf. 2.8.1).

### **7.4.2.2 District and cluster moderation**

The district assessment teams (DATs) should ensure the implementation of assessment policy at district, cluster and school level. This team also ensures the management and monitoring of assessment processes in the district and liaise with the cluster and school assessment teams. DAT should consist of different representatives from curriculum and professional development and support for each phase. These representatives include assessment specialists in science. The chairperson should be a PAT member. There should also be learning area representatives including those for Physical Sciences and Life Sciences. The DAT should ensure that every school is part of a cluster assessment team. DAT should coordinate, monitor, evaluate and ensure the functionality of cluster assessment teams. The implementation of the national and provincial assessment policies is monitored through conducting and performing the moderation processes. Moderation should cover cluster-based continuous assessment records and school-based

continuous assessment records. DAT should also ensure that schools establish school assessment teams (cf. 2.8.1.2). The cluster assessment team (CAT) should ensure the implementation of the assessment policy at school cluster level and ensure the management and monitoring of assessment processes in the clusters. Moderation and quality assurance of assessment should also take place at this level. Standardised cluster question papers may be written at this level because contextual factors may be similar in such instances (cf. 2.8.1.3).

### **7.4.2.3 Support and curriculum management**

District support services rely on school self-evaluations (SSE), school improvement plans (SIP) and external whole-school evaluation reports from supervisory teams. These reports then guide the district support services to implement quality assurance processes in schools to enhance performance. District management improvement is one of the critical focal points, especially in terms of support offered to schools, and there is a need to strengthen monitoring of the curriculum at school level to turn around learner performance (cf. 2.3.6).

## **7.4.3 School level**

### **7.4.3.1 Role of SMT**

The school management teams are responsible for the day-to-day running of the school. The dissemination of quality assurance policies and practices should be done timeously to all educators for implementation. SMTs should also gather the views of the educators as implementers of the quality assurance practices. The schools should have mechanisms that help them formulate quality assurance practices that suit their contextual factors. Policy formulation should not be unidirectional like top to bottom but also bottom to top. When educators feel that they own these policies it becomes easy for them to follow and implement them. The SMT members are also involved in quality assuring assessments and planning the implementation of assessment policies (cf. 2.8.1.4).

### **7.4.3.2 HOD quality assurance**

The head of department ensures that all quality assurance practices are implemented. The HODs are in direct contact with educators and are the first line in the quality assurance process at micro level, therefore the quality assurance tools in schools should be developed through dialogue between the two parties. Since the difference between more and less effective educators lies in teaching quality as opposed to teacher quality, the quality assurance tools should focus more on teaching quality. As educator content knowledge and learner academic performance have been correlated, highly qualified educators should play a central role in the effective dispensation of the curriculum (cf. 2.8.1.4).

### **7.4.3.3 IQMS, WSE and SSE**

Schools should conduct self-school evaluation every year in accordance with policy and this should become the baseline for supervisors' evaluation. The reports generated at the end are evidence-based as the supervisors will require SSE reports and school records, will observe lessons, conduct interviews and analyse questionnaires. The feedback given to schools should assist in introspection regarding their practices (cf. 2.2.2).

## **7.5 CONCLUDING REMARKS**

Quality assurance can be used to enhance the quality of science education in South Africa. The South African policies that promote all quality assurance processes in schools need to be strengthened and become more specific to the different learning areas, especially science, due to the impact it has on the country's economy in the long run. The Integrated Quality Management System (IQMS) is the main quality assurance system currently used in secondary schools in South Africa. The national policy on whole-school evaluation (WSE) is embedded within IQMS and is an instrument that tries to ensure that quality teaching and learning are promoted in schools. The WSE policy aims at improving the overall quality of education, including science education. Science education in South Africa has not reached the standard of most nations in terms of quality passes, and this is attributed to a number of factors

which were discussed in this study. It is the view of the researcher that quality assurance mechanisms can be put in place that are directed towards the attainment of quality science education. A supportive, developmental and stakeholder-bound science-directed quality assurance instrument and tools can be formulated. Such an instrument can be developed from the proposed quality assurance framework for the attainment of quality science education.

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## 9.1 APPENDIX A

### Self-administered questionnaire

**Title:** Towards Quality Science Education through Quality Assurance in South African Secondary Schools

Dear respondent

This questionnaire forms part of my doctoral research for the degree of PhD at the University of South Africa. You have been selected by purposive sampling strategy. Hence, I invite you to take part in this survey.

The questionnaire has been designed in order to gauge the extent to which South Africa is moving towards achieving quality science Education through quality assurance and the factors that impede quality science education. The findings of the study will help to improve quality assurance mechanisms specifically targeted at Science Education and overcome the challenges preventing attainment of quality science education. You are kindly requested to complete this survey questionnaire, comprising 8 sections as honestly and frankly as possible and according to your personal views and experience. No foreseeable risks are associated with the completion of the questionnaire which is for research purposes only. The questionnaire will take approximately 30 minutes to complete.

You are not required to indicate your name or organisation and your anonymity will be ensured; however, indication of your age, gender, occupation position etc. will contribute to a more comprehensive analysis. All information obtained from this questionnaire will be used for research purposes only and will remain confidential. Your participation in this survey is voluntary and you have the right to omit any question if so desired, or to withdraw from answering this survey without penalty at any stage. After the completion of the study, an electronic summary of the findings of the research will be made available to you on request.

Permission to undertake this survey has been granted by Gauteng Department of Education and the Ethics Committee of the College of Education, UNISA. If you have any research-related enquiries, they can be addressed directly to me or my supervisor. My contact details are: 074 263 4037 e-mail: zisanhidan@yahoo.com and my supervisor can be reached at 012 429 2840 Department of Science and Technology, College of Education (CEDU), UNISA, e-mail: motlhat@unisa.ac.za

By completing the questionnaire, you imply that you have agreed to participate in this research.

Please return the completed questionnaire to D Zisanhi before \_\_\_\_\_

**Please indicate your responses by writing the relevant number/ numbers where applicable in the spaces provided for questions A1 to A5**

**SECTION A: BIOGRAPHICAL DATA**

		Your response	OFFICIAL USE ONLY
<b>A</b>	<b>Gender Male=M Female=F</b>		
<b>A 1</b>	My age is between 1: 20-34 2: 35-49 3: 50-65		
<b>A 2</b>	I am currently 1: A PL 1 Science educator 2: A PL 2 Science HOD 3: A PL3 Deputy Principal 4: SGB Member		
<b>A 3</b>	Years of teaching experience/As SGB Member 1: 0-5 2: 6-10 3: 11-20 4: 21-30 5: 30+		
<b>A4</b>	Initial Teacher Qualifications 1: Teaching Certificate 2: Teaching Diploma 3: Three-year Degree 4: Four-year Degree 5: Other 6: N/A		
<b>A5</b>	Subsequent Teacher Qualifications 1: Honours degree 2: Master's degree 3: Administrative certificates 4: Other 5: N/A		

Do you have any other comments that will explain or clarify the above even more?

