An investigation of the quality of FET Physical Sciences formative assessments from selected schools in South Africa

BY

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I certify that Mr. Thabang Daniel Molise (Student: 965124) prepared this dissertation at the University of the Witwatersrand, under my supervision, and that it has been examined and approved as meeting the required level of scholarship for the fulfilment of the degree of Master's in Education.

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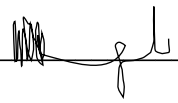
Signature: 

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DEDICATION

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ABSTRACT

Formative assessments are increasingly considered as an integral part of the teaching and learning process, because of their perceived ability to improve learners' academic achievement. Formative assessments are used to monitor learners' progress and are envisaged to promote the teaching and learning process. Because of the perceived effectiveness of formative assessments in improving the teaching and learning process, researchers have advocated for their frequent use in classrooms. If formative assessments are as important as perceived by stakeholders, then their quality should be ascertained to ensure that they achieve their intended goal. Unfortunately, most institutions tasked with the responsibility of monitoring the development and implementations of formative assessments in schools tend to focus mainly on determining learner performance on the assessments, and rarely evaluate their quality. In South Africa, formative assessments, commonly referred to as School Based Assessments (SBAs) are designed by both educators and the department of education and are administered by educators in schools. Assessment records in South Africa indicate that the performance of Further Education and Training (FET) Physical sciences learners in SBAs has been unsatisfactory since the adoption of the Curriculum and Assessment Policy Statement (CAPS). The quality of these assessments could partly account for the observed poor learner performance as they might not be measuring what they are intended to measure. This study used a qualitative multiple case study design to investigate the quality of Physical sciences formative assessments in selected South African schools, and the factors that influence educators' choices of formative assessment items. The critical Formative Assessments (FA) components framework (Herman, Osmundson & Silver, 2010) guided the study. The sample comprised of nine FET Physical sciences formative assessment past papers, administered to Grades 10 to 12 learners in 2019 and three Physical sciences educators. Data were collected using both document analysis and semi-structured interviews and the findings show that most of the analysed formative assessments are of low quality, and that educators rarely considered assessment quality indicators when designing formative assessments. We therefore recommend the training of Physical sciences educators in designing quality formative assessments.

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Chapter 1: INTRODUCTION

1.1. Introduction of the study

Formative assessments are increasingly considered as an integral part of the teaching and learning process. The notion of formative assessment, also known as assessment for learning, has become a subject of debate at educational conferences, government policy discussions and school-based deliberations in relation to their design, use and effectiveness in enhancing the teaching and learning processes (Department of Education: DoE, 2008). According to McManus, (2008, p.3), "Formative assessment is a process used by educators and learners to provide feedback during instruction, in order to adjust ongoing teaching and learning, and to improve learners' achievement, as intended by instructional outcomes". In line with this understanding of formative assessments, Shepard (2020) stated that Physical sciences formative assessments should not only be used to provide grades or to satisfy accountability demands of an external authority. He indicated that they should rather be used as part of instruction to support and enhance teaching and learning in schools, in order to improve learners' level of understanding, as well as to enable them to think critically and innovatively. Furthermore, William (2011), pointed out that formative assessments are aimed at answering the questions; "Is learning on track? What needs to change? Where does learning go next?" (p. 5). According to this author, the response to these questions could enable an educator to determine the extent to which learning, and teaching would be effective.

The ability of these assessments to improve learners' academic achievement is touted by both researchers and educators (Hanover researchers, 2014). For instance, Shepard (2020) stated that formative assessments can be used as a part of instruction, to support and enhance learning. In this respect, Hanover Researchers (2014) argued that learners who receive quality formative assessments perform better on a variety of achievement indicators than their peers. Regarding the teaching of Physical sciences, Nicol (2009), indicated that formative assessment and feedback on Physical sciences should be used to enhance the knowledge of learners, and to enable them to develop the skills needed for self-regulated learning. Because of the perceived effectiveness of formative assessments in improving learning, researchers have advocated for its frequent use in classrooms.

If formative assessments are as important as perceived by the authors stated above, then their quality should be ascertained to achieve effective education, as suggested by several researchers (Nicol, 2009; Shepard, 2020). Unfortunately, most institutions, which are tasked to monitor the development and implementations of formative assessments in schools, tend to focus mainly on

determining learner performance on the assessments, without looking at the quality of these formative assessments. For instance, in South Africa, education districts and curriculum assessment departments who are tasked to support and monitor formative assessments in Physical sciences rarely evaluate the quality of these assessments.

The quality of assessments could be measured by determining their; validity (Gardner, 2006), authenticity (Wiggins, 1998), the cognitive levels at which assessment items are pitched (Bezuidenhout & Alt, 2011), and their ability to meet the objectives of the CAPS document (DBoE, 2012-2014). For the purpose of this study, the term objectives represent the expected outcomes of the teaching and learning process. While there are numerous measures of assessment quality, the scope of this study does not allow an investigation of all the quality measures. As a result, only a few measures of quality assessments were investigated in this study. Specifically, the study was an endeavour to evaluate the quality of FET Physical Science formative assessments from selected schools in Gauteng, in relation to their; validity, authenticity, the cognitive levels at which assessment items are pitched, and their alignment to the CAPS objectives. In addition, factors that influence educators' choices of formative assessment tasks were explored.

1.2. Background of the study

The South African Department of Basic Education advocates for and prescribes the implementation of formative assessments in its educational policy documents. For instance, the CAPS (DBoE, 2011) and the National Protocol for assessment Grades R – 12 (DBoE, 2012-2014) recommend the setting and conducting of formative assessments for learning subjects such as Physical sciences. The purpose and objective of these two policy documents is to assist education districts and schools to meet the minimum requirements, standards and procedures for setting quality formative assessments for learners. These objectives are reiterated by ideas from recent documents circulated by different educational institutions such as the Formative Assessment for educators and learners (FAST) (McManusn 2008), National Protocol for assessment Grades R – 12 (DBoE, 2012-2014), State Collaborative on Assessment, and Student Standards (SCASS) (McManus, 2008) of the Council of Chief State School Officers (McManus, 2008). These institutions are meant to assist the South African Department of Education in making judgements about learners' performance in formative assessments (McManus, 2008).

In South Africa, formative assessments, commonly referred to as School Based Assessments (SBAs), are designed by both educators and the department of education, and they are administered by educators at schools. These assessments are envisaged to continually assess

learner's knowledge and skills, in order to adjust instructional practices and to enhance their learning. The measurement of learner achievement prescribed by the described documents consists of level descriptions that are meant to assist educators to grade learners at the correct level (*National Protocol for assessment Grades R – 12:* DoE, 2012-2014). Educators at all levels and in different subject areas, including Physical sciences, are expected to set quality formative assessments, and to record and report on learners' performance on these formative assessments, using achievement descriptors (e.g. 0 – 29 %, not achieved and 80 – 100 %, outstanding achievement (*National Protocol for assessment Grades R – 12:* DoE, 2012-2014). These descriptors are meant to ascertain, among other things, compliance and alignment with the assessment policy of the CAPS document, when developing formative assessments. In short, these documents are meant to ascertain the quality of formative assessments administered in schools.

The implementation of the assessment policy of the CAPS document in schools needs to be supported, monitored and evaluated, to determine its effectiveness. In this regard, (Diko, Haupt and Molefe, 2011) pointed out that it is the responsibility of education districts and curriculum assessment departments to support and monitor the administration of SBA in schools, in order to ensure their quality and alignment with the objectives of the CAPS document. The need to support and monitor the setting and implementation of formative assessments is meant to ascertain the quality of these assessments in schools, and to ensure their alignment with CAPS objectives. For this study, the phrases; 'formative assessment' and 'school-based assessments (SBAs)' are used interchangeably.

Despite the monitoring of SBAs processes by the Department of education and Department of curriculum and assessment, assessment records indicate that the performance of FET Physical sciences learners in SBAs has been unsatisfactory since the adoption of the CAPS. For example, the performances of Physical sciences learners in formative assessments, from 2018 to 2020, ranged from 56.5% to 61.09 % (District driven data, 2020). Even though these percentages seem to indicate a slight improvement in subsequent years, the highest percentage of 61.09% in grade 12 is still very low. This is concerning as this poor performance might suggest inadequacies in the design of the assessments and in their effectiveness in enhancing learner performance. This study investigated the quality of physical sciences formative assessments administered during the second term of 2019 only, due to the limited scope of the study and time, as well as resources constraints.

1.3. Problem statement

The performance of Physical sciences learners in formative assessment has been declared poor by the Department of Basic Education in South Africa (DBE, 2019). This poor performance of learners in formative assessments had been reported for many years. Denman and Al-Mahrooqi, (2018) stated that the outcomes of assessments must be beneficial and should act both to foster learning and to motivate learners. Therefore, if learners are consistently performing poorly in formative assessments, it could mean that these assessments might not be performing their role of fostering learning and motivating learners.

Many factors could affect the performance of learners in SBAs, including the quality of formative assessments, lack of training of Physical sciences educators in the development of quality formative assessments tasks, lack of alignment of formative assessments with the CAPS assessment objectives, and many others (NEEDU, 2018). Regrettably, learners exposed to poor quality assessments are not likely to benefit from them. Bransford and Donovan (2005) indicated that quality assessments are central for good teaching, and they are an inevitable key component in a learning environment that facilitates learners' learning with understanding. In addition, Hanover Researchers (2014) argued that learners who receive quality formative assessment perform better on a variety of achievement indicators than their peers. Therefore, high quality formative assessments are necessary for improved learner performance.

The key constituents of quality SBAs include fitness for purpose, validity, nature and timing of assessment (Gardner, 2006). Therefore, in order for Physical sciences formative assessments to be fit for purpose, they need to be valid, aligned with the objectives of the CAPS document, which stipulates what needs to be learnt and the level at which it is to be learned. Furthermore, the cognitive levels at which assessment items are pitched, as well as the authenticity of formative assessments contribute to their quality.

Although South African educators are formally trained on how to design assessments, there is very little information about their ability to design quality formative assessments. These educators are left to use their initiative and discretion to devise formative assessments, which might not meet the required assessment standards. The quality of formative assessments developed by Physical science educators could therefore partly account for learners' poor performance in these assessments. Regarding educators' ability to design quality formative assessments, Denman and Al-Mahrooqi (2018), pointed out that subject educators' cognitive levels determine the level at which they pitch their formative assessments. This implies that, if educators are not empowered in developing quality formative assessments, they are likely to peg

their formative tasks at low cognitive levels and may not be aligned with the learning objective of the CAPS or may set formative assessments tasks that might not enhance learning.

Currently, there is limited literature about the quality of Physical sciences formative assessments in the South African context. It is from this position that I explored the quality of formative assessments developed by Physical sciences educators during the second term of 2019, in relation to their validity, authenticity, the cognitive level at which they are pitched, and their alignment to the Physical sciences CAPS' objectives. The study also explored the factors that influence educators' choices of formative assessments.

1.4. Purpose and objectives of the study

The purpose of the study was to investigate the quality of Physical sciences formative assessments in selected schools, and to compare the quality of the assessments in participating schools. In addition, the factors that influence educators' choices of formative assessment items were explored. The study was conducted in Gauteng, Johannesburg North District (D10), and the target group were educators who are teaching Physical sciences in the FET phase (Grade 10-12).

Specific objectives of the study

The following were the specific objectives of the study:

- To establish the quality of Physical sciences formative assessments.
- To find out whether Physical science formative assessments are aligned with the objectives of the CAPS document.
- To compare the quality of formative assessments in different school types.
- To determine factors that influence Physical sciences educators' choice of formative assessment tasks.

1.5. Research questions

The primary research question for the study was: *What is the quality of Physical sciences formative assessments and what influences Physical sciences educators' choice of formative assessment items*?

Secondary Questions

1. What is the quality of selected FET Physical sciences formative assessments?
2. To what extent do selected Physical sciences formative assessments align with the objectives of the CAPS document?

3. How does the quality of formative assessments compare in different school types?
4. What influences selected Physical Science educators' choice of formative assessment tasks?

1.6. Rationale and significance of the study

As stated severally, the study is an attempt to determine the quality of Physical sciences formative assessments in terms of their validity, authenticity, the cognitive level at which they are pitched, and their alignment to the Physical sciences CAPS' objectives. The outcomes of the study could alert the Gauteng Department of Education (GDE) to the need to train educators in the development of quality formative assessments. This could be done by conducting workshops that may benefit and strengthen Physical sciences educators' ability to set effective quality formative assessments that continually support and improve the teaching and learning processes.

In addition, it is hoped that the results could motivate participating Physical sciences educators to think critically and innovatively about setting quality Physical sciences assessments that can; support and promote learning, effectively measure the skills acquired by Physical sciences learners, and prepare learners for application of acquired knowledge to real-world situations. The Gauteng Department of Education is also likely to benefit from the findings of the study by identifying the weaknesses found in formative assessments, and institute remedial measures to address them. The findings from the study are therefore likely to benefit education district officials, Physical sciences educators, and consequently Physical sciences learners.

1.7 Overview of the dissertation

This dissertation provides descriptions and justifications of the methods and techniques used to collect, analyse and discuss data that were used to respond to the research questions. In particular, Chapter 1 provided an introduction and background of the study, described the research problem, the aim of the study and the research questions, as well as the rationale for the study. Chapter 2 elaborates on existing literature that is related to the study, with focus on literature that deals with determining the quality of assessments, which provide a background to the study. Chapter 3 displays the research methods and techniques used in the study. The ethical considerations made in the study are also discussed. Chapter 4 presents the results obtained from the analysis of formative assessments and from interview responses. The results displayed in Chapter 4 are discussed in Chapter 5. The chapter also provides the implications and recommendations related to these findings. The limitations of the study and finally the concluding remarks of this study are presented under this chapter.

Chapter 2: LITERATURE REVIEW

In reviewing literature for this study, I discuss concepts that are relevant to the study and describe the conceptual framework that guided it. The concepts discussed include definition of assessment, formative assessments, quality of formative assessment, alignment of formative assessment with curriculum objectives, and factors that influence educators' choices of formative assessments.

2.1. Definition of assessment

Different scholars have defined the term "assessment" in diverse ways, and perhaps with different goals. According to Banta and Palomba (1994, p.4), "Assessments are systematic collection, review, and use of information about educational programs, undertaken for the purpose of improving learning and development". Oyinloye and Imenda (2019) considered assessments as the main educational tools available for different purposes, among which are to maximize learning, encourage learners, and to improve performance so that learners can meet pre-specified goals and standards.

In South Africa, the National Protocol of Assessment (DoE, 2012) described assessment as a planned process of identifying, gathering and interpreting information about the performance of learners. According to this document, processes that measure individual learners' attainment of knowledge (content, concepts and skills), and the ability to analyse and interpret the data and information constitute assessment. Shepard (2000) on the other hand considered assessments as indicators of school achievement and success, more so than tools to investigate the cause of success or failure during learning. My position in this study is to agree with the National Protocol of Assessment (DoE, 2012)'s description of assessments, as a planned process of identifying, gathering and interpreting information about the performance of learners. Hence, in this study, assessment constituted processes that measure achievement and attainment of learners' knowledge (content, concepts and skills).

There are different types of assessments with different objectives. These include diagnostic assessments, formative assessments and summative assessments. Of these, formative assessments are considered important tools to provide feedback about learners' achievement and their progress, during the process of teaching and learning (DBoE, 2011). It is therefore important that these assessments are of high quality, and that they meet curriculum goals. In this study, I measured the quality of Physical sciences formative assessments and determined their alignment with CAPS objectives. I also attempted to establish the factors that influence

educators' choices of formative assessment items. In the next section, I describe formative assessments.

2.2. Formative assessments

Dunn and Mulvenon (2009), regarded formative assessments, as assessments designed to monitor learners' progress during the learning process (i.e. assessment for learning), whilst the National Protocol of Assessment (DoE, 2012) described formative assessments as being aligned to the process of identifying, gathering and interpreting information about the performance of learners, during the teaching and learning process. In other words, formative assessments are aimed at supporting the learning process (Van der Horst & McDonald 2007).

Formative assessments have many discourses, one of which is that learners who are exposed to formative assessments perform better on a variety of achievement indicators, than their peers who are not (McManus, 2008). Another discourse of formative assessments is that they have the potential to improve learners' performance (McManus, 2008). Popham (2009)'s discourse on formative assessment was that formative assessments are not just tests but are an ongoing process to measure and bring about evidence of learning. On the other hand, Dunn and Mulvenon (2009) posited that, the purpose of using formative assessments is to measure learners' performance and progress during learning (assessment for learning). In addition, Harlen and Winter (2004) indicated that the use of formative assessments is to support and improve learning.

All the authors cited above seem to agree that formative assessments are designed for monitoring learners' progress during learning, and that they have the potential to support learning. Given the important role played by formative assessments in guiding the teaching and learning process, it is pertinent that they should be designed as high-quality assessments, for them to achieve their purpose. This study therefore focused on determining the quality of Physical sciences formative assessments, as essential tools for enhancing the teaching and learning process. The succeeding section discusses the quality of formative assessments.

2.3. Quality of formative assessments

The Oxford language google dictionary defines the word "*quality*" as "the degree to which an object or entity satisfies a specified set of attributes or requirements. However, the word "*quality*" has a distinct meaning in formative assessments, which is the ability of a formative assessment to improve student learning. In this regard, Rice (2003) held that it is widely recognised that quality formative assessments in schools are very important in influencing learner's achievement

and promotion. Bransford and Donovan (2005) also indicated that the quality of formative assessments is central to good teaching, facilitation of learners' learning and understanding, and should be based on standards or principles of outcomes. Absolum et al., (2009), supported the notion of quality formative assessments, as an integral part of learning, important for raising learners' achievement and supporting learning. Vandeyar and Killen (2003) also declared that if educators appreciate the fundamental principles of quality assessment, they would be able to adapt their assessment practices, not only in the classroom but also in any future curriculum framework.

Physical sciences formative assessments are aimed at satisfying the curriculum standards that influence learning and learner achievement. In line with the reviewed literature that the quality of formative assessments is important in influencing learners' achievement and promotion, the study investigated the quality of Physical sciences formative assessments, by looking at their validity, authenticity and the cognitive levels at which assessment items are pitched, as well as their alignment with the objectives of the CAPS document. The following paragraphs present descriptions of each of these quality measures of formative assessments.

Quality measure1: Validity of formative assessments

The term "*validity*" has reference to the quality of what is intended to be measured in an assessment. According to Harlen and Winter (2004), validity is an assessment of how well the outcome corresponds with the behaviour or construct it intends to test or assess. In line with this thought, the National Curriculum Statement (DoE, 2003) states that formative assessments are meant to provide evidence of learner progress and achievement, from the learning outcomes that are tested. This objective of the National Curriculum Statement aligns with the concept of assessment validity. Therefore, it was deemed appropriate to examine the validity of Physical sciences formative assessments. Taherdoost and Hassan (2020) outlined different types of assessment validity into, content validity, face validity, predictive validity, concurrent validity, and construct validity.

According to Taherdoost and Hassan (2020), content validity is determined by comparing the content of formative assessments with the content it intends to assess, from the curriculum. Face validity involves expert judgement of what a formative assessment appears to assess, while predictive validity of an assessment is "the extent to which an assessment reflects an intended future performance" (Taherdoost & Hassan, 2020 p.2). Concurrent validity is derived from the correlation of the outcomes of one formative assessment with another, which is meant to assess the same knowledge or skill. Construct validity is the judgement of how well the formative

assessment calls upon the knowledge and skills or other constructs that are supposedly assessed; Construct validity requires a clear definition of the domain being assessed, evidence in the assessment process, and the intended skills and knowledge acquired by the learners (Taherdoost and Hassan, 2020; Yaghmaei, 2003).

In this study, I determined the content validity of Physical sciences formative assessments because I am interested in knowing how well the formative assessments are aligned with the content prescribed by the CAPS curriculum. In addition, I tend to agree with Kulasegaram and Rangachari (2018)'s view that the validity of formative assessments has a significant role in promoting better understanding of concepts from a topic of interest, and in meaning-making measurement. In measuring the Content Validity Index (CVI) of Physical science formative assessments, I used the method used by Yusoff (2019) to measure the same construct. Yusoff's measurement method involves, preparing a content validation form, electing a review panel of experts, conducting content validation, determining assessment domains and items, providing a score on each item, and calculating Content Validity Index (CVI).

Quality measure 2: Authenticity of formative assessments

The concept of authenticity describes something that is real or genuine and not a counterfeit. According to Mohamed and Lebar (2017), authentic assessments emphasize what students can do in the context of real life and tend to measure students' skills, as they are needed in real life. In other words, authentic assessment refers to the measurement of learners' ability to deal with real life situations. For example, if learners are taught the danger of lightning during the storm, with reference to electrostatic charges, which create repulsive forces on two bodies, they should be able to use that knowledge to understand, avoid or protect themselves against a storm. Authentic assessments are meant to promote positive attitudes, fostering life-long learning skills, and improving social citizenry (Finch, 2002). They are also meant to develop learners' ability to transfer and apply knowledge, skills and values in situations resembling real-life contexts.

According to Reddy (2004), the adoption of Outcomes-Based Education in South Africa was perceived as a trigger and a trend towards authentic assessments. In outcomes-based education, learners engage in real-world tasks and scenario-based problem-solving activities that reflect local values, standards and controls (Moon, Brighton, Calahan & Robinson, 2005). Although the outcomes-based education is characterized by these attributes of authentic assessments, the CAPS document does not prescribe enough learning activities that would require authentic assessments, and it appears that not much thought is given to the development and use of authentic assessments. It is therefore not clear whether educators include authentic items in their

Physical sciences formative assessments. In an attempt to understand this issue, this study was meant to measure the authenticity of the formative assessments administered to Physical sciences learners.

Regarding the measurement of the authenticity of formative assessment tasks, Frey, Schmitt and Allen (2012) conducted a review of literature to develop a comprehensive list of critical components that various authors and researchers believe to determine the authentic nature of any classroom assessment. From this review, the authors found that most of the features that scholars consider to constitute authentic assessments could be categorized into three components. These categories include: (a) *context of the assessment*; realistic or contextual activity, the task is performance-based, and the task is cognitively complex. (b) *Role of the students*; a defence of the answer or product is required, the assessment is formative, and students collaborate with each other or with the teacher. (c) *Scoring* - the scoring criteria are known, or student developed, multiple indicators or portfolios are used for scoring, the performance expectation is mastery. Components (b) and (c) of authentic assessments, as described by Frey et al., (2012), are beyond the scope of the study. Authenticity in the context of this study therefore focuses on component (a), which is the '*context of the assessment*', because according to Frey et al., (2012, the degree to which an assessment task mirrors some reality outside of the classroom is a critical dimension of authenticity. Determining the authenticity of formative assessment in this study therefore involved identifying assessment items that appear to determine learners' potential to relate learnt material to real-world situations or contextual activities.

Quality measure: 3 Cognitive levels of formative assessments

The domain of measurement of educational attributes is defined in two dimensions: the content dimension and the cognitive dimension. Various scholars have suggested different models for measuring the cognitive dimension of educational attributes. These include the following models: The cognitive design models (CDS) framework by Embretson (1998); Evidence-centred design (ECD) framework by Robert Mislevy and colleagues (Mislevy, Steinberg, & Almond, 2003); and Benjamin Bloom's taxonomy framework (Bloom, et al., 1956). For this study, I explored the cognitive levels of formative assessments based on Benjamin Bloom (Bloom, et al., 1956)'s taxonomy of cognitive levels because the CAPS Physical sciences curriculum prescribes to this model (DBoE, 2011). Moreover, literature (Amin & Mirza, 2020) indicates that bloom's taxonomy of cognitive domains is the most adopted framework in education, and this could mean that most Physical sciences educators are familiar with it and perhaps use it to plan and execute lessons and assessments.

Bloom's taxonomy of educational objectives defines and distinguishes six different levels of human cognition, which are: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Bloom, et al., 1956). The initial purpose and intention of these cognitive levels was to help educators to avoid duplicative or redundant efforts in developing different assessment tasks that measure the same educational objectives. The taxonomy places emphasis on the hierarchical nature of the framework, asserting that the first three elements—Knowledge, Comprehension, and Application—represent lower levels of cognition and learning, while Analysis, Synthesis, and Evaluation are considered higher-order thinking skills (Bloom, et al., 1956). The intention of this study was to measure the quality of formative assessments from this hierarchical nature of the cognitive levels.

The original cognitive levels suggested by Bloom have been modified into the "Revised Bloom's Taxonomy," by Anderson and Krathwohl (2001). This revision was intentionally designed to be more useful to educators and to reflect the common ways in which it had come to be used in schools. In the revised version of Bloom's cognitive levels, all the categories are expressed as verbs rather than nouns. For instance, knowledge was changed to remembering, comprehension became understanding, while synthesis was renamed creating (Anderson & Krathwohl, 2001). In addition, creating became the highest cognitive level in the new classification system, switching places with evaluating (Anderson & Krathwohl, 2001). The revised version of cognitive levels is now classified as, Remembering, Understanding, Applying, Analysing, Evaluating, and Creating, in that order (Anderson & Krathwohl, 2001).

The Physical sciences CAPS document assigns assessment weights to these cognitive levels. Table 2.3 below, shows the prescribed cognitive level weights for teaching Physical sciences, in the South African context (DBoE, 2011). The alignment of formative assessment tasks with cognitive levels was determined in light of these weightings, in the study.

Table 2.3: *Weighting and descriptions of cognitive levels*

Cognitive levels	**Descriptions**	**% weighting**
1	Remembering	25 %
2	Understanding	30 %
3	Analysing and Application	40 %
4	Evaluating and Creating	5 %

Alignment of assessment tasks with cognitive levels has been determined in diverse ways. In this study I followed Keshavarz (2011)'s method, which involves the following steps: (1) Listing and

description of Bloom's cognitive levels. (2) Determination of the verbs used in creating students' learning outcome statements (Scott, 2003). (3) Formation of a linkage matrix table that associates each learning outcome with one or more assessment tools. (4) Description of the linkage matrix associated with each learning outcome. (5) And data-backed qualitative measurement of how well students achieved each learning outcome. This study employed steps (1) to (4) of Keshavarz (2011)'s method to measure the alignment of assessment tasks with Bloom's cognitive levels.

2.4. Alignment of formative assessments with curriculum objectives

About two decades ago, Ramsden (1992, cited in Biggs, 2003A) made a pertinent observation regarding assessments, which is that; "… *assessment is the curriculum, as far as the students are concerned. They will learn what they think they will be assessed on, not on what is in the curriculum, or even on what has been 'covered' in class.* Biggs, 2003A.p. 3)". This statement implies that if what is assessed is not based on the curriculum, then students will learn what is assessed, even though it is not part of the curriculum, and not learn what is prescribed by the curriculum. It is therefore crucial that assessment tasks are aligned with curriculum objectives.

Hofstein and Lunetta (2004) suggested that formative assessments should be modelled and aligned to curriculum learning objectives, in order to play a more prominent role in assisting learners to learn. Similarly, Biggs (2003B) argued that a good systematic teaching aligns learning, teaching and formative assessments to curriculum objectives, "so that all aspects of this [educational] system are in accordance with supporting appropriate learners' learning. p.11". In this regard, Dreyer (2008) argued that it is essential to determine if the teacher's instruction is assisting learners in their progress towards the achievement of learning aims or learning outcomes, and to eventually establish whether learners have learned what was expected of them. Van der Horst and McDonald (2007) also stated that it is imperative that formative assessments should give a clear indication of what learners are expected to learn.

Furthermore, Biggs (2003B) stated that educators need to be careful, to seek compatibility between the curriculum objectives, the teaching and learning tasks, and assessment procedures, because: "When there is alignment between what we want, how we teach and how we assess, teaching is likely to be much more effective than when there is not. p. 1". This close link between teaching, learning and assessment is also found in descriptions of assessment, in the Physical Sciences Curriculum and Assessment Policy Statement (DBoE, 2011. p.65). One of the most important requirements brought about by curriculum changes in South Africa was the alignment of the Physical Sciences formative assessments with the CAPS curriculum objectives (DBoE,

2011). Physical Science educators are therefore required to familiarize themselves with the CAPS policy document and effect the teaching and assessment practices stated in the curriculum (DBoE, 2011), which is envisaged to lead to quality teaching.

The objectives of the Physical sciences CAPS are presented as 'specific aims of Physical sciences" (DBoE, 2011.p.8). These aims include the following:

1. To make learners aware of their environment and to equip learners with investigating skills relating to physical and chemical phenomena.
2. To promote knowledge and skills in scientific inquiry and problem solving.
3. To promote the construction and application of scientific and technological knowledge.
4. To promote an understanding of the nature of science and its relationships to technology, society and the environment.

Although there are many objectives in the CAPS curriculum, these four Physical sciences CAPS objectives (aims) were used as the basis for determining the alignment of formative assessments with curriculum objectives. This is because these objectives relate to most of the content covered in Physical sciences in the second term of Grades 10, 11 and 12, upon which the analysed formative assessments were envisaged to be based.

Different researchers have used diverse methods to determine the alignment of assessments or content with curriculum objectives. For instance, Crotts, Sireci and Zenisky (2012) described three methods of evaluating the alignment between curriculum, assessment and instruction, namely, Webb methodology (Webb & Krathwohl, 2001); Achieve methodology (Rothman & colleagues, 2002) and Surveys of Enacted Curriculum (SEC) Methodology (Porter & Smithson, 2001). Of these methods of determining alignment with curriculum objectives, the 'Achieve' methodology is the one that is closely related to the purpose of the study. The 'Achieve' method of evaluating the alignment between curriculum, assessment, and instruction comprises two stages, namely 'Item level analysis' and 'Set-of-items analyses.

The first stage of the 'Achieve' method involves an item-by-item analysis of an assessment, to determine the content and performance 'centrality' of each item, compared to the objective to which it is matched. The second stage is a holistic evaluation of a set of items matched to an overarching standard, in terms of the overall level of challenge, the balance, and the range (Crotts, Sireci & Zenisky, 2012, p.1342). This evaluation method is based on the use of a team of carefully trained experts reaching consensus on the degree of match between the standards and

the assessment items, based on specific criteria. This method of evaluating the alignment of assessment and curriculum objectives was followed in the study.

2.5. Factors that influence educators' choice of formative assessments

As alluded to severally, assessment is an essential part of teaching and learning, and it is a key component in quality teaching (Edwards, 2013). This is particularly true for formative assessments, which are meant to support the learning process (Van der Horst & McDonald 2007). Educators' knowledge about formative assessment, including what to assess and how to assess students, is part of the pedagogical content knowledge (PCK) that teachers are expected to possess (Shulman, 1986). In this regard, Kulasegaram and Rangachari (2018) stated, in their article titled; "Beyond formative: Assessment to enrich student learning", that, it is educators' responsibility to design and administer quality assessments. This could be done by; constructing assessments that are aligned with the learning objectives; attending to the response processes of assessments and ensuring that these support transfer of learning; implementing regular formative testing to provide students with ongoing indication of their progress; and by ensuring that assessments provide students with actionable and meaningful feedback (Kulasegaram & Rangachari, 2018). This suggests that educators should be able to construct formative assessments that should achieve much more than just assigning grades to learners. However, several external and internal factors may influence educators' decisions about the content and quality of formative assessments (Izci, 2016). Therefore, the tasks that educators choose when designing formative assessments might not always meet the necessary standards for developing quality assessments.

In addition, most educators may not even be aware or be concerned about the quality of the formative assessments they administer to their learners. In this regard, Izci (2016) posited that teachers spend almost a third of their instructional time in assessment, without taking notice of factors that determine the quality of their formative assessments. It then becomes necessary to examine the factors that influence educators' choices of formative assessments. According to Kulasegaram and Rangachari (2018), the factors that influence educators' choices of assessment could include among other things, student learning, the range of learning outcomes, and learners' performance and competence. These authors further indicated that educators' choices of formative assessment are mainly influenced by what needs to be learned; ways and means set in place to meet learning needs, and prescribed measures of whether the needs have been achieved. Furthermore, Clarke and Hollingsworth (2002) identified external sources of information, personal knowledge, beliefs and attitude, professional experiences, conceptions of formative

assessment, and salient outcomes in teaching, as some of the factors that could account for educators' choices of formative assessment. In South Africa, we are not clear about the factors that influence Physical sciences educators' choices of formative assessment items.

Izci (2016) used a tentative framework to present the factors that affect teachers' adoption (choice) of formative assessments. This framework presents domains of factors that may affect teachers' choice of formative assessment, which are; personal factors, contextual factors, external factors, and resource-related factors. Izci explained these domains of factors as follows.

- **Personal factors –** factors that relate directly to teachers' perception of formative assessment, such as teachers' beliefs and values, teachers' knowledge (PCK), teachers' attitudes, teachers' orientations, teachers' experiences, teachers' self-efficacy and motivation, teaching and professional experience, and teachers' conceptions (understanding) of assessment (Izci, 2016, p. 2542-2543).
- **Contextual factors –** factors related to school context such as school environment and policy that affect teachers' formative practice. Examples include school context and internal policy, internal school support, students' attitudes, mistrust, and resistance, parents' views, cultural and social preferences. (Izci, 2016, p. 2544-2545).
- **External factors –** factors such as high stake and accountability assessment are related to local and national educational characteristics. State and local educational policies, High stake and accountability, and curriculum developers (Izci, 2016, p. 2545).
- **Resources-related factors –** factors such as professional development (PD) activities require resources such as money, time and information. For instance, professional development and educational research, teacher preparation, time and crowded curriculum, working conditions of teachers, and materials and funding (Izci, 2016, p. 2546).