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## SECTION B: QUALITY ASSURANCE MECHANISMS & POLICIES

*In the following part of the questionnaire, please rate to which extent the following statements applied to circumstances at your school. Tick the appropriate box.*

ITEM	CIRCUMSTANCES	Definitely not	Maybe not	No idea	Maybe yes	Definitely Yes	OFFICIAL USE ONLY
	<b>QUALITY ASSURANCE POLICIES</b>						
B1	Does the school have a clear vision, mission, aims, policies and management structure?						
B2	Does the school have any policies regarding quality assurance?						
B3	Does the school conduct annual self-evaluations (SSE)?						
B4	Are there subject improvement plans (SIP) produced after SSE?						
B5	Do you have subject policies that are customised for the school?						
B6	Do you have authority to review any of the policies you have?						
B7	Do you have meetings to disseminate the policies?						
B8	Are the district officials actively involved in evaluating school implementation of policies?						
	<b>QUALITY ASSURANCE MECHANISMS</b>	Definitely not	Maybe not	No idea	Maybe yes	Definitely Yes	OFFICIAL USE ONLY
B9	Does the principal consult the school management team before finalizing decisions?						
B10	Does the school management communicate their intentions of quality assurance to all stakeholders?						
B11	Does the school have a clear direction in terms of quality assurance processes?						
B12	Are there internal monitoring mechanisms for policy implementation?						
B13	Do HODs disseminate all policies to their educators?						
B14	Do the district officials support and guide the school to attain minimum standards?						
	<b>IQMS PROCESSES</b>	Definitely not	Maybe not	No idea	Maybe yes	Definitely Yes	OFFICIAL USE ONLY

<b>B15</b>	Does the school conduct IQMS as an ongoing process?						
<b>B16</b>	Is IQMS done in a free, fair and transparent manner?						
<b>B17</b>	Are all educators informed on time about the IQMS process?						
<b>B 18</b>	Are there specific parts of the IQMS that are targeted by the school for its particular needs?						
<b>B 19</b>	Do the performance standards in IQMS directly address the quality of teaching and learning?						
<b>B 20</b>	The standards should be reviewed regularly to ensure that the statements are relevant to the current situation of the school						

Do you have any other comments that will explain or clarify the above even more?

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### SECTION C: QUALITY OF SCIENCE IN SCHOOL

*In the following part of the questionnaire, please rate to which extent the following statements apply to the circumstances at your school.*

ITEM	CIRCUMSTANCES	Definitely not	Maybe no	No idea	Maybe yes	Definitely yes	OFFICIAL USE ONLY
	<b>QUALITY OF SCIENCE EDUCATORS</b>						
<b>C1</b>	Are there any set criteria when appointing science educators?						
<b>C2.1</b>	Does the school prioritise experience when appointing science educators?						
<b>C2.2</b>	Does the school prioritise qualifications when appointing science educators?						
<b>C3</b>	Do science educators present quality teaching and learning in class?						
<b>C4</b>	Do science educators have high expectations for their learners?						
<b>C5</b>	Are the educators knowledgeable about the subject/learning areas programmes?						

<b>C6</b>	Do the educators employ appropriate teaching strategies to accommodate all learners?						
<b>C7</b>	Do the educators use teaching resources appropriately?						
<b>C8</b>	Do the educators manage their classes well and create a good learning environment?						
<b>C9</b>	Have the educators any means of evaluating the success of the lesson?						
<b>C10</b>	Does the school provide development initiative for educators?						
	<b>QUALITY OF SCIENCE LEARNERS</b>	<b>Definitely not</b>	<b>Maybe not</b>	<b>No idea</b>	<b>Maybe yes</b>	<b>Definitely Yes</b>	<b>OFFICIAL USE ONLY</b>
<b>C11</b>	Does the school have selection criteria for learners who will take up Science at FET level?						
<b>C12</b>	Do all learners doing Science capable of reaching the expected outcomes?						
<b>C13</b>	Do learners unnecessarily disrupt the educators when teaching?						
<b>C14</b>	Do learners come to class on time and are ready to learn?						
<b>C15</b>	Do all learners respect the educators and accept authority?						
<b>C16</b>	Do learners know what is expected of them in class?						
<b>C17</b>	Do all learners participate during lesson times?						
<b>C18</b>	Is there effective teaching and learning progress in science classes?						
<b>C19</b>	Do the learners require extrinsic motivation to do their work?						
	<b>QUALITY OF ASSESSMENTS</b>	<b>Definitely not</b>	<b>Maybe not</b>	<b>No idea</b>	<b>Maybe yes</b>	<b>Definitely Yes</b>	<b>OFFICIAL USE ONLY</b>
<b>C20</b>	Do the educators assess learners in such a way to makes their teaching to be effective?						
<b>C21</b>	Do educators make good use of homework by giving feedback to learners?						
<b>C22</b>	Are the learners informed on the types and dates of all assessments?						
<b>C23</b>	Do all learners submit their assessment tasks on due dates?						
<b>C24</b>	Are all the tasks given undergoing necessary quality assurance process like pre-moderation and post -moderation?						

<b>C25</b>	Does the school have an active School Assessment Team (SAT)?						
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Do you have any other comments that will explain or clarify the above even more?