The study used these factors as guidelines for investigating the factors that influence educators' choices of formative assessments.

2.6. Conceptual framework

A conceptual framework is a structure of concepts, expectations, anticipations, beliefs and theories that support and inform a research study (Kaplan & Maxwell, 2005). Merriam and Tisdell (2009) described a conceptual framework as a fundamental structure used to frame a study. She added that a conceptual framework is the lens through which one can observe the

world and defines the researcher's interest, by drawing upon the concepts, definitions, terms, models and theories of a particular literature base and disciplinary orientation. In addition, Camp (2001) believed the conceptual framework explains the natural progression of a phenomenon. In other words, a conceptual framework guides the formulation of problem statements, research questions, data collection and data analysis, and data interpretation of an intended study (Camp, 2001). Furthermore, it links the concepts, empirical research and important theories used in promoting and systemizing the knowledge accessed by the researcher (Peshkin, 1993).

In order to focus the direction of this study, I used a framework that could accomplish the difficult task of accommodating the various aspects of assessment quality and the factors that influence Physical sciences educators' choices of formative assessment tasks. The aspects of assessment quality, in Hadjerrouit (2010)'s view, include validity, reliability, readability, cognitive levels, alignment with curriculum objectives, authenticity and so forth. Therefore, in this study, I needed to use a conceptual framework, which is multi-layered in nature.

In seeking to use a multi-layered conceptual framework, I adapted the critical Formative Assessments (FA) components framework used by Herman, et al. (2010), to guide the study, since most of the concepts from this framework align with those investigated in this study. Furthermore, this framework offers a logical structure of connected concepts, and it explains how the concepts used in the study link with each other. Herman, et al. (2010) used the framework to analyse and to determine the quality of formative assessments and their alignment with the curriculum. The study involved different categories of high school educators. Similarly, this study used the critical Formative Assessments (FA) components framework to determine the quality of Physical sciences formative assessments developed by educators from different high schools, and their alignment with the objectives of the CAPS.

The critical Formative Assessments components framework is grounded in the modern validity theory, with respect to the meaning of quality assessment measures (Herman, et al. 2010). The Critical Formative Assessments Components (CFAC) framework, is based on the reasoning that; "… a quality formative assessment process involves the specification of (significant) learning goals, iterative process of assessment, interpretation, and use of evidence to guide subsequent teaching and learning, to reduce the gap between students' current understandings and expected learning goals. p.2". The original CFAC framework consists of learning goals, assessment tasks, interpretation, and use of assessments, which interact in the contexts of the state, educational district, the school, and the classroom.

The study was premised on and directed by the four adapted constructs of the Critical formative assessment components framework, which include: (1) assessment Quality Interpretations (QI), (2) choice of Assessment Tasks (AT), (3) Alignment to Curriculum Objectives [CASPS] (CO), (4) and Cognitive Levels (CL). These four adapted constructs were examined in the contexts of the school, the classroom and the educator (teacher), which represent the units that were involved in determining the quality of formative assessments during the study. In this regard, formative assessments developed by Physical sciences educators, for grades (classroom) 10 to 12, from selected schools were examined to determine; their alignment to the CAPS objectives, the levels at which they are pitched and their quality. In addition, factors that influence educators' choices of formative assessment items were explored. The original CFAC framework is displayed in Figure 1 (A), while Figure 1 (B) shows the adapted version of the framework that was used in the study.

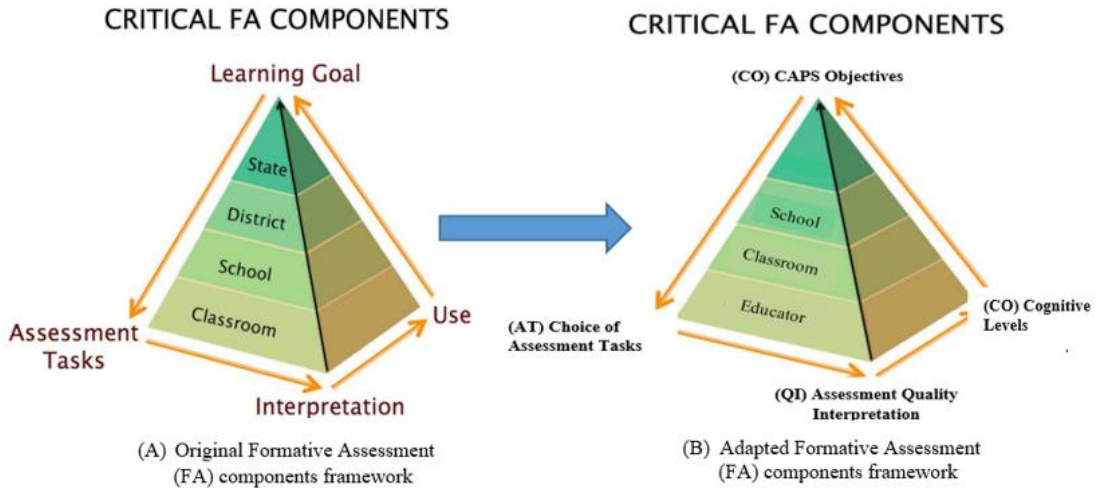


Figure 2.1. Critical formative assessments components frame-work (Adapted from: Herman, Osmundson & Silver, 2010).

The first construct, the assessment Quality Interpretations (QI), is an umbrella concept, which relates to the focus of the study; the determination of the quality of Physical sciences formative assessments. The other attributes of the framework were analysed and interpreted in order to determine the quality of the formative assessments. Determination of the quality of formative assessments also includes the measurement of their validity and authenticity. The second construct; choice of Assessments Tasks (AT) refers to the formative assessment choices that educators make. The quality of an assessment could be affected by the assessment choices that educators make. Therefore, this construct is meant to determine factors influencing educators' choices that could affect the quality of Physical sciences formative assessments. The choice of Assessments Tasks (AT) by educators was further explored by comparing the quality of

formative assessments of different school types to provide insights into the similarities and discrepancies in the quality of formative assessments developed in these schools.

The third construct; CAPS Objectives (CO) involves the determination of the quality of formative assessments (tasks), interpreted in terms of their alignment with CAPS objectives. CAPS is the South African national curriculum, and the CAPS objectives that were considered in the study are listed in section 2.4. The fourth construct; Cognitive Levels (CL) refers to the measurement of the quality of formative assessments according to the cognitive levels upon which assessment items are pitched. The cognitive levels considered in this study are the revised Bloom's Taxonomy," suggested by Anderson and Krathwohl (2001).

Figure 2.1 (B) therefore provides a picture or visual display of how the concepts and ideas investigated in this study related to one another, and how they collectively contribute to an understanding of the overall quality of Physical sciences formative assessments. The passages that follow describe the design, methods and techniques that were used to collect and analyse the data in the study.

Chapter 3: METHODOLOGY

The focus of the study was to investigate the quality of Physical sciences formative assessments and their alignment to CAPS objectives. This chapter presents the research approach and design used in the study. It describes; research paradigm, the research site, population and sampling, data collection and analysis procedures, data analysis techniques, and ethical considerations.

3.1. Research approach and design

In the study, I used a qualitative research approach to make subjective judgements on the quality of Physical sciences formative assessments and their alignment to CAPS objectives, as well as the factors that influence educators' choices of formative assessments. Qualitative methods and techniques were used to collect and analyse data, and to interpret the results to get a better understanding of the quality of Physical sciences formative assessments. A qualitative research approach is used to describe and analyse people's individual and collective social interactions, beliefs, thoughts and perceptions (Mcmillan & Schumacher, 2010). Furthermore, qualitative research emphasizes gathering of data on a naturally occurring phenomenon, mostly in the form of words rather than numbers (Mcmillan & Schumacher, 2010), where the researcher does not attempt to manipulate the phenomenon of interest (Maree, 2007). In qualitative research, the researcher serves as the instrument of data collections and asks the participants broad, open-ended questions (Maree, 2007). The characteristics of qualitative studies include face-to-face data collection methods and interacting with selected persons in their natural setting (Maree, 2007). The study reported here involved the collection of data from assessments, which is a naturally occurring phenomenon in education, and the research did not attempt to manipulate the phenomenon of interest. These features make a qualitative approach suitable for the study.

A multiple-case study design was employed to explore the quality of FET Physical sciences formative assessments. Yin (2003) described a case study research method as an empirical inquiry that investigates contemporary phenomena within its real-life context. According to Yin (2003), a case study involves the exploration of individuals, organizations, relationships or programmes. A multiple-case study design is the most suitable design for this study because the quality of formative assessments is a complex contemporary social phenomenon, which involves real-life issues. The design is a case multiple-case study because the study did not focus on one school (case) but involved three schools. Each school and the sample units involved were viewed as separate cases, in the context of this study.

3.2. Research paradigm

In educational research, the term paradigm is used to describe a researcher's worldview, perspective, thinking, school of thought, or a set of shared beliefs that inform the meaning or interpretation of research data (Mackenzie & Knipe, 2006). Willis, Muktha and Rema (2007) explained that "a paradigm is a comprehensive belief system, world view, or framework that guides research and practice in a field" (p. 8). Lather (1986) also clarified that a research paradigm inherently reflects the researcher's beliefs about the world that s/he lives in, and wants to live in. Furthermore, a research paradigm constitutes the abstract beliefs and principles that shape how researchers see the world, and how s/he interprets and acts within that world. Lather (1986) further described a research paradigm as the conceptual lens through which the researcher examines the methodological aspects of their research project, to determine the research methods that are used and how the data is analysed.

There is no research paradigm that is superior to others, but each paradigm has a specific purpose in providing a distinct means of producing unique knowledge (Taylor, Bogdan & DE Vault, 2015). Candy (1989), one of the leaders in the field of paradigms, suggested the grouping of paradigms into three main taxonomies, namely; positivists, interpretivist, or critical paradigm, while Tashakkori and Teddlie (2003) proposed a fourth type, which borrows elements from these three paradigms, and they called it pragmatic paradigm.

A pragmatic paradigm was used as the lens through which the findings of this study were viewed. A pragmatic paradigm according to Kivunja and Kuyini (2017) is a paradigm that promotes relationships in research that are best determined by what the researcher deems appropriate to that particular study. The pragmatic paradigm characteristics that relate to the research study include: (i) It seeks to utilise the best approaches to gaining knowledge, using every approach that helps that knowledge discovery. (ii) The choice of research methods depends on the purpose of the research. (iii) It allows a search for useful points of connection, within the research project, that facilitate understanding of situations (Kivunja & Kuyini, 2017). In line with this paradigm, this study employed a mixture of methods and techniques from different research traditions to obtain the necessary information for answering the research questions.

3.3. Research Site

A research site is a place in which a research study occurs (Maree, 2007). The study took place in Gauteng where educational districts are divided into three categories (A, B, and C), according to their geographical location. Johannesburg North district, where the study was done, is located

in category B, which is in central Johannesburg and Far North of Johannesburg. The district monitors some schools in Soweto; almost all schools in Johannesburg (central schools), schools in far North (Randburg schools), and far North schools known as Cosmo city schools.

In the case of this study, the research site involves selected schools in the Johannesburg North Education District (D10), in the Gauteng province. The rationale behind this choice of the research site is that I, as the researcher, work in the province and specifically with Johannesburg North Education District schools, as a Subject Education Specialists (SES) also known as subject advisor, for Physical sciences. Therefore, the site was easily accessible to the researcher. Easy accessibility to educators made the study less expensive and feasible. As a SES, I coordinate and monitor learning activities, as well as advise educators on best teaching and learning practices. I am aware of the power dynamics, which might arise because of my position as a (SES), at the research site. To mitigate this issue, I used a research assistant who does not know the participants, to interview the participating educators. Hence, the professional relationship between the participating educators and myself did not significantly affect the results of the study.

3.4. Study population

A study population is a complete set of elements (persons or objects) that possess some common characteristic defined by criteria established by the researcher (Landreneau & Creek, 2009). In addition, McMillan and Schumacher (2010) defined a population as a group of elements or cases, whether individuals, objects or events, that conform to specific criteria and to which the researcher proposes to take a broad view of the results of the research. The population in this study comprised is FET (Grades 10 to 12) Physical sciences formative assessments administered in schools in the Gauteng province of South Africa, and FET physical sciences subject teachers in the same location.

FET (Grades 10 to 12) Physical sciences formative assessment papers entails tests, classroom exercises, practical activities, assignments and homework administered by either the subject educators or the educational district, during the course of a learning unit, for improving the processes of teaching and learning. Physical sciences subject educators refer to the educators who teach Physical sciences at FET level, and who administered the reviewed assessment papers. Physical sciences educators are required, by educational districts, to teach according to prescribed topics and to set formative assessment tasks based on these topics. The formative

assessments that were analysed in this study therefore consist of assessment items based on the topics in Table 3.1 below.

3.5. Sample and Sampling Methods

A sample is "a small group of subjects or participants from whom data is collected (McMillan & Schumacher, 2010:119)". A convenience purposive sampling method was used to collect qualitative data in this study. Convenient purposive sampling is a combination of convenient sampling and purposive sampling. Convenient sampling is a method used to select individuals who are available and willing to participate in the study (Maree, 2007), while purposive sampling, according to Maree (2007:257), is a sampling method, which gives the researcher an opportunity to select participants who have defining characteristics that make them holders of the information needed for the study. It was necessary to use both convenient and purposive sampling in this study because the researcher accessed formative assessment papers and educators from schools where he is the subject advisor. Therefore, it was convenient for him. In addition, these past formative assessment papers and the educators possessed the information required for the study. Therefore, the selection of these samples was purposive.

3.5.1. Sampling of participating schools

Due to time and resource limitations, I sampled 3 schools out of the 68 schools in Johannesburg North District D10. The criteria used for sampling the schools is as follows, to ensure their homogeneity: Schools should,

- use English as a medium of instruction.
- have been operational for at least five years.
- offer Maths, Sciences and Technology (MST) subjects.
- have FET phase; Grade (10-12).

I further used what the department of education calls, "*Education Management Information System*" (EMIS) numbers to select participating schools. The EMIS is a unique, 8-digit number assigned to all schools by the Department of Education (DoE). It is used to identify school functionality, responsibilities and school management systems. It is further used to identify the school's location, type of school and the medium of instruction the school is using. Furthermore, there are special schools that are classified as Maths Science Technology and Engineering schools (MST) schools, amongst the 68 schools in Johannesburg North district. These schools

were part of the schools that I selected. Schools that meet the stated criteria were divided into Township Public Schools 18, former model C schools 12 and Independent Schools 16. One school was randomly selected from each of the three groups of school types for participation in the study.

3.5.2. Sampling of participating educators

Three educators were sampled for participation in the study. Participating educators were sampled from the three selected schools, according to the following criteria:

1. Educators should have the Requirement Educational Qualification Value (REQV: 13 and above).
2. Educators should have 3-5 years' Physical sciences teaching experience at FET level.
3. Educators should use English as First Additional Language (FAL).
4. Educators' qualifications should be relevant to the teaching of Physical sciences.

Requirement Educational Qualification Value (REQV) are qualification levels of Educators in South Africa. Educators at level REQV 13 are those with Diploma in teaching, those at level REQV 14, have Honours qualifications, and finally those at REQV 15 have master's degree and above. One Physical sciences educator was randomly selected from those who met the stated criteria, in each of the three participating schools. In cases where only one educator taught Physical sciences to grades 10 to 12, that educator was by default selected to participate in the study. The selected sample consisted of one female educator from one school, and two male educators from the other two schools.

3.5.3. Sampling of Physical sciences formative assessment papers

Formative assessment papers administered during the second term of 2019 were analysed in this study because 2019 was the year in which the least learner performance on formative assessments was recorded. Moreover, it was not possible to analyse assessments administered in different years due to resource and time constraints, as well as the limited scope of the study. Second term formative assessments were selected because by the second term, learners would have settled into their new grades, and the educators would have established patterns of formative assessments, and are not pressurized by the need to prepare learners for final examinations. The following table provides information about the topics covered in Physical sciences during the second terms of each grade, which are expected to be included in formative assessments.

Table 3.1: *FET Physical sciences term 2 topics*

KNOWLEDGE AREA: CHEMICAL CHANGE					
GRADE 1O		GRADE 11		GRADE 12	
% cumulative completion	% cumulative completion	% cumulative completion	% cumulative completion	% cumulative completion	% cumulative completion
64. 3	71. 4	92. 6	93. 4	96. 0	100
Electrolytes Ion exchange R_x Conductivity Ppt reactions Redox Rx	Molar concentration Molar volume Stoichiometry Informal test, week 22-26	Oxidation numbers Redox reactions	Balance redox R_X Informal test, week 31 - 34	Electrochemical reactions Electrolytic cells Galvanic cells Relation current & potential to rates & equilibrium Understanding redox processes Cell notation	Std electrode potentials Redox R_x Writing eq. (½ & net redox reactions) Calculations (emf) ON/ application Chloroalkali industry Recovery of aluminium

Nine past Physical sciences formative question papers were sampled from 2019 term two assessments. In Gauteng, most high schools have resource centres where they keep official documents, including past assessment papers. Three formative assessments past papers, set and administered by the participating educators, were randomly selected from each grade (grades 10, 11 & 12), in the participating schools, resulting in the use of nine formative assessments past papers in the study. It was necessary to review formative assessments across three grades in order to determine whether there were any improvements in the quality of formative assessments as learners progressed in subsequent grades. The quality of these formative assessments past papers was analysed in the study, as described under section 3.9. The next section describes how the researcher gained access to the participants and participating units.

3.6. Gaining Access to schools

To gain access to schools, conduct interviews with educators, and to collect the relevant documents, I used both overt and covert access methods, which I consider important for obtaining data from and about the participating units. Overt access was used when seeking permission for conducting the research project from gatekeepers, such as the GDE, the district education office, school principals and from the participants (Denzin & Lincoln, 2000). The second method involved the use of 'Covert access' (Denzin &Lincoln, 2000), which involves using available data to obtain information on the quality of Physical sciences formative assessments. When using this method, the participants and the chief education specialist for curriculum were informed about the collection of formative assessment papers from selected schools. The use of

these two access methods enabled the researcher to access the participating Physical sciences educators and formative assessment papers required for the study.

3.7. Data collection

Data collection involves gathering information about the variables in the study (McMillan & Schumacher, 2010). The researcher decides where data would be collected, when it would be collected, by whom, and if necessary, specifics of the experiment (McMillan & Schumacher, 2010).

I collected qualitative data using the qualitative research methods described below. Qualitative data collection involves both interactive and non-interactive data collection methods. The non-interactive data collection method used in this study involved an analysis of formative assessment past papers, while the interactive data collection method involved interviews with Physical sciences educators, to determine their perceptions about the factors that directly or indirectly influence their choices of formative assessment tasks.

For question 1, which is; "What is the quality of FET Physical sciences formative assessments?", data were collected using document analysis, where formative assessment items were examined to determine their quality, in terms of their validity, reliability, authenticity and the cognitive levels at which they are pitched. Regarding question number two, which dealt with the extent to which Physical sciences formative assessments align with the objectives of the CAPS document, I also used document analysis to examine items in formative assessment past papers, to determine their alignment with the objectives in the CAPS document. In doing so, each item from assessment past papers was measured against the objectives of the CAPS curriculum, to determine whether it is aligned to any of the objectives.

Question 3, which was meant to determine how the quality of formative assessments compared in different types of schools, was answered by comparing the validity, authenticity, and the alignment of assessment items with Bloom's cognitive levels and the objectives of the CAPS document, in the three participating schools. In relation to question 4, which looks at factors that influence Physical Science educators' choices of formative assessment tasks, I used semi-structured interviews to collect relevant data from participating educators. The interview schedule was developed by the researcher and validated by the research supervisor. Semi-structured interviews were preferred because the researcher was able to obtain in-depth information and to probe for more information from participants.

3.8. Data Analysis

Data analysis is the process of making sense of the collected data, which involves, "consolidation, reducing what people have said and what the researcher has seen and read, and interpretation of the data, to derive or make meaning out of the process (Mpya, 2007. p.15)". It is a complex process that involves moving back and forth between concrete bits of data and abstract concepts, inductive and deductive reasoning, and between descriptions and interpretations (Mpya, 2007). Similarly, in the current study, data collected to respond to the research questions were described and interpreted using a reiterative method involving inductive and deductive reasoning. The specific procedures for analysing data related to the themes of the study are explained below.

3.8.1. Quality of formative assessments

Research question 1, which is; "What is the quality of FET Physical sciences formative assessments?", involved the determination of the validity, authenticity and the cognitive levels at which formative assessment tasks are pitched. The analysis of data to determine these parameters of quality assessment is explained under the sub-sections below.

Validity of formative assessments

This study involved the determination of content validity, which is the extent to which an assessment represents all facets of the tasks within the domain being assessed (Heale & Twycross, 2015). According to Koller, Levenson and Gluck (2017), the content validity of an instrument can be determined using experts in the field, who individually rate assessment items against a set of objectives. The frequency with which assessment items are related to the stipulated content is considered the content validity of the assessment instrument. These frequencies are converted into percentages or Content Validity Indices (CVI). The CVIs are calculated by dividing the percentage of the items under each predetermined content by a 100. If the resulting CVI is 0.7 and above, then the assessment is considered content valid, whereas a CVI of less than 0.7 renders the assessment less valid (Polit & Beck, 2006). This method was used to determine the content validity of formative assessments from each school, involving two experts in the field of Physical sciences education. The average rating of these experts were used to determine the frequency with which assessment items were related to the stipulated Physical sciences content. For this study, the content to which assessment items were related was term two Physical sciences topics for grades 10 to 12.

Authenticity of formative assessments

This study also measured the authenticity of Physical sciences formative assessments. Determination of the quality of assessments with reference to authenticity, relates to establishing learners' potential to apply learnt content to real-world situations (Mohamed & Lebar, 2017). Content analysis was used to determine the authenticity of the formative assessments from participating schools, by looking at each task from the formative assessments and determining whether it relates to real life contexts or not. The total number of items that relate to real life contexts, out of the total number of assessment items was determined for each formative assessment paper, and used to determine the authenticity of the formative assessments. If 50% or more of the formative assessment items relate to real life contexts, then the assessment is considered authentic. On the converse, if the total number of items relating to real life situations is less than 50%, then the assessment is considered less authentic (Frey, et al., 2012).

Cognitive levels at which formative assessments are pitched

Another assessment quality measure investigated in the study is the cognitive levels at which assessment tasks are pitched. The cognitive levels considered in this study are based on the revised Bloom's Taxonomy of educational objectives, which include; remembering, understanding, applying, analysing, evaluating and creating (Anderson & Krathwohl, 2001). The revised Bloom taxonomy was selected because most educators have typically used it to inform or guide their development of assessments (tests and other evaluation tools). Content analysis was used to determine the cognitive levels at which different tasks from formative question papers were pitched. Items from formative assessment papers were examined to determine the cognitive level (s) at which they are pitched. The total number of items pitched at a particular cognitive level, such as remembering, was determined for each question paper. These totals were presented in histograms and used to make inferences and conclusions about the cognitive levels at which assessment items are pitched.

3.8.2. Alignment of formative assessments with CAPS objectives.

For research question 2, which is; "To what extent do Physical sciences formative assessments align with the objectives of the CAPS document", I used content analysis to determine whether the formative assessments are aligned with the CAPS objectives. To do so, I identified the common CAPS objectives for the grades 10, 11, and 12 in the Physical science curriculum (see section 2.4 for the list of CAPS objectives). Thereafter, formative assessment items were

examined to determine whether they are aligned with any of the identified objectives or not. The total number of items aligned to the CAPS objectives per assessment paper, grade, and school were determined and used to make conclusions about the alignment of assessment with the CAPS documents. This method of determining the alignment of assessment items to curriculum objectives is often used by the Department of Basic Education (2012-2014).

3.8.3. Comparison of the quality of formative assessments in participating schools

Research question 3 relates to the comparison of the quality of formative assessments in different types of schools. The quality of formative assessments in the participating schools were compared using the following process. First, averages of the coefficients and figures obtained from the calculations of validity, authenticity and cognitive levels of formative assessments for each grade and school were computed. Secondly, these averages were displayed on histograms to show variations in the quality of formative assessments, in relation to the stated quality measures. These histograms were then used to compare the quality of assessment of the three participating schools.

3.8.4. Factors that influence educators' selection of assessment tasks.

In response to question 4, which is; "What influences Physical Science educators' choices of formative assessment tasks", I analysed interview responses using thematic analysis. Thematic analysis is described as a form of pattern recognition within the data, with emerging themes becoming the categories for analysis (Fereday & Muir-Cochrane, 2006). In doing so, I used the six key steps of the thematic data analysis process, as used by Xu and Zammit (2020) that the researcher should; (1) familiarize himself with data, (2) generate initial codes (3) search for themes (4) review themes (5) define and name themes, and (6) produce the report.

In analysing data from interviews, I transcribed the interview video recordings verbatim. I also asked a colleague to transcribe the video recordings to make sure that the information from the participants is captured accurately. After reading the data severally, I coded it for recognition and to understand and make sense of it. Coding is defined as the marking of segments of the data with symbols, descriptive words or unique identifying names (Creswell, Plano & Clark, 2010) for easy identification. The codes were used to identify categories and sub-categories that emerged from the collected data. After coding the transcribed data, I categorised the identified factors that influence educators' choice of formative tasks into emerging themes, which were then used to make conclusions. This data analysis method is consistent with Le Compte (2000) views that qualitative analysis is an inductive process of organising data into categories and identifying patterns among these categories.

3.9. Ethics Consideration

Every study involving humans requires a set of ethical considerations (Merriam & Tisdell, 2009). The ethical considerations that this study considered included informed consent, confidentiality, the right to privacy and anonymity, and the right to protection against possible harm.

Informed consent

Informed consent is a mechanism for ensuring that people understand what it means to participate in a particular research study, so that they can decide in a conscious, deliberate way, whether they want to participate or not. According to Kumar (2005), informed consent involves seeking permission from participants to participate in the study. In this regard, the study was explained to the participants, and participants were issued with consent forms and requested to sign them, if they willingly agreed to participate in the study, and submit a copy to the researcher.

Confidentiality and anonymity

Confidentiality and anonymity involve the manner in which research information is safeguarded and the identity of the people and the institutions involved are protected (Punch, Creed & Hyde, 2006). Assurance of confidentiality of data was achieved by saving the information in a password protected document on my personal computer. Anonymity is a condition in which researchers and the public do not know the identity of participants. In situations where research poses some risks for participants, anonymity may improve cooperation. While it is difficult for the researcher to maintain anonymity of the participants, he assured participants that their identity would not be revealed to the public, and that letters and numbers would be used to represent participants and their institutions. Moreover, the research setting, and participants would not be described in reports in a way that would reveal their identity (McMillan & Schumacher, 2010).

The right to privacy

Everyone has the right to privacy. In this study, participants' right to privacy was respected by making appointments with participants for the interviews, ensuring they are not interviewed at awkward times and places. It helps to ensure privacy in research, so that participants are not inconvenienced, and that they can feel comfortable to reveal information that would not be linked to them.

The right to protection against possible harm

The researcher has an obligation to safeguard participants against harm, by protecting their health, wellbeing and human rights. It is not always easy or even possible to measure the dangers of a certain research context. However, I ensured that participants are protected from psychological, emotional and professional harm, by ensuring anonymity, using the information provided strictly for the research only, and assuring participants of psychological counselling if required.

The following chapter presents the results of the study.

Chapter 4: RESULTS

Introduction

The purpose of the study was to investigate the quality of Physical Sciences formative assessments in selected schools, and to compare the quality of the assessments in participating schools. In addition, the factors that influence educators' choices of formative assessment items were explored.

The primary research question was: What is the quality of Physical sciences formative assessments and what influences Physical Sciences educators' choices of formative assessment items? In order to explore this question, the following sub-questions were investigated.

1. What is the quality of selected FET Physical Sciences formative assessments?
2. To what extent do selected Physical Sciences formative assessments align with the objectives of the CAPS document?
3. How does the quality of formative assessments compare in different school types?
4. What influences selected Physical Science educators' choices of formative assessment tasks?

Document analysis and semi-structured interviews were used to collect data. Therefore, the results of the study are presented in two sections, where the first section displays data from Document analysis, while the second section displays data from the semi-structured interviews.

4.1. Document analysis results

Document analyses were used to respond to research questions 1, 2 and 3. Formative assessments from three schools were analysed to determine their quality, in terms of their content validity, authenticity and alignment to revised Bloom's cognitive levels in response to research question 1. The alignment of formative assessment with Physical science CAPS objectives was also analysed to respond to research question 2. Finally, quantities of the quality measures determined from assessments from the three participating schools were compared to respond to research question 3. The results from these analyses are presented below.

4.1.1. Quality of Physical sciences formative assessments

The graphs and the tables below show the qualitative data obtained from the review of question papers that were collected from the three different schools. The results from the review of formative assessment papers are presented in the following order: content validity, authenticity, alignment of assessments with Bloom's cognitive levels and with the CAPS objectives.

4.1.1.1. Content validity of formative assessments

The topics that were used to determine the content validity of the assessments, which are taught in the second terms of each grade are listed below.

Table 4.1: *Descriptions of Physical science topics taught in different grades*

	Grade 10 topics	Grade 11 topics	Grade 12 topics
Topic 1	Revised matter and classification	Vectors in one and two dimensions	Momentum and Impulse
Topic 2	States of matter and the kinetic molecular theory	Newton's laws of motion	Vertical Projectile motion
Topic 3	The Atom	Atomic Combination	Organic compounds and structures (Nomenclature)
Topic 4	Periodic Table	Newton's Universal law of gravity	organic reactions and Polymers
Topic 5	Chemical Bonding	Atomic Combination	

The alignment of the items from the reviewed formative assessments is tabulated on the table below, in the form of percentages.

Table 4.2: *Percentages and Content validity index of Grade 10, 11 and 12 formative assessments in selected schools*

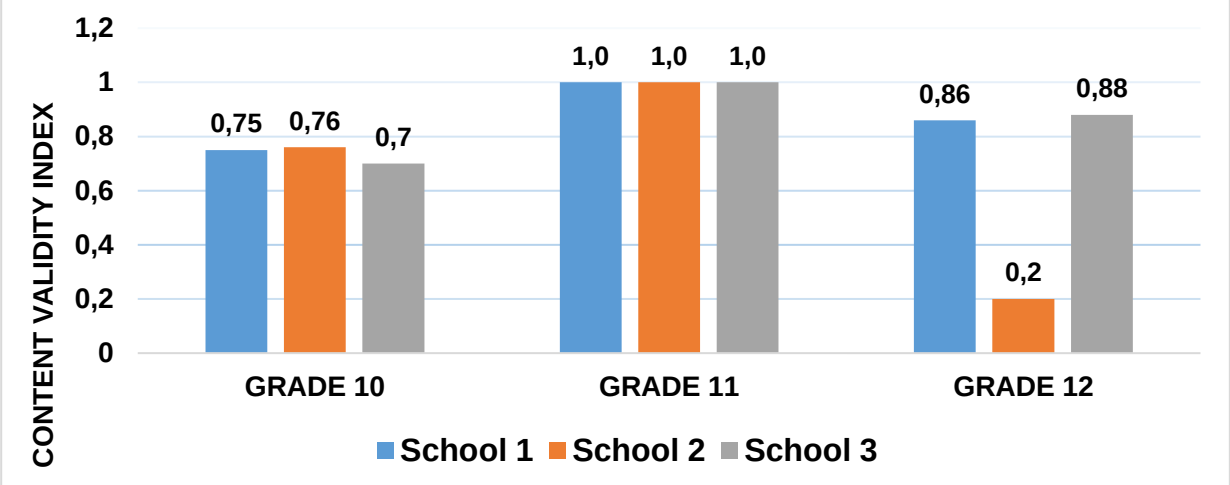
	GRADE 10							GRADE 11							GRADE 12					
Schools	Topic 1%	Topic 2%	Topic 3%	Topic 4%	Topic 5%	Not aligned	***CVI**	Topic 1%	Topic 2%	Topic 3%	Topic 4%	Topic 5%	Not aligned	***CVI**	Topic 1%	Topic 2%	Topic 3%	Topic 4%	Not aligned	***CVI**
1	18	23	2	17	15	25	**0,75**	0	16	63	21	0	0	**1,0**	0	45	41	0	14	**0,86**
2	3	19	35	11	8	24	**0,76**	0	21	19	14	46	0	**1,0**	20	0	0	0	80	**0,2**
3	13	17	22	3	15	30	**0,7**	0	22	18	14	46	0	**1,0**	14	30	28	16	12	**0,88**

*CVI = Content Validity Index

For each assessment paper in each grade, the percentages of items aligned to each topic were determined. Items, which were not aligned to any of the topics stipulated for the grade in term

one were placed under the 'not-aligned' column. The assessments from school 2 and school 3 were based on common department question papers, with minor changes, hence the similarity in the number of items focusing on the various topics. The sums of the percentages under the different topics per school were calculated and divided by 100 to obtain the Content Validity Index (CVI) of that specific assessment paper. For example, for the grade 10 assessment in school 1, 30% of the items in the paper were aligned to topic 1, none were aligned to topics 2 and 3, while 20% of the topics were aligned to each of topics 4 and 5, giving a sum of 70%. The 70% was divided by 100 to provide a CVI of 0.7. In this assessment, there were no items that were not aligned to any of the stipulated topics. The CVIs for the assessments from the different schools are presented in Graph 4.1 below.