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### SECTION D: FACTORS IMPEDING QUALITY SCIENCE EDUCATION

*In the following part of the questionnaire, please rate to which extent the following statements apply to circumstances at your school.*

ITEM	CIRCUMSTANCES	Definitely not	May be no	No idea	Maybe yes	Definitely yes	OFFICIAL USE ONLY
	<b>SUPPORT SYSTEMS &amp; LTSM</b>						
<b>D1</b>	Does the school have well equipped Science Laboratories?						
<b>D2</b>	Are there any laboratory technicians/assistants in the school?						
<b>D3</b>	Is there a need for laboratory technicians in the school?						
<b>D4</b>	Does lack of resources limit teaching and learning of science?						
<b>D5</b>	Does the availability of science laboratory/science kits improve teaching styles and performance of learners in science?						
<b>D6</b>	Do science experiments help learners to improve the quality of science?						
	<b>CONTACT TIME AND EDUCATOR WORKLOAD</b>	Definitely not	Maybe not	No idea	Maybe yes	Definitely Yes	OFFICIAL USE ONLY
<b>D7</b>	Are the lesson periods long enough to cover all prepared daily work by educators?						
<b>D8</b>	Do learners finish all given work during the prescribed period?						
<b>D9</b>	Are educators overwhelmed by administrative paperwork in your school?						
<b>D10</b>	Do science educators require less periods so as to prepare for practical work or experiments?						
<b>D11</b>	Are there any quality assurance mechanisms that check quantity						

	and quality of work given by educators?						
<b>D12</b>	Are the timeframes given for work coverage realistic and attainable?						
	<b>LANGUAGE IN SCIENCE TEACHING AND LEARNING</b>	<b>Definitely not</b>	<b>Maybe not</b>	<b>No idea</b>	<b>Maybe yes</b>	<b>Definitely Yes</b>	<b>OFFICIAL USE ONLY</b>
<b>D13</b>	Learners have limited academic language understanding.						
<b>D14</b>	Learners who underachieve usually their home language is not English.						
<b>D15</b>	Learners have difficulties understanding scientific technical terms.						
<b>D16</b>	Learners find it difficult to listen and understand English due to its phonological/pronunciation system which differs from their home languages.						
<b>D17</b>	Learners understand scientific concepts better if taught in more than one language.						
	<b>ENQUIRY-BASED TEACHING AND LEARNING OF SCIENCE</b>	<b>Definitely not</b>	<b>Maybe not</b>	<b>No idea</b>	<b>Maybe yes</b>	<b>Definitely Yes</b>	<b>OFFICIAL USE ONLY</b>
<b>D18</b>	Do science learners use 'monological' interactions: one-way kind of reasoning (discussions and explanations)?						
<b>D19</b>	Do science learners use dialogical interactions i.e. multiple and contrasting kinds of reasoning (argumentation and questioning phenomenon)?						
<b>D20</b>	Learners experiment with new situations beyond the classroom.						
<b>D21</b>	Educators actively give feedback to learners in communication, accuracy of knowledge, skills and thought process.						
	<b>MOTIVATION AND INFORMAL SCIENCE LEARNING</b>	<b>Definitely not</b>	<b>Maybe not</b>	<b>No idea</b>	<b>Maybe yes</b>	<b>Definitely Yes</b>	<b>OFFICIAL USE ONLY</b>
<b>D22</b>	Does the school have a policy on excursions and integration of formal and informal learning?						
<b>D23</b>	Are the learners always motivated by the stakeholders to study hard?						
<b>D24</b>	Does the school have workshops to motivate the learners?						
<b>D25</b>	Educators are motivated by financial rewards to do extra work						
<b>D26</b>	Does the school have any planned educational excursions?						

<b>D27</b>	Are the lessons planned in such a way that learners are directed to do research on their own?						
<b>D28</b>	Are parents actively involved in their children's learning?						

Do you have any other comments that will explain or clarify the above even more?

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### SECTION E: IMPACT OF QUALITY ASSURANCE ON QUALITY OF SCIENCE EDUCATION

*Please use a tick to indicate your degree of agreement with each statement below. The following has been used **strongly agree, agree, disagree, strongly disagree, not certain** (questions E1 to E11).*

ITEM	STATEMENTS	Strongly Agree	Agree	Disagree	Strongly Disagree	Not Certain	OFFICIAL USE ONLY
<b>E1</b>	Are the policies and mechanisms helping the school to attain its aims?						
<b>E2</b>	Quality assurance processes have enhanced the quality of science in the school.						
<b>E3</b>	Quality assurance processes have led to infrastructure development in the school.						
<b>E4</b>	IQMS has led to professional staff development training.						
<b>E5</b>	IQMS process has helped in improving the quality of science in the school.						
<b>E6</b>	District officials monitoring and supporting programmes have enhanced the quality of science.						
<b>E7</b>	Recommendations from district inspection teams are usually implemented.						
<b>E8</b>	The district officials'/inspection teams provide guidance and support following the school visits.						

<b>E9</b>	The SGB members are involved in enhancing quality of science education in the school.						
<b>E10</b>	Recommendations by the SGB are taken seriously by the educators.						
<b>E11</b>	The benefits of quality assurance processes are long-term.						

Do you have any other comments that will explain or clarify the above even more?

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## 9.2

## APPENDIX B

### 9.2.1 INTERVIEW GUIDE: IQMS DISTRICT OFFICIALS

#### Section A: Information about the respondent

1. Designation \_\_\_\_\_
2. Department/Section \_\_\_\_\_
3. Gender    MALE        FEMALE
4. Age \_\_\_\_\_
5. Highest education level \_\_\_\_\_
6. Date of interview \_\_\_\_\_

#### SECTION B

1. Is there a relationship between quality assurance and quality science education?
2. Were there wide consultations with educators when IQMS was introduced in South Africa?
3. What impact has IQMS had on the quality of education especially in Science?
4. How are the policies in education communicated to the school educators?
5. In terms of quality assurance, what do you regard as your main duties/responsibilities?
6. What do you consider the general purpose of evaluation /staff appraisal to be?
7. What is your understanding of the whole-school evaluation concept?
8. What staff development programmes do you conduct for educators?
9. What do you consider the purpose of the integrated quality management system (IQMS) to be?
10. What were some of the challenges that you were faced with during the whole-school evaluation process?
11. Outline the areas in your district regarding WSE that were considered very strong and weak.
12. In terms of the weaknesses identified, what plans are in place to attend to these?
13. What improvement strategies have been adopted to focus on areas that require attention in school in this district?
14. What suggestions will you offer regarding the IQMS process to improve the quality of Science education?

## 9.2.2 INTERVIEW GUIDE: QUALITY ASSURANCE DISTRICT OFFICIALS

### Section A: Information about the respondent

1. Designation \_\_\_\_\_
2. Department/Section \_\_\_\_\_
3. Gender    MALE        FEMALE
4. Age \_\_\_\_\_
5. Highest Education level \_\_\_\_\_
6. Date of interview \_\_\_\_\_

### SECTION B

- 1 What is the quality assurance mechanism put in place by the Department of Basic Education?
- 2 What exactly do you quality assure (teacher quality, assessment quality, LTSM quality infrastructure)?
- 3 Can you explain further from question 2 above?
- 4 What impact have the quality assurance mechanisms had on the quality of Science education?
- 5 Which policies are in places which ensure that quality assurance is adhered to?
- 6 Which bodies were put in place to quality assure education in secondary schools?
- 7 What are the main duties of these bodies?
- 8 What do you regard as your main duties/responsibilities in terms of assessment quality assurance?
- 9 Who are the implementers of the quality assurance?
- 10 What instruments do you use when checking quality / standards in schools?
- 11 Do you train educators about the quality assurance processes?
- 12 What do you consider the general purpose of quality assurance to be?
- 13 What do you consider to be the purpose of the integrated quality management system (IQMS) to be?
- 14 What are some of the challenges faced by schools with regards to quality assurance and evaluation process?

- 15 In terms of the weaknesses identified, what plans are in place to attend to these?
- 16 What improvement strategies have been adopted to focus on areas that require attention in the schools?
- 17 What suggestions will you offer regarding improving quality of science through quality assurance?

### 9.2.3 INTERVIEW GUIDE: SPECIAL PROJECTS DISTRICT OFFICIALS

#### Section A: Information about the respondent

1. Designation \_\_\_\_\_
2. Department/Section \_\_\_\_\_
3. Gender    MALE        FEMALE
4. Age \_\_\_\_\_
5. Highest education level \_\_\_\_\_
6. Date of interview \_\_\_\_\_

#### SECTION B

1. What are the functions of your department/section?
2. How do you identify areas of need?
3. Which projects are you currently doing to support school education?
4. In terms of SSIP programmes how do you appoint your educators especially in science?
5. How does your quality assure the interventions programmes in schools? Do you have checklist and monitoring tools available?
6. How do you assess the effectiveness of your programmes?
7. Since the introduction of SSIP classes is there an improvement in the quality of passes in science?
8. What are the future plans to further improve the quality and quantity of passes in all grades in science?

## 9.2.4 INTERVIEW GUIDE: SCIENCE FACILITATORS DISTRICT OFFICIAL

### Section A: Information about the respondent

1. Designation \_\_\_\_\_
2. Department/Section \_\_\_\_\_
3. Gender    MALE        FEMALE
4. Age \_\_\_\_\_
5. Highest Education level \_\_\_\_\_
6. Date of interview \_\_\_\_\_

### SECTION B

1. Do you have mechanisms in place to disseminate policies to the schools?
2. How do you assist in maintaining standards in science?
  - 2.1 How often do you workshop the HODs and educators
3. How do you quality assure the work being done by educators in schools?
  - 3.1 Do you have any tools that you use
  - 3.2 Are your recommendations taken seriously and implemented in schools
4. What is the role of UMALUSI in quality assurance especially in science learning areas?
5. How often do you visit schools to monitor the progress and implementation of policies?
  - 5.1 Do you also motivate learners when you visit schools
  - 5.2 How do schools integrate formal and non-formal education
6. Are all science educators informed about the new policies with reference to NCS/CAPS? Do you have workshops planned to train new educators?
7. Are you part of the DAT? If yes do you quality assure all assessments given t learners in schools?
  - 7.1 How do you support school Assessment teams (SAT)
  - 7.2 How do you interact with the Provincial Assessment Teams (PAT)
8. Do all schools comply with policies in science? If not how do you support them?
9. Are the quality assurance policies, practices helping to improve the quality of science education? If so how?
10. What are the challenges that science educators face in schools

- 10.1 Are there enough infrastructure/labs in your schools? If not how important are practical activities and what alternatives are there?
- 10.2 Are laboratory technicians/assistance important at all in schools?
- 10.3 Aren't science educators overwhelmed by practical activities and paperwork in schools?
- 10.4 Are the educators highly qualified and do you assist in appointment of educators
- 10.5 Are all the science learners capable of reaching their goals? If not what are the reasons?
- 10.6 Are the enough resources in terms of LTSM in your schools
- 10.7 Are parents actively involved in their children's learning of science

## 9.2.5 INTERVIEW GUIDE: DEPUTY PRINCIPALS FOR CURRICULUM

### Section A: Information about the respondent

1. Designation \_\_\_\_\_
2. Department/Section \_\_\_\_\_
3. Gender    MALE        FEMALE
4. Age \_\_\_\_\_
5. Highest Education level \_\_\_\_\_
6. Date of interview \_\_\_\_\_

### SECTION B

1. Do you have policies that address quality assurance in schools?
2. Explain the IQMS policy implementation and procedures.
3. Can you take me through Whole School Evaluation processes?
4. Explain how the nine focus areas impact on science education.
5. What are the challenges faced by the schools that impede quality science education.
6. How do you integrate formal and non-formal learning of science?
7. How do you quality assure assessments in your school?
8. What improvement strategies have been adopted to focus on areas that require attention in your schools?
9. What suggestions will you offer regarding improving quality of science through quality assurance?

## 9.3 APPENDIX C

### 9.3.1 SAMPLE TRANSCRIBED INTERVIEWS

#### INTERVIEW GUIDE: IQMS DISTRICT OFFICIAL (DO1.1: Rose)

##### Section A: Information about the respondent

1. Designation: Senior Education Specialist: HR

1 Department/Section: THRS-PMD

2 Gender MALE  FEMALE

3 Age ----yrs.

4 Highest Education level: Advanced SHRM

5 Date of interview: 12 April 2016

##### SECTION B

1. Is there relationship between Quality assurance and quality science education?

“There is a great relation between the two as they both involve verification.”

2. Were there wide consultations with educators when IQMS was introduced in South Africa?

“Yes, there were consultations with educators when IQMS was introduced. We should remember that before IQMS, it was focusing on only on the Performance Appraisal of the educators, but due to research and findings it was made clear that development needs to be holistically and should not only focus on educators hence Whole School stakeholders were also part of the school. This indicated the Whole school also needed development and different focus areas within the school were looked and included in IQMS. Unions were part of the consultation and it was agreed upon. The Advantage of getting the buy in of the unions made it easy for educators to accept the process.”

3. What impact has IQMS had on the quality of education especially in Science?

“IQMS is able to ascertain the gaps in Science and development is aligned to specific areas for science educators. Bursaries are offered for educators to further their studies to uplift the standard of quality in Science. There are areas where educators need to be improved especially when they are not able to teach the correct methods in Science.”

4. How are the policies in education communicated to the school educators?

“Advocacy of policies are very crucial for better understanding by all those who will be involved. This allows educators to be able to raise their concerns and fears regarding

new policies to be implemented by them. Trainings allow educators to understand purposes and the advantage of the transformation.”