Figure 4.1: *Histogram of content validity indices of Grade 10, 11 and 12 formative assessments in selected schools*



The graph above shows that the content validity indices of the formative assessments from three selected schools were at 0.7 and above, for most of the grades. This means that most of the assessment items were based on the Physical science content prescribed for term one and are therefore considered to have content validity. However, the Grade 12 assessment from school 2 has a content validity index of 0.2, which means that most of the assessment items in this assessment were not aligned to the topics prescribed for term one in this grade.

4.1.1.2. Authenticity of formative assessments

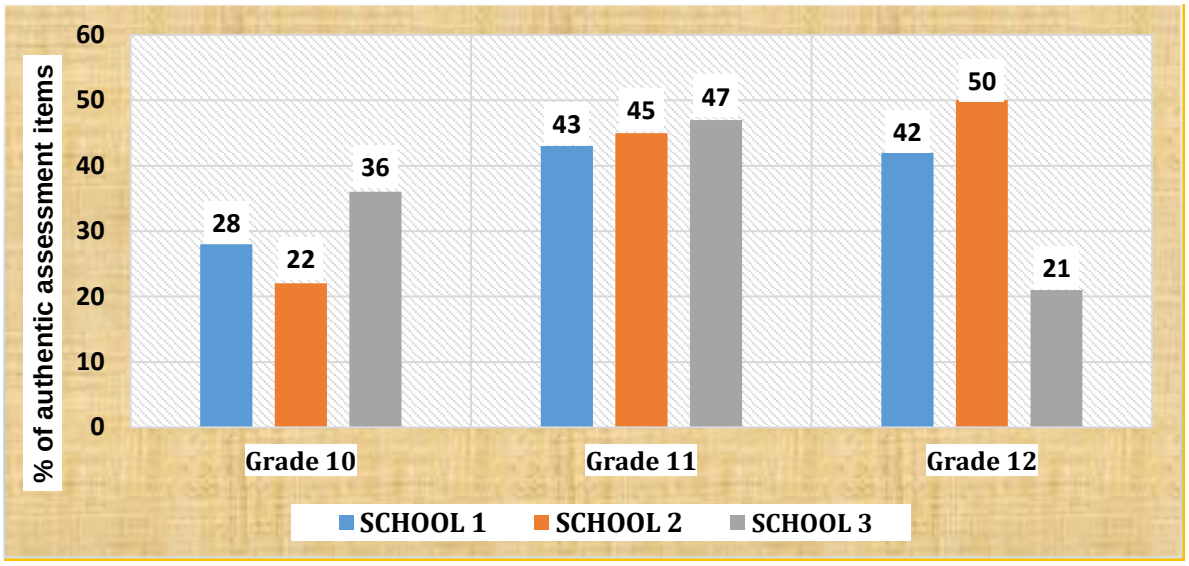
To calculate the authenticity of the formative assessments from different schools, items from the past papers were examined and it was determined whether they relate to real life contexts or not. For each assessment paper, the percentage results of the items that relate to real life contexts were determined and displayed in Table 4.3 below.

Table 4.3: *Percentages of authentic items in Grade 10, 11 and 12 formative assessments from selected schools*

School	Grade 10 /%	Grade 11 /%	Grade 12 /%
1	28	43	42
2	22	45	50
3	36	47	21

The percentages of authentic items in formative assessments from selected schools are shown in the graph below.

Figure 4.2: *Histogram of the authenticity of formative assessment from selected schools*



Looking at graph above, it is clear that, of the three grades, only the grade 12 formative assessment from school 2 is authentic, with 50% of the assessment items involving on real life situations. All the other assessments from the different schools and grades have less than 50% authenticity. Grade 10 assessments have the lowest authenticity.

4.1.1.3. Alignment of formative assessments with Bloom's cognitive levels

In this section, the alignment of formative assessment with the cognitive levels from Bloom's taxonomy, which include: remember, understand, apply, analyse, evaluate and create, was determined.

This was done by identifying the verbs associated with the assessment items, and then relate them to appropriate cognitive levels. For instance, if an item requires learners to name or identify something, then the question is at the 'remember' cognitive level. On the other hand, if the

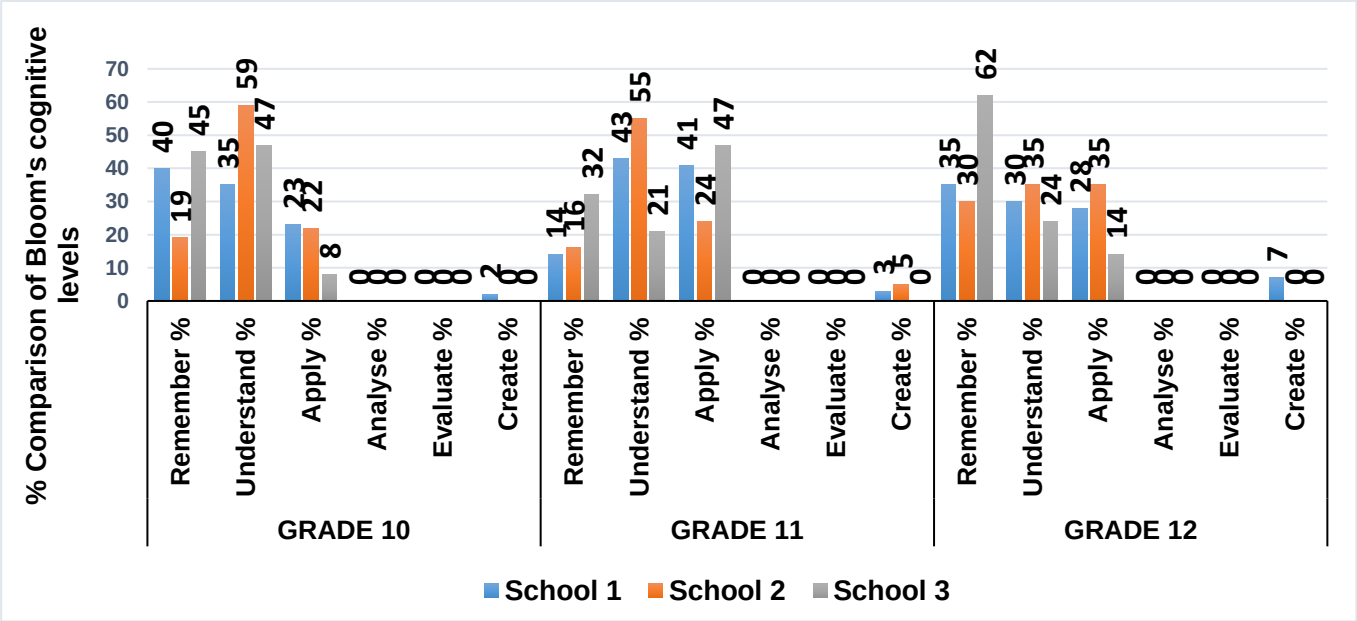
question requires the learners to construct or to formulate, then the question is at the 'creation' cognitive level. See appendix X for the verbs used to identify the cognitive levels at which formative assessment items were pitched. The percentages of the items pitched at each of Bloom's cognitive levels were calculated and are presented in Table 4.4 below.

Table 4.4: *Percentages of assessment items aligned to Bloom's cognitive levels in selected schools*

	GRADE 10						GRADE 11						GRADE 12					
School No.	Remember/ %	Understand/ %	Apply/ %	Analyse/ %	Evaluate/ %	Create/ %	Remember/ %	Understand/ %	Apply/ %	Analyse/ %	Evaluate/ %	Create/ %	Remember/ %	Understand/ %	Apply/ %	Analyse/ %	Evaluate/ %	Create/ %
1	40	35	23	0	0	2	14	43	41	0	0	3	35	30	28	0	0	7
2	19	59	22	0	0	0	16	55	24	0	0	5	30	35	35	0	0	0
3	45	47	8	0	0	0	32	21	47	0	0	0	62	24	14	0	0	0

The percentages of items pitched at each cognitive level in different grades in the participating schools are presented in the histogram in figure 4.3.

Figure 4.3: *Histogram of the alignment of formative assessments with the revised Bloom's cognitive levels from selected schools*



It is evident from the above graph that most of the formative assessments from all participating schools are pitched at the first three cognitive levels, i.e. 'remember', 'understand' and 'apply', which are lower order thinking levels.

Moreover, most of the assessment items are pitched at the understanding level. Only the Grade 10 and grade 12 assessments from school 1 had some assessment items pitched at the "create" cognitive level.

4.1.2. Alignment of formative assessment with Physical science CAPS objectives

To determine the alignment of formative assessments with the objectives in the CAPS Physical Sciences document, each of the assessment items were examined and linked to the relevant Physical Sciences CAPS objectives, which are indicated in Table 4.5 below:

Table 4.5: *CAPS objectives for Physical sciences*

Objective 1	To make learners aware of their environment. To equip them with investigative skills. Relating to physical and chemical phenomenon
Objective 2	To promote knowledge To promote skills in scientific inquiry To promote problem solving
Objective 3	To promote the construction of scientific and technological knowledge To promote application of scientific knowledge To promote application of technological knowledge.
Objective 4	To promote understanding of nature of science. To promote understanding of nature of science in relation to technology To promote understanding of nature of science in relation to society and the environment.

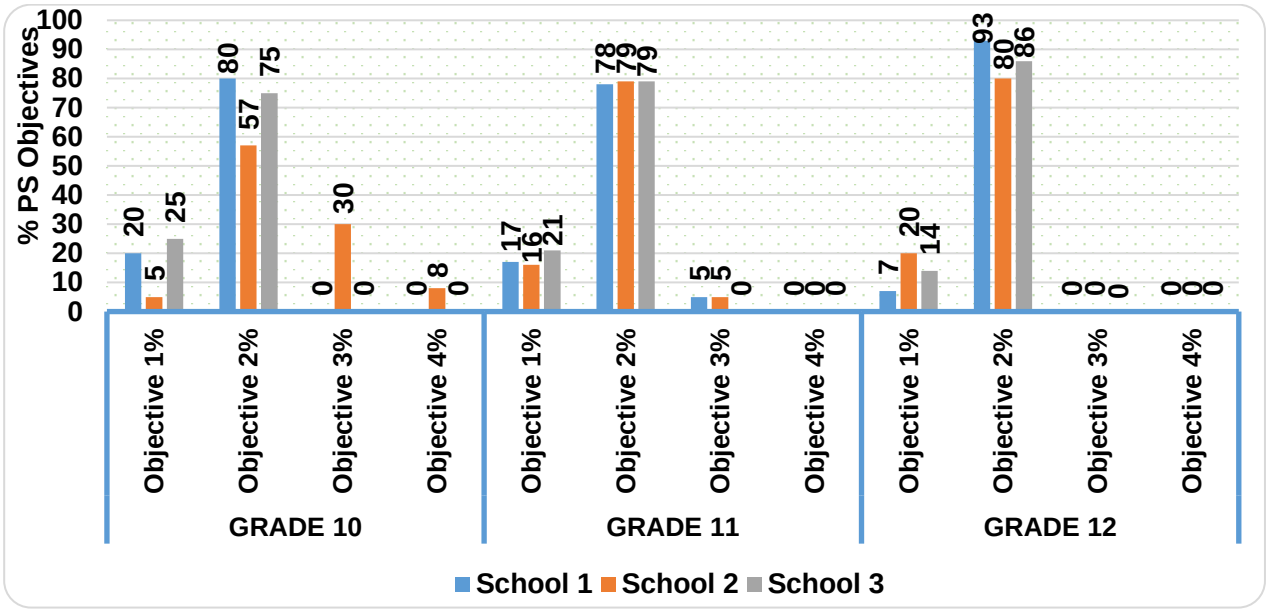
The percentages of assessment items that were aligned to each of the stated CAPS objectives were calculated. Items that fell under more than one objective were included into each of the relevant objectives. The percentages of items under each objective are displayed in the Table 4.6 below.

Table 4.6: *Percentages of assessment items aligned to CAPS physical sciences objectives in selected schools*

School No.	GRADE 10				GRADE 11				GRADE 12			
	Objective 1%	Objective 2%	Objective 3%	Objective 4%	Objective 1%	Objective 2%	Objective 3%	Objective 4%	Objective 1%	Objective 2%	Objective 3%	Objective 4%
School 1	20	80	0	0	16	78	5	0	7	93	0	0
School 2	5	57	30	8	16	79	5	0	20	80	0	0
School 3	25	75	0	0	21	79	0	0	14	86	0	0

The percentages of assessment items under each CAPS objective are displayed in the graph below.

Figure 4.4: Histogram of the alignment of formative assessment from selected schools with CAPS Physical sciences objectives



Looking at the graph, it shows that the assessments from the three schools are mostly aligned to objective two. Objective one has the second highest number of assessment items associated with it. Of the four objectives, objective 4 reflects the lowest percentage of formative items aligned to it, in all grades.

4.1.3. Comparison of the quality of formative assessment among different schools

This section displays the data required to respond to research question 3, which deals with the comparison of the quality of formative assessments in all three participating schools. The quality measures which were compared are; (a) content validity, (b) authenticity, (c) alignment with Bloom's cognitive levels and (4) alignment with CAPS objectives.

It is important to mention, at this point that, the tables and histograms used to compare the stated quality measures in participating schools are the same as those used for determination of the quality of formative assessments in themes 4.1.1 and 4.1.2 above. Therefore, the tables and histograms displayed under these themes will not be reproduced in the current theme. Rather I will simply refer to the relevant tables and figures from themes 4.1.1 and 4.1.2, when making the comparisons.

4.1.3.1. Content validity

As explained earlier, a Content Validity Index (CVI) of 0.7 and above is considered valid, whereas a CVI of less than 0.7 renders the assessment less valid (Polit & Beck, 2006). The comparison of the content validity of formative assessments from the three participating schools is displayed on table 4.2 and Figure 4.1 above. This figure shows that in Grade 10, the assessments from schools 1 and 2 have the same content validity index (0.8), while that of school 1 is slightly lower (0.7). Strangely, in Grade 11, all the assessments from the three schools have a content validity index of 1.0, which means that all the items in the assessments were aligned to the content prescribed for the grade in term one. In grade 12, school 1 has the highest CVI of 0.9, while school 2 has the lowest CVI of 0.2, and the assessment is considered to be invalid as its CVI is less than 0.7, which is the accepted CVI for valid assessments (see Table 4.1).

In summary, the assessments of the assessments from all three schools were valid in terms of their alignment to the prescribed content. However, the average CVI for school 2 is 0.67, which is less than 0.7. Assessments from school 1 have the highest content validity with a CVI of 0.87, followed by school 3 with an averaged CVI of 0.83.

4.1.3.2. Authenticity

Authenticity of an assessment relates to the inclusion of sufficient assessment items that require learners to apply learnt content to real-world situations (Mohamed & Lebar, 2017). The formative assessment from the three participating schools were considered authentic if 50% and above of the assessment items are based on real-life issues (Frey, et al., 2012). The information displayed on figure 4.2 above shows that formative assessments, from the three participating schools, except one were not authentic, as less than 50% of the items in the assessments were authentic. Only the Grade 12 assessment from school 2 had 50% of the items linked to real-life situations. Nonetheless, the Grade 11 assessments from all three schools and the Grade 12 assessment from school 1 had more than 40% of the items in their assessments linked to real life situations, which signifies that although the assessments did not reach the 50% threshold, an effort was made to include a significant number of authentic items (See Figure 4.2). Grade 10 formative assessments from all participating schools are generally less authentic.

4.1.3.3. Alignment with Blooms' cognitive levels

For this measure of assessment quality, assessment items were related to the revised Bloom's Taxonomy of educational objectives, which include; remembering, understanding, applying, analysing, evaluating and creating (Anderson & Krathwohl, 2001). The first three levels i.e. 'remembering', 'understanding' and 'apply' are considered to involve lower order thinking skills, while the last three levels i.e. 'analyse', 'evaluate' and 'create' reflect higher order thinking skills. Based on this understanding, items from the formative assessment from the three participating schools were related to each of the revised Bloom's cognitive levels.

In Grade 10, school 2 had more items at the 'understand' level (59%), followed by school 3 (47%). For the 'remember' level, school 3 had the highest number of items (45%), followed by school 1 (40%). In addition, Schools 1 and 2 almost have the same number of assessment items (23% and 22% respectively) under the 'apply' cognitive level, with school 3 having the least number of assessment items (8%) at this level. Only school 1 included assessment items pitched at the 'create' cognitive level (See Table 5).

For Grade 11 assessments, School 2 has the highest number of items (55%) under the 'understand' cognitive level, followed by school 1 with 43% assessment items under this level. In this grade, the second cognitive level with the highest number of assessment items is 'apply', where school 3 has the highest number of assessment items (47%), followed by school 1 with 41% of the assessment items. Furthermore, School 3 has the highest assessment items (32%) under the 'remember' level, with schools 1 and 2 having more or less the same number of items (14% and 16% respectively). Schools 1 and 2 included some 'create' items in their assessments (3% and 5% respectively) (See Table 5).