5. In terms of quality assurance, what do you regard as your main duties/responsibilities?
  - “My responsibilities as an official are to visit school and monitor quality of IQMS implementation in schools, checking whether the process is of quality and steps followed by all structured involved. If there are gaps in the implementation, as an official I usually assist and give trainings especially on the school development teams and School Management Teams as they are, they should take lead in the implementation of the processes. If educators are developed against their Performance Standards this will yield great improvement in the learner achievement.”
  - “I also receive reports on the development of educators, giving detailed information who was involved developed against the educator’s Personal Growth Plan and the School Improvement Plan.”
  - “Quality should also be able evident in their records i.e. Master Files and educator Personal Files. Checking for development of educators that is consistently done and updated in files. This should also link with their curriculum duties in learning and teaching in the school.”
  
6. What do you consider the general purpose of evaluation /staff appraisal to be?
  - “The main purpose of evaluation is to check whether educator is still on track with the policies of education, is learners improving in their subjects, is the educator able to deliver the subject knowledge to learners correctly.”
  - “If there are gaps in teaching, an educator will be re skilled to improve weaknesses observed by development support group.”
  
7. What is your understanding of the whole-school evaluation concept?

“Whole school evaluation is when school management Teams and relevant stakeholders (Governing Bodies) conduct a SWOT analysis against the nine (9) focus areas of the school. They will be able to improve where their weaknesses are and prioritize development thereof.”
  
8. What staff development programmes do you conduct for educators?

“Our role in Performance Management and Development is developing educators on the interpretation of the policy i.e. Collective Agreement 8 of 2003(IQMS). Specific development is conducted by Teacher Development Unit where they check according to school improvement plan their specific needs on all educators. In-service Training is organized, relating to the specific need of educators, personnel staff, all involved in the school.”
  
9. What do you consider the purpose of the integrated quality management system (IQMS) to be?

“The purpose of the IQMS is mainly to assess strengths and areas of development i.e. weaknesses, assessing the competence of educators in their teaching and learning, promoting accountability by all structures involved and promote institutions effectiveness with the assistance of whole school evaluation.”

9.1 As a follow up question how is IQMS implemented

“There are eleven steps to implement IQMS and twelve steps to conduct performance measurements which I will summarise as

For IQMS implementation Step 1 is electing staff development team,2 advocacy and training of new educators on the IQMS,3 developing implementation plan ,4 self-evaluation by educators 5, selection of development support groups,6 pre-evaluation discussions between educators and development support groups (DSG), 7 conducting baseline evaluation for the new educators, 8 post evaluation meetings, 9developing personal growth plans (PGP) , 10 Submission of PGPs to the DSGs and finally development of the school improvement plan (SIP) which is submitted to us by the schools.

The twelve steps in conducting performance measurements are

- Drawing up timetable for performance measurement
- Pre-evaluation meeting for summative evaluation
- Conducting lesson observation
- Post evaluation meetings and feedback on observations
- Resolution of differences
- Completion of composite score sheets
- Updating of PGPs
- Completion of documents of performance measurements
- Making copies of signed forms ,plans and reports and files
- Submitting original signed document to my office for processing
- Capturing the summative evaluation scores into a composite schedule and submitting it to the provincial office
- Implementation of salary and grade progression.

10. What were some of the challenges that you were faced with during the whole-school evaluation process?

11.

“Educators are afraid to voice out their concerns honestly with the fear of being victimized after the process. Things that are not done correctly during this time they will need to state for the school to progress. Some managers become subjective when educators’ concerns are raised for development purposes.”

12. Outline the areas in your district regarding WSE that were considered very strong and weak.

13.

“My answer will be based on my observation on some schools I have interacted with and this might not mean all school have the common problems.

WSE has 9 Focus Areas of which all need to be consistently maintained improved and revisited from time to time. I think the Basic Functionality Area that deal with amending policies of schools is very weak in some schools, reason being that schools just don’t give themselves time to review timeously their policies and they just comply for the sake of submissions. School Safety and Discipline has been a major problem at schools as educators feel their safety is compromised. One would have instances where learners,

educators are not safe in the school due to the community threats. Some learners within are not well disciplined as a result this impacts greatly on the learning and teaching. Educators find themselves disciplining rather than teaching. The community and parents don't take the lead in this aspect."

"I would consider schools that are strong will be evident in their results of Grade 12 or Annual National Assessment. This implies that the leadership takes a lead in the improvement of learners and results. There is great support from all those involved. Improved results will be maintained and consistently monitored by the district officials."

14. In terms of the weaknesses identified, what plans are in place to attend to these?

"In terms of results dropping in some schools, management have to account on what strategies they will improve learners."

"Policies need to be reviewed and internal whole school evaluation conducted yearly. Everyone i.e. community and parental involvement is improved. Educating the SGB's so that they are able to run their schools smoothly as a result they are well informed."

15. What improvement strategies have been adopted to focus on areas that require attention in school in this district?

- "Learner Achievement through motivational talks by the district has greatly yielded great results in the success of learners."
- "Educator Development Programmes by Teacher Development."
- "School Management Team Development."
- "School Governing Bodies Trained"
- "Task Teams to assist in late coming at schools conducted."
- "Networking i.e. twinning schools to support each other."
- "Continuous monitoring and support by officials to support in relevant subjects."

16. What suggestions will you offer regarding the IQMS process to improve the quality of Science Education?

- "Infrastructure i.e. having science laboratories for improvement of learning and teaching."
- "Educators to be consistently trained on aspects of teaching the subject especially on areas those learners are lacking in."

### 9.3.2 INTERVIEW GUIDE: IQMS DISTRICT OFFICIAL (DO1.2: Jacky)

#### Section A: Information about the respondent

1. Designation: Senior Education Specialist: HR
- 6 Department/Section: THRS-PMD
- 7 Gender MALE  FEMALE
- 8 Age xx yrs.
- 9 Highest Education level: Diploma HRM
- 10 Date of interview: 20 May 2016

#### SECTION B

1. Is there relationship between Quality assurance and quality science education?

“Quality assurance entails the mechanisms in place to maintain standards or to make schools to comply with policy. Quality Science education on the other hand involves good results in science. I believe that quality assurance actually influences the quality of science results .If all quality assurance processes are followed like quality assuring assessments in school even the quality of results will be good.”

2. Were there wide consultations with educators when IQMS was introduced in South Africa?

“Yes, The implementation of IQMS took place in stages was introduced. We should remember that before IQMS, it was focusing on only on the Performance Appraisal of the educators, but due to research and findings it was made clear that development needs to be holistically and should not only focus on educators hence Whole School stakeholders were also part of the school. This indicated the Whole school also needed development and different focus areas within the school were looked and included in IQMS. Unions were part of the consultation and it was agreed upon. The Advantage of getting the buy in of the unions made it easy for educators to accept the process.”