In Grade 12, formative assessments from all three schools contained items which were more or less uniformly distributed under the 'remember', 'understand' and 'apply' cognitive levels. In this grade school 3 has the highest number of items (62%) under the 'remember' cognitive level, then school 1 with 35% and school 2 with 30% of the assessment items at this level. For the 'understand' and 'apply' cognitive levels, school 2 has the highest number of assessment items (35% at each level), followed by school 3 with 30% and 28% of the assessment items pitched at these levels. School 3 has the least number of items at these cognitive levels. Only the assessment from school 1 included assessment items (7%) at the 'create' cognitive level (Figure 4.3).

Overall, all assessments from the three participating schools were mostly aligned with the first three cognitive levels of the revised Bloom taxonomy; Remember, Understand and Apply. None of the schools assessed learners at analysis and evaluation cognitive levels. School 1 included more 'create' assessment items than the other two schools, and school 3 assessments do not go beyond the 'apply' cognitive level (See Table 4.3).

4.1.3.4. Alignment with CAPS objectives

Another measure of assessment quality is alignment of assessment items with the objectives of the subject, which are provided on Table 4.5. From the information on graph 4.4, it appears that most of the items in formative assessments from all participating schools are aligned with objective 2 of the Physical sciences curriculum. In grade 10, 80% of the assessment items from school 1 related to objective 2, 75% of the assessment items from the assessment from school 3 were associated with objective 3, and 57% of the items from the assessment from school 2 were based on the same objective. 20% and 25% of the assessment items from Schools 1 and 3 respectively are based on objective 1. Only the assessment from school 2 had items based on objectives 3 and 4.

For the Grade 11 assessments, most items were also based on objective 2, and all the assessments from the three schools had 78% to 79% of their items based on this objective. The items based on objective 1 are 16% for school 1, 16% for school 2 and 21% for school 3. All assessments from the three schools had 5% of their assessment items based on objective 3, while none of the items from all the assessments were based on object 4.

Similarly, in Grade 12, most of the assessment items (80% to 93%) were based on objective 2. For objective 1, 7% of the assessment items from school 1 were based on this objective, school 2 had 20% of its assessment items based on the objective and 14% of the assessment items from school 3 based on the objective. None of the participating schools set assessment items based on objectives 3 and 4.

4.2. Semi-structured interviews results

Semi-structured interviews were used to collect data to respond to question 4, which relates to factors that influence educators' choice of formative assessment tasks. In addition, data from interviews were meant to corroborate the findings from document analysis. The codes used in

the interview narratives are E followed by a number stands for the educator number, T followed by a number represents the theme number, and roman numerals represent the interview question. For example, E1T2iv represents a response provided by Educator 1, under theme 2 for question number 4. The following narratives describe responses from interviewed educators.

Theme one: Quality of FET formative assessments

This theme was meant to solicit information for answering research questions 1, where the researcher wanted to determine participants' perceptions about the quality of their formative assessments. Participants were initially asked to explain how they ensure that their formative assessments are of high quality. In response to this question, participants indicated that; the content covered, what is prescribed by CAPs policy document and assessment policies, assessment of other educators' inputs and moderations and cognitive levels determine the quality of formative assessments.

> *E2T2ii: "The quality of formative assessment is determined by CAPS policy document and assessment policies. Further, educators' inputs and moderation will ensure high quality of formative assessment.*

Furthermore, participants' responses to questions related to different quality measures are discussed below.

Sub-theme 1: Alignment of formative assessments with prescribed content.

This sub-theme displays participants' responses regarding their adherence to prescribed content when setting formative assessments during a specified learning period. The first question asked under this sub-theme was: Do you consider the content covered in your lessons when setting formative assessments? Educators' responses to this question was that content is important for providing the scope for *planning and to structure assessment questions. For example, E2T2ix responded that; "The type of content that is different has an effect in the planning of assessments, which in turn impacts the level of questions that are asked*". It appears that the participating educators perceive assessment quality in relation to the inclusion of prescribed content only.

Sub-theme 2: Authenticity of formative assessments

In this sub-theme, participants were required to indicate whether they think aligning formative assessments to real life situations is important when setting formative assessments. Their collective responses suggest that they value the inclusion of real-life issues in assessments

because it provides an opportunity for learners to apply what they have learnt to everyday life, and it also motivates them to solve real-life problems. For instance, one participant provided the following response.

> E1T2iii: *Yes! "Aligning formative assessment to real life situations is important as it shows the learners the importance of what they have learned, the need for learning content and how it can benefit them in real life situations, with the potential to motivate them as they relate what they do in class to the future*".

When asked how often they align formative assessments to real life situations, two of the educators' responses did not answer the question of '*how often*'. Only one educator indicated that he does not often align formative assessments to real-life situations. He explained that learners often miss the essence of the question if it is related to a real-life situation as they become enthralled with the real-life situation instead of looking at the science in the question. He also claimed that learners usually confuse new science terms with those from real life situations.

Sub-theme 3: Alignment of formative assessments with Blooms' cognitive levels

Under this sub-theme, educators were required to indicate whether they consciously try to align their formative assessments with the cognitive levels of Bloom's taxonomy. In response to this question, educators indicated that Bloom's cognitive levels are deliberately taken into cognisance when setting formative assessment tasks, to avoid repeating questions pitched at the same cognitive level, as evident from the quotation below.

> *E1T2vii: Yes! "Although it is not done all the time. It is important to visit Bloom's cognitive levels when asking questions that relate to Physical Sciences so that*
>
> *educators do not ask learners the same type of questions all the time".*

Regarding the frequency with which educators align assessment items with Bloom's cognitive levels, two of them responded that they do not always align assessments with Bloom's taxonomy of cognitive levels. One indicated that she relates all her assessment tasks to Bloom's cognitive levels as indicated in this statement; E3T2viii: "*In every task, I try by all means to include the cognitive levels*"

4.2.1. Theme two: Alignment of formative assessments with CAPs objectives

In order to obtain information to respond to research question 2, which relates to the extent to which participants aligned their formative assessments with the objectives of the Physical

sciences CAPS document. When asked whether they align Physical sciences formative assessment tasks with the objectives of the CAPS document, all participants indicated that aligning formative assessment to CAPs objectives is important as a guide to assess learners' competence in prescribed physical sciences content. For example, one participant said,

> E1T2v: *Yes! "It is important to align Physical sciences formative assessment tasks with the objectives of the CAPS document, because the document is designed to allow learners to acquire knowledge progressively and it accommodates all learners in class*".

The participants were further asked how often they consciously try to align formative assessment tasks with CAPS objectives. Their responses suggest that they do so every single day, as implied in this statement: E1T2vi: "*Alignment of formative assessment tasks to CAPS objectives is always done so that not more or less of work is done in the particular topic for the particular grade*".

4.2.2. Theme three: Factors that influence educators' choices of formative assessment tasks

Under this theme, the investigator wanted to find out participants' perceptions about the factors that influence their choices of formative assessment items, in response to research question 4. When asked about the personal factors that they thought affected their choices of formative assessment tasks, they provided different reasons, which include; challenge to with engage CAPs and Assessment policies, educators' knowledge of the subject, lack of foundational knowledge (language and mathematical proficiency); inexperience in teaching the content and the challenge to infuse CAPs objectives in formative assessments. Some of these factors are expressed in the quotation below.

> E1T2x: *"Knowledge of the subject is important, because it becomes easy to align assessments with relevant content. And through experience, educators will know learners' response to certain tasks and which tasks will measure what knowledge and understanding".*

In relation to the contextual (circumstantial) factors that they take into consideration when selecting formative assessment tasks, the participants provided several factors. These include: (1) lack of resources (infrastructure, photocopying facilities, worksheets, materials for practical activity, stationery). (2) Large class sizes make educators set assessments that can be marked fast. (3) Learners' inability to comprehend simple Physical Science terms or concepts. And (4)

high teaching workloads, which does not leave educators with sufficient time to focus on setting quality assessments, as evident in the statement below:

> E1T2xi: "*There are number of contextual factors that one takes into consideration when selecting formative assessments: The size of the class, materials for conducting practical work, photocopying facilities to produce worksheets for the and educators' workload, in terms of number of period per day, makes it impossible to select effective formative assessment tasks".*

These contextual factors present difficulty in making rational choices of formative assessments, according to the participating educators. Nonetheless, interviewed educators did not mention any of the measures of quality in assessments, such as validity, authenticity, alignment to cognitive levels and to curriculum objectives.

4.3. Summary of findings

The results presented in this chapter involves the determination of the quality of Physical sciences formative assessments in relation to their content validity, authenticity, alignment with the cognitive levels of Bloom's taxonomy and alignment with the Physical sciences CAPS objectives.

The first research question was, "What is the quality of selected FET Physical sciences formative assessments? The findings regarding this question are summarized as follows:

- *Content Validity* – All three schools' formative assessments met the recommended content validity with CVI of 0.7 and above, except for one grade 12 assessment, except for one grade 12 assessment, which has CVI of 0.2.
- *Authenticity* – Formative assessments from all the three schools were of low authenticity.
- *Alignment with Bloom's cognitive level* – Most formative assessments from the three schools were pitched on low order thinking skills, with very few pitched at high order thinking skills.

The second research question relates to the extent to which selected Physical sciences formative assessments align with the objectives of the CAPS document. The findings indicate that: Most of the formative assessments from the three participating schools were related to objective 2: To promote knowledge and skills in scientific inquiry and problem solving, and on objective 1: To

make learners aware of their environment and to equip learners with investigating skills relating to physical and chemical phenomena. Higher order thinking levels were rarely assessed.

Regarding the third research question, results from the comparison of the quality of Physical sciences formative assessments from selected schools for grade 10 – 12 showed similar trends for all assessments from the participating schools, regardless of their socio-economic status.

The fourth research question sought to establish the factors that influence educators' choices of formative assessments and educators cited several personal and contextual factors that could negatively impact on the quality of formative assessments. The personal factors include lack of; knowledge of CAPs and Assessment policies, subject matter knowledge, foundational knowledge; PCK for teaching the content, and the challenge to infuse CAPs objectives in formative assessments. The cited contextual factors are: lack of resources, large class sizes learners' inability to comprehend simple Physical Science terms or concepts, and high teaching workloads.

Having presented the findings of the study, the next chapter discusses these findings.

Chapter 5: DISCUSSION OF FINDINGS

Introduction

This chapter includes a summary of the study, a discussion of findings involving; the quality of FET formative assessments, alignment of formative assessments with CAPs objectives, comparison of the quality of formative assessments from selected schools and factors that influence educators' choices of formative assessment tasks. In addition, the chapter also discusses the limitations and implications of the findings, as well as recommendations and conclusions.

5.1. Summary of the study

The purpose of the study was to determine the quality of Physical Sciences formative assessments in terms of their validity, authenticity, the cognitive levels at which they were pitched, and their alignment to the Physical Sciences CAPs objectives, as well as the factors that influenced educators' choices of formative assessment items. In addition, I compared the quality of formative assessments from participating schools and explored the factors that influenced educators' choices of formative assessments items. These investigations and comparisons were an attempt to address the primary research questions of this study, which is: *What is the quality of Physical sciences formative assessments and what influences Physical sciences educators' choice of formative assessment items*?

The qualitative research approach used to collect data was successful in achieving the objectives of the study. Collection of data using document analysis and interviews proved to be effective for determining the quality of physical sciences formative assessments and the factors that influence educators' choices of formative assessment tasks. The following section discusses the findings of the study. The conceptual framework of this study was used to pull the different aspects of the study together, to have a holistic understanding of the quality of Physical sciences formative assessments administered to learners. In doing so, the researcher understood how each measure of assessment quality and factors that affect educators' choice of formative assessment tasks influence the overall quality of Physical sciences formative assessments.

5.2. Discussion of findings

In this section, I will discuss the findings pertaining to the; quality of Physical sciences formative assessments, alignment of formative assessments with CAPs objectives, comparison of the

quality of formative assessments from selected schools, and factors that influence educators' choices of formative assessment tasks.

5.2.1. Quality of Physical sciences formative assessments

The first sub-theme discusses the quality of physical sciences formative assessments, in relation to their content validity, authenticity, and alignment with revised Bloom's cognitive levels.

The finding from this study shows that in relation to content validity, all the formative assessments from the selected schools met the recommended content validity, except the Grade 12 assessment from school 2, whose content validity index was 0.2. This means that, as far as content validity is concerned, most of the formative assessments reviewed are of high quality. Many scholars recommend content validity indices of 0.7 and above, as acceptable levels for quality assessment. For instance, in a study conducted by Wynd, Schmidt & Schaefer (2003), they considered assessments with content validity of 0.7 as having high content validity. In addition, Polit and Beck (2006) indicated that assessments with a content validity index of 0.8 and above reflect high quality assessments.

This finding is important as it suggests that the Physical sciences formative assessments used to assess FET learners are mostly based on the content that is prescribed for each grade. However, the one grade 12 assessment from school 2, which has a low content validity, might be an indication that some of the formative assessments used to assess FET learners, may be of poor quality. It might be necessary to conduct other studies to corroborate this finding.

Regarding the quality of formative assessments in relation to their authenticity, the findings from the study indicate that the authenticity of all the formative assessments from the selected schools is low. This is because all the assessments contained less than 50% of authentic items, except one grade 12 assessment from school 2, which had an authenticity level of 50%. This finding from the study is worrying as it implies that most of the FET Physical sciences formative assessments administered to learners consist of items that are not related to real life issues, but focus on theoretical and abstract content. It is worth noting that this is the only assessment that was found to have a low content validity index (CVI = 0.2). This correlation might suggest that when educators focus on designing authentic assessments, they stand the risk of deviating from the prescribed course content.

The finding from this study is parallel to that from Frey, et al. (2012)'s study, where it was observed that the analysed high school formative assessments had low authenticity. The authors

assumed that the result could have been a result of the difficulty experienced by high school educators when dealing with a number of factors related to assessments, such as; lack of understanding of the meaning of assessments, time constraints, complexity of thought, and low levels of student participation. Furthermore, Kankam, et al. (2014) asserted that assessments from high schools are of low authenticity because educational policies do not recognise the importance of authentic assessments.

Chan and Sidhu (2010) suggested that authentic assessment should be viewed as an alternative to traditional standardized assessments and should be given more attention. It is important to improve the authenticity of FET Physical sciences formative assessments because the subject deals with real life issues and learners need to be trained and assessed in these issues. In this regard, Frey, et al., (2012) emphasised the need to increase the quality of formative assessments in terms of their authenticity, in order to increase learners' complex thought and ability to solve real life problems.

In relation to alignment of formative assessments with Bloom's cognitive levels, the findings reflect that most of the items in the analysed formative assessments from the three participating schools are based on the first three cognitive levels (remember, understand and apply), which assess low order thinking (Anderson & Krathwohl, 2001). None or very few items were pitch at the last three levels of Bloom's taxonomy (analyse, evaluate and create). This implies that formative assessment items from all three selected schools, from grade 10 – 12, measure learners' low levels of cognition, rather than higher order thinking skills that are required in the workplace and in everyday activities.

Motlhabane (2017) mentioned that assessment questions should be structured from low to high order thinking skills in order to test different knowledge skills and to determine the quality of learning. Literature (Edwards, 2010) suggests that formative assessments pitched at low levels of knowledge compromise learners' core knowledge and conceptual understanding of Physical Sciences. Given the fact that formative assessments support teaching and learning (Van der Horst & McDonald 2007), the finding from this study, is of concern as it implies that learners might leave the schooling system without developing higher order thinking skills, which are necessary to address issues and solve problems both at work and in everyday life. These findings suggest a need to improve the quality of formative assessments, especially regarding their authenticity and alignment with Bloom's cognitive levels, in order to improve the quality of these assessments in determining learners' real capabilities.

Designing quality assessments might require experienced educators who know the correct verbs to use to test higher order thinking skills. Therefore, the Department of Education needs to initiate Continued Professional Development (CPD) programmes to capacitate educators in generating questions that go beyond just remembering laws and principles, but include the assessment of higher order thinking skills (Motlhabane, 2017). However, there is need for more research to determine the quality of FET formative assessments in Physical sciences, to corroborate the findings from the current study.

5.2.2. Alignment of formative assessment with Physical science CAPS objectives.

The findings from this study show that items in FET Physical sciences formative assessments from the three selected schools were mainly focussing on objective 2, which is "*To promote knowledge and skills in scientific inquiry and problem solving*". This was followed by objective 1; "*To make learners aware of their environment and to equip learners with investigating skills relating to physical and chemical phenomena*". Very few assessment items are related to objectives 3 and 4, which relate to "*To promote the construction and application of scientific and technological knowledge*" and "*To promote an understanding of the nature of science and its relationships to technology, society and the environmen*t", respectively.