3. What impact has IQMS had on the quality of education especially in Science?

“IQMS is able to ascertain the gaps in Science and development is aligned to specific areas for science educators. Bursaries are offered for educators to further their studies to uplift the standard of quality in Science. There are areas where educators need to be improved especially when they are not able to teach the correct methods in Science.”

4. How are the policies in education communicated to the school educators?

“Advocacy of policies are very crucial for better understanding by all those who will be involved. This allows educators to be able to raise their concerns and fears regarding new policies to be implemented by them. Trainings allow educators to understand purposes and the advantage of the transformation.”

5. In terms of quality assurance, what do you regard as your main duties/responsibilities?

- “My responsibilities as an official are to visit school and monitor quality of IQMS implementation in schools, checking whether the process is of quality and steps followed by all structured involved. If there are gaps in the implementation, as an official I usually assist and give trainings especially on the school development teams and School Management Teams as they are, they should take lead in the implementation of the processes. If educators are developed against their Performance Standards this will yield great improvement in the learner achievement.”
- “I also receive reports on the development of educators, giving detailed information who was involved developed against the educator’s Personal Growth Plan and the School Improvement Plan.”
- “Quality should also be able evident in their records i.e. Master Files and educator Personal Files. Checking for development of educators that is consistently done and updated in files. This should also link with their curriculum duties in learning and teaching in the school.”

6. What do you consider the general purpose of evaluation /staff appraisal to be?

- “The main purpose of evaluation is to check whether educator is still on track with the policies of education, is learners improving in their subjects, is the educator able to deliver the subject knowledge to learners correctly.”
- “If there are gaps in teaching, an educator will be re skilled to improve weaknesses observed by development support group.”

7. What is your understanding of the whole-school evaluation concept?

“Whole school evaluation is when school management Teams and relevant stakeholders (Governing Bodies) conduct a SWOT analysis against the nine (9) focus areas of the school. They will be able to improve where their weaknesses are and prioritize development thereof.”

8. What staff development programmes do you conduct for educators?

“Our role in Performance Management and Development is developing educators on the interpretation of the policy i.e. Collective Agreement 8 of 2003(IQMS). Specific development is conducted by Teacher Development Unit where they check according to school improvement plan their specific needs on all educators. In-service Training is organized, relating to the specific need of educators, personnel staff, all involved in the school.”

9. What do you consider the purpose of the integrated quality management system (IQMS) to be?

“The purpose of the IQMS is mainly to assess strengths and areas of development i.e. weaknesses, assessing the competence of educators in their teaching and learning, promoting accountability by all structures involved and promote institutions effectiveness with the assistance of whole school evaluation.”

- a. As a follow up question how is IQMS implemented
- b.

“There are eleven steps to implement IQMS and twelve steps to conduct performance measurements which I will summarise as follows:

For IQMS implementation Step 1 is electing staff development team, 2 advocacy and training of new educators on the IQMS,3 developing implementation plan ,4 self-evaluation by educators 5, selection of development support groups,6 pre-evaluation discussions between educators and development support groups (DSG), 7 conducting baseline evaluation for the new educators, 8 post evaluation meetings, 9 developing personal growth plans (PGP) , 10 Submission of PGPs to the DSGs and finally development of the school improvement plan (SIP) which is submitted to us by the schools.

The twelve steps in conducting performance measurements are

- Drawing up timetable for performance measurement
- Pre-evaluation meeting for summative evaluation
- Conducting lesson observation
- Post evaluation meetings and feedback on observations
- Resolution of differences
- Completion of composite score sheets
- Updating of PGPs
- Completion of documents of performance measurements
- Making copies of signed forms ,plans and reports and files
- Submitting original signed document to my office for processing
- Capturing the summative evaluation scores into a composite schedule and submitting it to the provincial office
- Implementation of salary and grade progression.

10. What were some of the challenges that you were faced with during the whole-school evaluation process?

“Educators are afraid to voice out their concerns honestly with the fear of being victimized after the process. Things that are not done correctly during this time they will need to state for the school to progress. Some managers become subjective when educators’ concerns are raised for development purposes.”

11. Outline the areas in your district regarding WSE that were considered very strong and weak.

“My answer will be based on my observation on some schools I have interacted with and this might not mean all school have the common problems.

WSE has 9 Focus Areas of which all need to be consistently maintained improved and revisited from time to time. I think the Basic Functionality Area that deal with amending policies of schools is very weak in some schools, reason being that schools just don’t give themselves time to review timeously their policies and they just comply for the sake

of submissions. School Safety and Discipline has been a major problem at schools as educators feel their safety is compromised. One would have instances where learners, educators are not safe in the school due to the community threats. Some learners within are not well disciplined as a result this impacts greatly on the learning and teaching. Educators find themselves disciplining rather than teaching. The community and parents don't take the lead in this aspect."

"I would consider schools that are strong will be evident in their results of Grade 12 or Annual National Assessment. This implies that the leadership takes a lead in the improvement of learners and results. There is great support from all those involved. Improved results will be maintained and consistently monitored by the district officials."

12. In terms of the weaknesses identified, what plans are in place to attend to these?

"In terms of results dropping in some schools, management have to account on what strategies they will improve learners."

"Policies need to be reviewed and internal whole school evaluation conducted yearly. Everyone i.e. community and parental involvement is improved. Educating the SGB's so that they are able to run their schools smoothly as a result they are well informed."

13. What improvement strategies have been adopted to focus on areas that require attention in school in this district?

- "Learner Achievement through motivational Talks by the district has greatly yielded great results in the success of learners."
- "Educator Development Programmes by Teacher Development."
- "School Management Team Development."
- "School Governing Bodies Trained"
- "Task Teams to assist in late coming at schools conducted."
- "Networking i.e. twinning schools to support each other."
- "Continuous monitoring and support by officials to support in relevant subjects."

14. What suggestions will you offer regarding the IQMS process to improve the quality of Science Education?

- "Infrastructure i.e. having science laboratories for improvement of learning and teaching."
- "Educators to be consistently trained on aspects of teaching the subject especially on areas those learners are lacking in."

## 9.4

## APPENDIX D

### (REQUEST LETTERS)

#### 9.4.1 LETTER TO THE DISTRICT DIRECTOR

Enquiries D. Zisanhi  
0742634037  
0837889283  
zisanhidan@yahoo.com

Thyme Close  
Zakariyya Park  
Johannesburg  
1813

5 April 2016

The District Director  
Johannesburg South D11

Dear Sir/Madam

#### **REQUEST: PERMISSION TO CONDUCT ACADEMIC RESEARCH**

My name is Daniel Zisanhi I am doing research with my supervisor, Prof A.T. Motlhabane, an associate professor in the department of Science and Technology towards a PhD in Curriculum Studies at the University of South Africa. I hereby wish to request your permission to conduct research in your District (Johannesburg South D11). The aim of the study is to explore the role of quality assurance in science education and the factors impeding the quality of science education using selected schools.

The district has been chosen because it has shown marked improvement in quality of science and also its notable quality assurance mechanisms. The schools have been purposefully selected due to their quest towards quality science education. Permission has been granted by the Gauteng department of education. The study aims to explore the role of quality assurance in science education and the factors impeding the quality of science education using selected schools at presenting steps taken by the district and schools. This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of Science quality assurance mechanisms.

All information obtained from the district and schools will be held in strict confidence before destroying it after five years. The participants in this survey will remain anonymous and there are no potential risks in this study. A copy of the final document will be made available to the Gauteng Department of Education and to the district upon request.

The research will take place during formal schooling hours preferably during the extra mural activity time. Interviews, documents and questionnaires will be used to collect data. The data will be used solely to compile the dissertation for the Doctoral study with specialization in Curriculum Studies. The dissertation will therefore be read by examiners and the academic community. The findings will also be used for publication in academic journals and for presentation at academic conferences.

I will follow the University of South Africa research ethics regulations and will use the information for the purposes of this study only. Participation is voluntary; participants may withdraw their participation at any stage during the research process, prior to the reporting of the findings for the project.

Also note that your name, the name of your institution and other participants' names will be withheld in the reporting of the data. No information shared will be disclosed to members of staff at the University in a way that will allow them to identify the name of the institution which participated in the research. As such, confidentiality and anonymity will be guaranteed. If you will agree to participate in this research, please sign this letter as a declaration of your consent.

PARTICIPANT (DISTRICT DIRECTOR)	.....
SIGNATURE:	.....
DATE:	.....
RESEARCHER'S SIGNATURE:	.....
DATE:	.....

Furthermore, to collect research data it is sometimes necessary to use a voice recorder so that no important information is lost before it can be captured and reported. Again, these recordings will only be used for the purpose of this research and not for any other purposes. If you agree to the use of such devices during the research in your district offices and schools, please sign the second acknowledgement of your consent to the use of these recorders below:

PARTICIPANT (DISTRICT DIRECTOR)	.....
SIGNATURE :	.....

DATE : .....  
RESEARCHER'S SIGNATURE : .....  
DATE: .....

Should you have any questions about the research and/or the contents of this letter, please do not hesitate to contact me for further information.

Thanking you for your kind consideration of the above.

Kind regards

Daniel Zisanhi

## 9.4.2

## LETTER TO SCHOOL PRINCIPALS

Enquiries D Zisanhi  
Cell: 074 263 4037  
074 63 4037  
zisanhidan@yahoo.co

Thyme Close  
Zakariyya Park Ext 4  
Johannesburg  
1813

14 April 2016

The Principal \_\_\_\_\_

Dear Sir/Madam

### Re: PERMISSION TO CONDUCT ACADEMIC RESEARCH

My name is Daniel Zisanhi I am doing research with my supervisor, Prof A.T. Motlhabane, an associate professor in the department of Science and Technology towards a PhD in Curriculum Studies at the University of South Africa.

I hereby wish to request your permission to conduct research in your school. The aim of the study is to explore the role of quality assurance in science education and the factors impeding the quality of science education using selected schools.

This exploratory study aims to add to the literature by building rich descriptions of complex situations, to give directions for future research and to increase understanding of Science quality assurance can be used to improve quality of science. It aims to make recommendations for educational and community-based strategies which can be implemented nationally and internationally.

Your school has been purposefully selected because it has shown marked improvement in quality of science and also the notable quality assurance mechanisms in the school. Science educators and Science HODs / Deputy Principals and SGB members will also be requested to participate in the research by completing the questionnaire and provide documents based on Quality assurance mechanisms for science in schools or participate in an interview.

I undertake to ensure strict confidentiality with the information collected and all respondents will remain anonymous. A copy of the report would be made available to the department of Education and also made available to the school.

The research will take place during formal schooling hours preferably during the extra mural activity time. Interviews, documents and questionnaires will be used to collect data. The data will be used solely to compile the thesis for the PHD study with specialization in Curriculum Studies. The dissertation will therefore be read by examiners and the academic community. The findings will also be used for publication in academic journals and for presentation at academic conferences.

I will follow the University of South Africa research ethics regulations and will use the information for the purposes of this study only. Participation is voluntary; participants may

withdraw their participation at any stage during the research process, prior to the reporting of the findings for the project.

Also note that your name, the name of your institution and other participants' names will be withheld in the reporting of the data. No information shared will be disclosed to members of staff at the University in a way that will allow them to identify the name of the institution which participated in the research. As such, confidentiality and anonymity will be guaranteed. If you will agree to participate in this research, please sign this letter as a declaration of your consent.

PARTICIPANT (PRINCIPAL)	.....
SIGNATURE:	.....
DATE:	.....
RESEARCHER'S SIGNATURE:	.....
DATE:	.....

Furthermore, to collect research data it is sometimes necessary to use a voice recorder so that no important information is lost before it can be captured and reported. Again, these recordings will only be used for the purpose of this research and not for any other purposes. If you agree to the use of such devices during the research process at your school, please sign the second acknowledgement of your consent to the use of these recorders below:

PARTICIPANT' (PRINCIPAL)	.....
SIGNATURE:	.....
DATE:	.....
RESEARCHER'S SIGNATURE:	.....
DATE:	.....

Should you have any questions about the research and/ or the contents of this letter, please do not hesitate to contact me for further information.

I trust this will be given your kind consideration and time.

Kind regards

Daniel Zisanhi



### 9.4.3 LETTER TO RESEARCH PARTICIPANTS

Thyme Close  
Zakariyya Park Ext 4  
Johannesburg  
1813  
11 April 2016

Dear Research Participant

This letter is an invitation to consider participating in a study I, Daniel Zisanhi am conducting as part of my research as a doctoral student entitled Towards Quality Science Education through Quality Assurance in South African Secondary Schools at the University of South Africa. Permission for the study has been given by the Gauteng Department of Education and the Ethics Committee of the College of Education, UNISA. I have purposefully identified you as a possible participant because of your valuable experience and expertise related to my research topic. The study aims to explore the role of quality assurance in science education and the factors impeding the quality of science education using selected schools.