This result entails that FET Physical sciences formative assessments are still designed to test content acquisition rather than understanding of the nature of sciences and application of knowledge. Khoza (2015) found similar results that assessments in South Africa do not always focus on curriculum objectives and concluded that educators were unable to interpret the current curriculum, hence there is a misalignment between formative assessments and what is prescribed in the curriculum. In this regard, Maphalala and Mpofu (2017) found that educators experienced difficulty in shifting from the competent-based curriculum (NCS) to the performance-based curriculum (CAPs), hence are unable to interpret the intended curriculum. The CAPS was introduced to strengthen the National Curriculum in order to improve the quality of teaching, learning and assessment in schools (Maphalala & Mpofu, 2017). Therefore, the quality of FET Physical sciences assessments is compromised if educators do not address some of the objectives of the curriculum.

5.2.3. Comparison of the quality of formative assessment among the participating schools

The purpose of this theme is to compare the quality of FET Physical sciences formative assessments from a township public school, a former model C school and an independent school. The comparisons focused on the content validity, authenticity, alignment to Bloom's cognitive levels and CAPs objectives, of formative assessments from the participating schools. Therefore, the discussion of the comparison of these quality measures in different schools is done separately.

Comparison of the content validity of assessments from the three participating schools

A comparison of the quality of Grade 10 formative assessments of the three selected schools showed that the content validity index of all formative assessments from the compared schools was almost the same, with slight differences. The formative assessments from all the three schools had CVI of 0.7 and above, which indicates high content validity. The same applies to the formative assessments for Grade11, in that all assessments from the three selected schools had the same content validity of 1.0. For Grade 12, the content validity indices of formative assessments from school 1 and 3 were almost the same, with CVIs values of 0.86 and 0.88. However, the formative assessment from school 2 has a very low CVI of 0.2. These results suggest that all the participating schools based their formative assessments on the prescribed subject content. This means that the quality formative assessments from all the three selected schools was high, in relation to their content validity, as the CVIs were over 0.7, which is the benchmark for acceptable assessment content validity indices (Yusoff, 2019). It may be inferred that there is no substantial difference in formative assessments from township public schools, former model C schools and independent schools, regarding their content validity. The use of common formative assessments from the Department of education, in addition to educator-developed assessments, might partly account for the uniformity of the quality of formative assessments in the three different school types.

Comparison of the authenticity of assessments from the three participating schools

When comparing the quality of Grade 10 formative assessments in terms of authenticity, it was evident that the authenticity of formative assessments from all three schools was below the benchmark of 50%. Formative assessments from school 3 had the highest authenticity of 36%, followed by school 1 with authenticity of 28%. For Grade 11 formative assessments, the findings also show low authenticity of the assessments from all the three schools, with slight differences (43, 45 & 47 %). In Grade 12, school 3 reflected a very low percentage of authentic formative assessment items (21%), compared to schools 1 and 2, with the assessment from school 2

showing the highest percentage (50%) of authentic items. 2. Generally, all the assessments from the three schools showed low authenticity, as Frey, et al., (2012) suggested that only assessments with authenticity of above 50% are considered to reflect high quality assessments. The authenticity of assessments plays a significant role in developing students' skills and ability necessary for dealing with real life situations (Mohamed & Lebar, 2017). It is therefore worrying that none of the three sampled schools designs formative assessments that determine learners' competence in dealing with real life issues.

Comparison of the alignment of the assessment from the three participating schools with Bloom's Cognitive levels

Regarding the alignment of FET formative assessments with Bloom's cognitive levels, the results show that all the three schools focused their assessment items on the first three levels of Bloom's taxonomy (remember, understand & apply). Formative assessments from school 1 contained a few items pitched at the create level, in all three grades. The Grade 11 assessment from school 2 also had some items pitched at the create level, while the assessment from school 3 had no items pitched at this level. None of the formative assessments from all the three schools had items pitched at the analyse and evaluate levels. This comparison shows that all three participating schools design assessments that are pitched at low thinking levels. Educators' tendency to assess low order thinking has been observed by other scholars. For instance, a study conducted by Kabombwe, Machila, and Sikayomya, (2021) showed that items in all analysed exam papers did not require higher-level cognitive skills, in relation to Bloom's taxonomy. It seems that the tendency for educators to focus on setting lower order thinking assessments is common, which impacts negatively on the cognitive quality of their learners. There is therefore a need to encourage and to train educators to design high quality formative assessments, in relation to Bloom's cognitive levels.

Comparisons of the alignment of assessments from the three participating schools with CAPs objectives

Comparison of the Grade 10 formative assessments from the three schools in terms of alignment to the CAPs objectives indicated that all the three schools focused their formative assessments on objectives 1 and 2, at the expense of the other two objectives. In this grade, school 1 appeared to have more assessment items aligned to objective 2, followed by school 3. Comparison of the alignment of Grade 11 formative assessment to CAPS objectives showed that all three schools had approximately the same number of assessment items based on objective 2, and a few on objective 1. Similarly, for the grade 12 formative assessments, all three schools aligned their

assessment to CAPs objective 2 and 1, with the majority of items focusing on objective 2. This comparison shows that the majority of the assessment items from all the three participating schools were aligned to only two out of the four objectives of the CAPS curriculum, which reflect low assessment quality. The neglect of two of the CAPS objectives when setting formative assessments might signify educators' lack of familiarity with the CAPS objectives. To this effect, Biggs (2003B) emphasised compatibility between curriculum objectives and assessments and argued for educators to familiarise themselves with educational policy documents.

5.2.4. Factors that influence educators' choices of formative assessment tasks

In an attempt to gain a deeper understanding of the quality of Physical sciences formative assessments, educators who designed the analysed formative assessments were interviewed to establish the factors that influenced their choices of formative assessment tasks. The results showed that the quality of formative assessment from all selected schools was compromised by different factors, which include both personal and contextual factors. Personal factors include lack of; knowledge of CAPs and Assessment policies, subject matter knowledge, foundational knowledge; PCK for teaching the content and the challenge to infuse CAPs objectives in formative assessments. On the other hand, the cited contextual factors were lack of resources, large class sizes, learners' inability to comprehend simple Physical Science terms or concepts, and high teaching workloads.

In relation to factors that influence educators' choice of formative assessments, Clarke and Hollingsworth (2002) and Izci (2016) found that educators' personal knowledge and resources could negatively influence their choice of formative assessments. Among the factors identified by Clarke and Hollingsworth (2002) are professional experience and salient outcomes in teaching. Furthermore, Izci (2016) identified contextual factors such as school context, internal policies, and external factors (curriculum salience and policy documents), as influencing educators' choices of assessment.

The need to develop and administer high quality formative assessments cannot be over emphasized, as high-quality formative assessments are necessary for improving learners' performance and to enable them to compete effectively with their peers, globally. However, it seems that educators are not at liberty to choose the type of tasks to include into their formative assessments as they are constrained by several factors, some of which are beyond their control. This means that the problem of educators' failure to develop high quality FET Physical sciences formative assessments should be collectively addressed by both the educators themselves, and the school management, as well as the Department of education.

5.3. Limitations of the study

This research was conducted at three schools selected from the Gauteng province. Furthermore, only a small sample size of formative assessment papers and three educators were involved in the study. Therefore, the sample was not sufficient to provide enough evidence to conclusively determine the quality of formative assessments administered to physical sciences learners. Consequently, the findings of the study are only confined to the schools involved in this study and cannot be generalised to the entire South African physical sciences assessments. In addition, only the formative assessments administered in 2019 were analysed. It is necessary to analyse formative assessments administered over a longer time, such as three consecutive years, to determine the emerging pattern regarding the quality of formative assessments, as learners' progress from Grade 10, to Grade 11, then Grade 12. However, this was not possible in this study because of time and resource constraints as pointed out earlier.

5.4. Implications of the findings & Recommendations

The findings from this study are that; formative assessments from the three participating schools mostly had a high content validity, low authenticity, involved the determination of low cognitive thinking levels, and were based on two out of the four CAPS objectives explored. Basically, these findings suggest that the formative assessments examined were of low quality. Based on these findings, it is imperative that Policy makers, District assessment teams and educators find ways of improving the quality of Physical sciences formative assessments. To this extent, District assessment teams have the responsibility to improve learners' skills and ability (Kankam et al., 2014). In order to improve the quality of Physical sciences formative assessments, educators and education assessment teams could work together to design high quality assessments, which take into account all the quality measures investigated in this study, as suggested by Harlen and Winter (2004). This would provide the necessary training and experience needed by educators to design high-quality assessments.

Moreover, District assessment teams should ensure that formative assessments are based on the objectives of the CAPS policy document. In this regard, Biggs (2003B), suggested that educators teaching science should begin to look at the alignment of curriculum objectives, teaching and learning tasks and assessment. On the same note, DBoE (2011) emphasizes the need for educators to familiarize themselves with the CAPS policy document and to apply it in their teaching and assessment practices. There might be a need for educators to be workshopped on the objectives of the Physical sciences CAPS and on how to address them in assessments.

Furthermore, the participating educators identified several constraints that affect their choices of formative assessment tasks. It is incumbent upon school administrators and district education officials to find ways of mitigating these barriers in order to improve the quality of formative assessments in physical sciences classrooms.

Finally, this study was a case study involving a small sample of Physical sciences formative assessment and educators, and it only focussed on assessments administered in 2019. Further studies involving a larger sample should be conducted to corroborate or nullify the findings from this study. Such studies should also consider determining the quality of physical sciences assessments over a number of years to have a comprehensive understanding of this phenomenon.

5.5. Conclusions.

The problem that this study attempted to address is the quality of formative assessments, which could partly account for the poor performances of Physical sciences learners (DoE, 2019). In order to address this problem, I sought to answer the primary research question that; *"*What is the quality of Physical Sciences formative assessments and what influences Physical Sciences educators' choices of formative assessment items?" This question was divided into four sub-questions.

In response to the first and second sub-questions, which sought to determine the quality of FET Physical sciences formative assessments, the study found that most of the analysed formative assessments have a high content validity, low authenticity, involves the determination of low cognitive thinking levels, and were based on two out of the four CAPS objectives explored.

Results related to the third question, which involved a comparison of the quality of formative assessments in participating schools showed that approximately, all formative assessments from the different school types; Township Public School, former model C school and Independent School were approximately of the same quality, in relation to the stated quality measures.

The fourth question was meant to establish the factors that influence educators' choices of formative assessments tasks. The findings indicate that several personal and contextual factors influence educators' choices of formative assessment tasks (see section 4.2.3). Some of these factors are beyond educators' control. For example, large classroom size is a contextual factor that cannot be controlled easily by educators. However, other factors such as educators' inability to engage with CAPs policies relate to educators' lack of skills and competences, and can easily be mitigated by the educators themselves.

In conclusion, the findings from this study have partly addressed the study problem in that the findings have established that quality of FET Physical sciences formative assessments is generally poor, which could affect the performance of learners in the subject. Furthermore, the study has identified several factors that affect educators' choices of formative assessments, which in turn might affect the quality of the assessments, and consequently the performance of learners. There is therefore a need to improve the quality of FET Physical sciences formative assessments. Nonetheless, further investigations involving more schools are required to corroborate the findings from this study.

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Appendices

Appendix 1: Ethics clearance certificate.

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

SCHOOL OF EDUCATION ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: 2021ECE011M**
PROJECT TITLE	An investigation of the quality of FET Physical Sciences formative assessments from selected schools in South Africa.
INVESTIGATOR	**THABANG DANIEL MOLISE**
SCHOOL/DEPARTMENT OF INVESTIGATOR	WITS SCHOOL OF EDUCATION
DATE CONSIDERED	12 April 2020
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	Date of submission of the project report

ISSUE DATE OF CERTIFICATE 19 April 2020 **CHAIRPERSON** (Dr Paul Goldschagg)

cc: Supervisor: Dr Monde Kazeni

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** emailed to the Ethics Office: Matsie.Mabeta@wits.ac.za .

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

Appendix 2: Head of School permission letter (Principal's permission letter)

University of the Witwatersrand,
Wits School of education
27 St. Andrews Road, Park town
Johannesburg, 2193
Tel: +27 11 717 – 3049

13 April 2021

Dear Sir/Madam,

Re: Permission to conduct research at _____

My name is Thabang Molise.

I am a Master's student in the School of Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, where I am investigating the quality of FET, Physical Sciences formative assessments from selected schools in South Africa, under the supervision of Dr Monde Kazeni.

I am therefore seeking permission to conduct my research in the above selected schools. I will be researching on the quality of Physical Sciences formative assessments and compare such quality of the assessment in the selected schools. In addition, the factors that influenced educators' choices of formative assessments.

The research intends to support the quality of formative assessments administered at school and to improve the quality of formative assessments as required by the department. In addition to improve the performance of the learners exposed to the assessment tasks.

The research will entail collecting data from educators in the selected schools and their previous formative assessments question papers.

I request permission to get access to selected schools, educators and schools' previous question papers.

I would like to invite educators to take part in an interview, which is part of this research project. This will be a single interview that will take about 30 minutes after school. Their responsibility in the interview will be to answer questions related to the factors that influence their choices of FET Physical sciences formative assessments. With your permission, I would like to audio record the interview using a digital device, so that I can listen to it at a later stage.

Educators will be asked to give their written or verbal consent before the research begins. Their responses will be treated confidentially, and identities (their names and the name of the organization) will be anonymous unless otherwise expressly indicated. Individual privacy will be maintained in all published and written data resulting from the study.

The results will be communicated. The interview responses and the results will be kept confidential by storing them in a password protected file on my personal computer and will be reported in such a way that people would not link it to you, apart from the research team.

The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

I therefore request permission in writing to conduct my research at your organization. The permission letter should be on your organization's headed paper, signed and dated, and specifically referring to myself by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

First name Last name
Thabang Molise
083 965 4724
Thabang.Molise@gauteng.gov.za

Supervisor:
Name: Dr. M.M.M. Kazeni
E-mail: monde.kazeni@wits.ac.za
Phone number: 011 717 3073

Appendix 3: Consent letter

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG | WSoE Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 • Private Bag 3, Wits 2050, South Africa
Tel. +27 11 717-3049 • Fax: +27 11 717-3009 • Website: www.wits.ac.za

Consent Form

Title of project:

An investigation of the quality of FET Physical sciences formative assessments from selected schools in South Africa.

Name of researcher:

Thabang Daniel Molise

I, ... agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following: (Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
I agree that the researcher may use anonymous quotes in his / her research report	YES	NO
I agree that the interview may be audio recorded	YES	NO
I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO

..... (signature)

..... (name of participant)

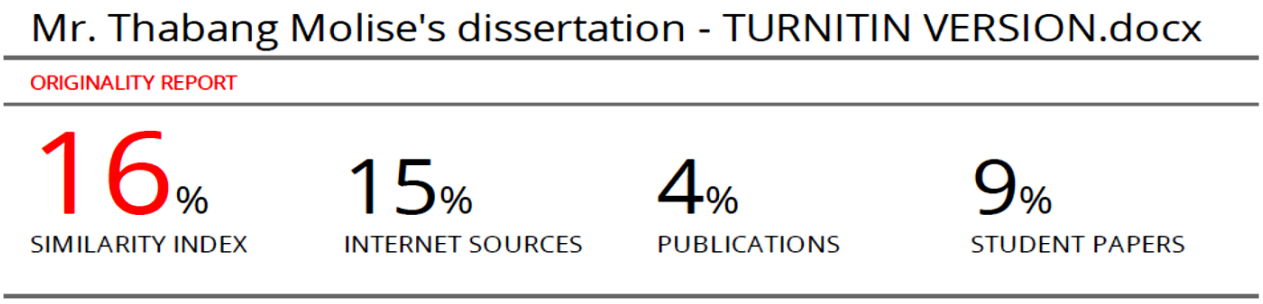
..... (date)

..... (Signature)

Thabang Daniel Molise ..... (name of person seeking consent)

..... (date)

Appendix 4: Plagiarism/ Turnitin report



Appendix 5: GDE Research Request form

For admin. Use only:
Ref. no.:
Enquiries: 011 3550775

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

1. PARTICULARS OF THE RESEARCHER

1.1	**Details of the Researcher**
Surname and Initials:	Molise T.D
First Name/s:	Thabang Daniel
Title (Prof / Dr / Mr / Mrs / Ms):	Mr
Student Number (if relevant):	965124
SA ID Number:	6610095390084
Work permit no. (If not SA citizen)	N/A

1.2	**Private Contact Details**
Home Address	***Postal Address (if different)***
3118 b, Zone 3, P.O. Pimville	3118 b, Zone 3, P.O. Pimville
Joseph Street	Joseph Street
Soweto	Soweto
Gauteng	Gauteng
Postal Code: 1809	*Postal Code:* 1809
Tel: N/A	*Cell: 083 965 4724*
Fax: N/A	*E-mail: Thabang.Molise@gauteng.gov.za*

2. PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	*Purpose of the Research (Place cross where appropriate)*
Undergraduate Study - Self	
Postgraduate Study - Self	X
Private Company/Agency – Commissioned by Provincial Government or Department	
Private Research by Independent Researcher	
Non-Governmental Organisation	
National Department of Education	
Commissions and Committees	
Independent Research Agencies	
Statutory Research Agencies	
Higher Education Institutions only	

2.2	*Full title of Thesis / Dissertation / Research Project*
An Investigation of the quality of FET Physical Sciences formative assessments	
From selected schools in South Africa.	