I would like to provide you with more information about this project and what your involvement would entail if you should agree to take part. The importance of quality assurance in education is substantial and well documented. In this interview I would like to have your views and opinions on this topic. This information can be used to improve quality assurance mechanisms specifically targeted at Science Education.

Your participation in this study is voluntary. It will involve an interview of approximately 30 minutes in length to take place in a mutually agreed upon location at a time convenient to you. You may decline to answer any of the interview questions if you so wish. Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

With your kind permission, the interview will be audio-recorded to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or to clarify any points. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collected during this study will be retained on a password protected computer for 5 years in my locked office. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at 074 2634037 or by e-mail at zisanhidan@yahoo.com. I look forward to speaking with you very much and thank you in advance for your assistance in this project. If you accept my invitation to participate, I will request you to sign the consent form which follows below.

Yours sincerely

Daniel Zisanhi

**9.4.4 CONSENT FORM**

I have read the information presented in the information letter about the study entitled Towards Quality Science Education through Quality Assurance in South African Secondary Schools. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and add any additional details I wanted. I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am also aware that excerpts from the interview may be included in publications to come from this research, with the understanding that the quotations will be anonymous. I was informed that I may withdraw my consent at any time without penalty by advising the researcher. With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Participant's Name/Code (Please print): \_\_\_\_\_

Participant's signature: \_\_\_\_\_

Researcher's name: \_\_\_\_\_

Researcher's signature: \_\_\_\_\_

Date: \_\_\_\_\_

## GDE APPROVAL LETTER



GAUTENG PROVINCE

EDUCATION  
REPUBLIC OF SOUTH AFRICA

For administrative use only:  
Reference no: D2016 / 445  
enquiries: Diane Bunting 011 843 6503

## GDE RESEARCH APPROVAL LETTER

Date:	31 March 2016
Validity of Research Approval:	31 March 2016 to 30 September 2016
Name of Researcher:	Zisanhi D.
Address of Researcher:	995 Thyme close; Zakariyya Park; Extension 4; Johannesburg; 1813
Telephone / Fax Number/s:	083 788 5684; 074 263 4037
Email address:	zisanhidan@yahoo.com
Research Topic:	Towards quality Science education through quality assurance in South African Secondary Schools.
Number and type of schools:	TWO Secondary schools
District/s/HO	Johannesburg South

**Re: Approval in Respect of Request to Conduct Research**

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved. A separate copy of this letter must be presented to the Principal, SGB and the relevant District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted. However participation is VOLUNTARY.

The following conditions apply to GDE research. The researcher has agreed to and may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

***CONDITIONS FOR CONDUCTING RESEARCH IN GDE***

1. The District/Head Office Senior Manager/s concerned, the Principal/s and the chairperson/s of the School Governing Body (SGB.) must be presented with a copy of this letter.
2. The Researcher will make every effort to obtain the goodwill and co-operation of the GDE District officials, principals, SGBs, teachers, parents and learners involved. Participation is voluntary and additional remuneration will not be paid;

*Handwritten signature*  
2016/03/31

1

3. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal and/or Director must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
4. Research may only commence from the second week of February and must be concluded by the end of the THIRD quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
5. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
6. It is the researcher's responsibility to obtain written consent from the SGB/s; principal/s, educator/s, parents and learners, as applicable, before commencing with research.
7. The researcher is responsible for supplying and utilizing his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institution/s, staff and/or the office/s visited for supplying such resources.
8. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research title, report or summary.
9. On completion of the study the researcher must supply the Director: Education Research and Knowledge Management, with electronic copies of the Research Report, Thesis, Dissertation as well as a Research Summary (on the GDE Summary template). Failure to submit your Research Report, Thesis, Dissertation and Research Summary on completion of your studies / project – a month after graduation or project completion - may result in permission being withheld from you and your Supervisor in future.
10. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned;
11. Should the researcher have been involved with research at a school and/or a district/head office level, the Director/s and school/s concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards



.....  
**Dr David Makhado**

**Director: Education Research and Knowledge Management**

DATE: 2016/03/31  
 .....

## ETHICS CLEARANCE CERTIFICATE



## COLLEGE OF EDUCATION RESEARCH ETHICS REVIEW COMMITTEE

17 February 2016

Ref : 2016/02/17/46285873/41/MC

Student : Mr D Zisanhi

Student Number : 46285873

Dear Mr D Zisanhi

**Decision: Ethics Approval****Researcher**

Mr D Zisanhi  
Tel: 074 263 4037  
Email: [46285873@mylife.unisa.ac.za](mailto:46285873@mylife.unisa.ac.za)

**Supervisor**

Prof AT Motlhabane  
College of Education  
Department of Science and Technology Education  
Tel: 012 429 2840  
Email: [motlhat@unisa.ac.za](mailto:motlhat@unisa.ac.za)

**Proposal:** Towards quality science education through quality assurance in South African secondary schools

**Qualification:** D Ed in Curriculum and Instructional Studies

Thank you for the application for research ethics clearance by the College of Education Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the research.

*The application was reviewed in compliance with the Unisa Policy on Research Ethics by the College of Education Research Ethics Review Committee on 17 February 2016.*

*The proposed research may now commence with the proviso that:*

- 1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
- 2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the College of Education Ethics Review Committee.*

*An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for*



University of South Africa  
Preller Street, Muckleneuk Ridge, City of Tshwane  
PO Box 392 UNISA 0003 South Africa  
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150  
[www.unisa.ac.za](http://www.unisa.ac.za)

the research participants.

- 3) The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.

Note:

The reference number **2016/02/17/46285873/41/MC** should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the College of Education RERC.

Kind regards,



**Dr M Claassens**  
**CHAIRPERSON: CEDU RERC**  
[mcdtc@netactive.co.za](mailto:mcdtc@netactive.co.za)



**Prof VI McKay**  
**EXECUTIVE DEAN**

LANGUAGE AND TECHNICAL EDITING LETTER

***Emmerentia Steyn***

**Text-editor & Translator**

APEd, APTrans (SATI)

Cell: 083 515 7978

E-mail: [steyne@mweb.co.za](mailto:steyne@mweb.co.za)

---

I hereby declare that I text-edited the DEd thesis, *Towards quality science education through quality assurance in the Johannesburg South district: South Africa*, by Daniel Zisanhi.



E STEYN

SATI number 1000023

22 December 2017