2.3	**Value of the Research to Education (Attach Research Proposal)**
The research is intended to benefit: GDE and District officials, educators and Learners.	

2.4	**Date**
***Envisaged date of* completion of research in GDE Institutions**	**2023**
***Envisaged date of* submission of Research Report and Research Summary to GDE:**	**2023**

2.5	**Student and Postgraduate Enrolment Particulars**
Name of institution where enrolled:	Wits School of education
Degree / Qualification:	Master's Degree
Faculty and Discipline / Area of Study:	Wits School of Education
Name of Supervisor / Promoter:	Dr. Monde Kazeni

2.6	**Employer**

Name of Organisation:	Department of Education
Position in Organisation:	Facilitator in Physical Sciences
Head of Organisation:	Mr Sipho Mkhulise
Street Address:	Biccard St, Johannesburg, 2001 Braamfontein
Postal Code:	2001
Telephone Number (Code + Ext):	011 694 9300
Fax Number:	011 694 9300
E-mail:	Sipho.Mkhulise@gauteng.gov.za

2.7	**PERSAL Number (GDE employees only)**

1	5	4	0	0	5	8	1

3. PROPOSED RESEARCH METHOD/S

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

3.1 *Questionnaire/s (If Yes, supply copies of each to be used)*

YES		**NO**	**X**

3.2 *Interview/s (If Yes, provide copies of each schedule)*

YES	**X**	**NO**	

- Interviews will need to be carried out on-line, or until such a time when GDE policy changes and allows face to face interviews.

3.3 *Use of official documents*

YES	**X**	**NO**	
If Yes, please specify the document/s: Learners past question			
Papers, grade (10 – 12).			

3.4 ***Workshop/s / Group Discussions (If Yes, Supply details)***

YES		**NO**	**X**
N/A			
N/A			

3.5 ***Standardised Tests (e.g. Psychometric Tests)***

YES		**NO**	**X**
If Yes, please specify the test/s to be used and provide a copy/ies			
N/A			
N/A			

4. INSTITUTIONS TO BE INVOLVED IN THE RESEARCH

4.1 ***Type and NUMBER of Institutions (Please indicate by placing a cross alongside all types of institutions to be researched)***

INSTITUTIONS	**Write NUMBER here**
Primary Schools	
Secondary Schools (X)	3
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Districts and / or Head Office	

4.2 Name/s of institutions to be researched (Please complete on a separate sheet if space is found to be insufficient)

Name/s of Institution/s
Lofentse Girls (township) School in Soweto
Immaculate (Private) School in Soweto
Greenside (Model C) School in Johannesburg

4.3 District/s where the study is to be conducted. ***(Please indicate by placing a cross alongside the relevant district/s)***

District/s			
Ekurhuleni North		*Ekurhuleni South*	
Gauteng East		***Gauteng North***	
Gauteng West		***Johannesburg Central***	
Johannesburg East		***Johannesburg North***	**X**
Johannesburg South		***Johannesburg West***	
Sedibeng East		***Sedibeng West***	
Tshwane North		***Tshwane South***	
Tshwane West			

If Head Office/s (Please indicate Directorate/s)

4.4 *Number of learners to be involved per school (Please indicate the number by gender)*

Grade	1		2		3		4		5		6	
Gender	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*
Number												

Grade	7		8		9		10		11		12	
Gender	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*	*B*	*G*
Number												

4.5 *Number of educators/officials involved in the study (Please indicate the number in the relevant column)*

Type of staff	Educators	HODs	Deputy Principals	Principal	Lecturers	Office Based Officials
Number	*3*					

4.6 *Are the participants to be involved in groups or individually?*

Groups		***Individually***	**X**

4.7 *Average period of time each participant will be involved in the test or other research activities (Please indicate time in minutes)*

Participant/s	**Activity**	**Time**
Educator	**Interview**	**20**

4.8 *Time of day that you propose to conduct your research.*

During school hours (for limited observation only)		After School Hours	X

4.9 *School term/s during which the research would be undertaken*

First Term		Second Term	X	Third Term	

CONDITIONS FOR CONDUCTING RESEARCH IN GDE

Permission may be granted to proceed with the above study subject to the conditions listed below being met and permission may be withdrawn should any of these conditions be flouted:

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;*
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).*
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.*

DECLARATION BY THE RESEARCHER	
1. I declare that all statements made by myself in this application are true and accurate.	
2. I accept the conditions associated with the granting of approval to conduct research and undertake to abide by them.	
Signature:	
Date:	*26 February 2020*
DECLARATION BY SUPERVISOR / PROMOTER / LECTURER	
I declare that: Thabang Daniel Molise	
1. <u>is enrolled at the institution</u> / employed by the organisation to which the undersigned is attached.	
2. The questionnaires / structured interviews / tests meet the criteria of: • Educational Accountability; • Proper Research Design; • Sensitivity towards Participants; • Correct Content and Terminology; • Acceptable Grammar; • Absence of Non-essential / Superfluous items; • Ethical clearance	
3. I will ensure that after successful completion of the degree / project an electronic copy of the Research Report / Thesis / Dissertation and a Research Summary (on the GDE template) will be sent by the researcher to the GDE.	
Surname:	*Kazeni*
First Name/s:	*Monde*
Institution / Organisation:	Wits University
Faculty / Department (where relevant):	Wits School of education
Telephone:	011 717 3073
E-mail:	*Monde Kazeni <monde.kazeni@wits.ac.za>*
Signature:	

Date:	*February 2021*

ANNEXURE A: **ADDITIONAL INFORMATION FOR GROUP RESEARCH**

This information must be completed by **every** researcher/ student who will be visiting GDE Institutions for research purposes.

By signing this declaration, the researcher / students accepts the conditions associated with the granting of approval to conduct research in GDE Institutions and undertakes to abide by them.

Supervisor/ Promoter / Lecturer's Surname and Name……

DECLARATION BY RESEARCHERS / STUDENTS:

Surname & Initials	**Name**	**Tel**	**Cell**	**Email address**	**Signature**
Molise T.D	Thabang	N/A	083 9654 724	Thabang.Molise@ gauteng.gov.za	

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to Gumani.mukatuni@gauteng.gov.za; Dineo.Mashigo@gauteng.gov.za and please copy (cc) ResearchInfo@gauteng.gov.za. The last 2 pages of this document must however have the original signatures of both the researcher and his/her supervisor or promoter. It should be scanned and emailed, posted or hand delivered (in a sealed envelope) to Gumani Mukatuni, 7th Floor, 6 Hollard Building, Main and Simmonds Streets, Johannesburg. All enquiries pertaining to the status of research requests can be directed to Gumani Mukatuni on tel. no. 011 355 0775 or Dineo Mashigo on tel. no. 011 355 0336.

Appendix 6: Participant's information sheet

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG | WSoE Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 • Private Bag 3, Wits 2050, South Africa
Tel. +27 11 717-3049 • Fax: +27 11 717-3009 • Website: www.wits.ac.za

Participant Information Sheet

Dear Sir / Madam,

My name is Thabang Molise and I am a Masters student in Wits School of Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating the quality of FET, Physical Sciences formative assessments from selected schools in South Africa, under the supervision of Dr Monde Kazeni. I will also compare the quality of formative assessments in different school types.

As part of this project, I would like to invite you to take part in an interview. This activity will involve single interview and will take around 20 minutes. Your responsibility in the interview will be to answer questions related to the factors that influence your choices of FET Physical sciences formative assessments. With your permission, I would also like to record the interview using a digital device (audio recording), so that I can listen to it at a later stage.

There will be no personal costs to you if you participate in this project, and you will not receive any direct benefits from participation. In addition, there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw at any time or not answer any question if you do not want to. The interview responses will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely using a computer password and will not disclosed to anyone else in a way it could be linked to you, apart from the research team. I will be using a pseudonym (false name) in my final research report, to represent your participation. If you experience any distress or discomfort at any point in the interview, we will stop the interview or resume another time. If you need some support or counselling services following the interview, these are available free of charge at Wits University. If you have any questions about this research, during or afterward the interview, feel free to contact me on the details listed below. This study will be written up as a Masters research report, which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you.

The data collected from this research project will be stored in password protected computer file and will be kept for 5 years, before destroying it. With your permission the data collected from this research project may be used by other researchers. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical); telephone +27(0) 11 717 1408 and email hrec-medical.researchoffice@wits.ac.za

Yours sincerely,
Thabang Molise

Researcher:
Name: Thabang Molise
email: Thabang.Molise@gauteng.gov.za
Phone number: 083 9654 724

Supervisor:
Name: Dr. M.M.M. Kazeni
E-mail: monde.kazeni@wits.ac.za Phone number: 011 717 3073

Appendix 7: Data collection schedules

SEMI-STRUCTURED INTERVIEW SCHEDULE

Title: An investigation of the quality of FET Physical Sciences formative assessments from selected schools in South Africa.

Researcher: Thabang Molise.

Interviewee code [ ]

INTRODUCTION.

Thank you for agreeing to participate in this discussion about the quality of FET Physical sciences formative assessments. My name is Thabang Molise, and I am a Masters Student at the University of the Witwatersrand. The Masters study requires me to conduct research, and I would like to ask you some questions related to my research. In this interview, I intend to discuss your perceptions regarding the factors that influence Physical Science educator's choices of formative assessment tasks.

There are no wrong or right answers in this discussion, but the information you provide will be valuable to my study and to the field of science education. The interview will approximately last for 30 minutes, and it consists of a biography section and the main interview section. I will audio record the interview, so that I can listen to our discussion at a later stage, to capture your views correctly. All information gathered from this interview will be kept confidential, and your identity and that of your school will not be disclosed to the public. Furthermore, your responses to the interview questions will not be used against you in any way. You are therefore requested to feel free to say what you really think and how you real feel.

Do you agree to proceed with the interview? Do you have any questions or comments, before we start? Please feel free to stop the interview at any point if you feel uncomfortable.

SECTION 1. BIOGRAPHICAL DATA

1. Gender

Male	
Female	

2. What is your nationality [ ]

3. In which range does your age fall?

20 to 25 years	
25 to 30 years	
30 to 35 years	
Above 35 years	

4. What is your highest qualification?

B.Ed.	
B.Ed. Hons	
Masters	
PhD	

5. In which range does your teaching experience fall?

0 to 2 years		
2 to 5 years		
5 to 10 years		
10 to 15 years		
More than 15 years		

SEMI-STRUCTURED INTERVIEW SCHEDULE

SECTION 2. INTERVIEW ITEMS

I am going to ask you some questions regarding the factors that inspire you to choose the tasks that you include in your formative assessments.

1. What is your understanding of formative assessments? (ice-breaking)

2. How do you ensure that your formative assessments are of high quality?

3. Do you think aligning formative assessments to real life situations is important when setting formative assessments? Please explain your answer.

4. How often do you align formative assessment tasks to real life situations?

5. Do you align Physical sciences formative assessment tasks with the objectives of the CAPS document? Please explain your answer.

6. How often do you make sure that your formative assessment tasks are aligned with CAPS objectives?

7. Do you align Physical sciences formative assessment tasks with Bloom's cognitive levels? Please explain your answer.

8. How often do you align your formative assessments with Blooms' cognitive levels?

9. Do you consider the content covered in your lessons when setting formative assessments? Please explain your answer.

10. Which personal factors do you think affect your choice of formative assessment tasks?

11. Which contextual (circumstantial) factors do you take into consideration when selecting formative assessment tasks?

Thank you for participating in this interview. Your contribution is highly appreciated and will go a long way towards improving the quality of Physical sciences formative assessments.

Thank you!

Interview Transcripts.

An investigation of the quality of FET Physical sciences of formative assessments from selected schools in South Africa.

For codes, E followed by a number stands for the educator number, T followed by a number represents the theme number, and roman numerals represent the interview question. For example, E1T2iv represents a response provided by Educator 1, under theme 2, question number 4. The following are the responses from interviewed teachers, for various interview questions.

Question 1: What is your understanding of formative assessment?

E1T2i: response "Formative assessment is the **assessment** that assist educators in **teaching** and helping them **assess** learners understanding on content and concepts that were taught"

Another educator in agreement with first educator pointed it out that:

E2T2i: response "Formative assessments is a process taking place to assess formally if whether learners have gained an understanding of the concepts and overall content that have been taught"

E3T2i: response "Formative assessment is the way of obtaining feedback from learners so as to improve their learning" This was an ice breaker!

Question 2: How do you ensure that your formative assessments are of high quality?

E1T2ii: response "The high quality of formative assessments tasks is based on learner's knowledge, enough content covered as guided by CAPS policy document, with the opportunity to identify learner's problems"

E2T2ii: response "The quality of formative assessment, depends on departmental resources such as past question papers, CAPS policy document and assessment policies. Further, educators' inputs and moderation will give ensure high quality of formative assessment.

The third educator pointed in out that:

E3T2ii: response "The high quality formative assessments are guided by questions of different cognitive levels with the exceptions of multiple choice questions.

Question 3: Do you think aligning formative assessments to real life situations is important when setting formative assessments? Please explain your answer.

E1T2iii: Yes! "Aligning formative assessment to real life situation is important as it shows to the learners the importance of what they have learned, the need to learning that content and how it can benefit them in real life situation with potential to motivate them as they give value to what they do in class for the future".

The second educator responded:

E2T2iii: Yes! "Though this process is challenging, however aligning formative assessments to real life situations is not exceptions to science"

E3T2iii: Yes! "Aligning formative assessments to real life situation is important to enable learners to see the importance of what they have learn in class. The opportunity to see how they can solve real life challenges using science. The chance to apply what they have learned in class to the real life situation. It adds up to their understanding of the science concepts.

Question 4: How often do you align formative assessment tasks to real life situations?

E1T2iv: response "Sciences is practical with abstract concepts, which can only be explained by bringing outside knowledge to the classroom using real life situations to the learners".

The second educator held that:

E2T2iv: "Aligning formative assessment tasks to real life situation is not often implemented probably not much. Argued that learners often miss the essence of the question when there is real life situation in it. They become enthralled with the real life situation instead of looking at the science in the question. Confusion of new terms from science with those from real life situation".

E3T2iv: response "With nearly every question that is asked, is related to real life situation.

Question 5: Do you align Physical sciences formative assessment tasks with the objectives of the CAPS document? Please explain your answer.

E1T2v: Yes! "It is important to align Physical sciences formative assessment tasks with the objectives of the CAPS document, because the document is designed to allow learners to acquire knowledge progressively, from different levels of knowledge to accommodate all learners in class".

E2T2v: Yes! "That's something definitely, his formative assessments tasks are guided by examples from CAPS objectives".

E3T2v: Yes! "Teaching Physical sciences formative assessments tasks is aligned to CAPS document with reference to the examples from the document"

Question 6: How often do you make sure that your formative assessment tasks are aligned with CAPS objectives?

E1T2vi: response "Alignment of formative assessment task to CAPS objectives is always done so that not more or less of work is done in the particular topic for the particular grade".

The second educator pointed it out that:

E2T2vi: "Alignment of formative assessment task is done every single time; it would have to be really a strange situation not using CAPS guidelines when aligning formative assessments".

E3T2vi: pointed it out that "nearly always"

Question 7: Do you align Physical sciences formative assessment tasks with Bloom's cognitive levels? Please explain your answer.

E1T2vii: Yes! "Although it is not all the time, however it is important to visit Bloom's cognitive levels when asking questions that relate to Physical sciences. So that educators do not lose the learners by asking them the same type of questions all the time"

E2T2vii: response " Alignment to Bloom's cognitive levels is not done formally, but engage Blooms cognitive levels subconsciously by looking at the task and knowing how many questions should make what level"

E3T2vii: response "He uses Bloom's cognitive levels whenever he writes formative assessment tasks using words such as 'define', 'describe', 'explain', 'discuss' etc."

Question 8: How often do you align your formative assessments with Blooms' cognitive levels?

E1T2viii: response "Not always, because sometimes when going to class expecting learners to know one two three and only to find that they have no basics"

E2T2viii: response "Informally almost with every single assessment. Formally hardly ever.

E3T2viii: response "In every task, trying by all means to include cognitive levels"

Question 9: Do you consider the content covered in your lessons when setting formative assessments? Please explain your answer.

E1T2ix: Yes! "The content covered in the lesson serve as a scope of the formative assessment tasks"

E2T2ix: Yes! “Even though the planning of content is compromised by different situations, this compromise the level of questions”

E3T2ix: Yes! “Content consideration is paramount, so that learners comprehend with questions related to the topic”.

Question 10: Which personal factors do you think affect your choice of formative assessment tasks?

E1T2x: response “Thorough knowledge in the subject is important, it becomes easy to align with what has to be asked. Through experience educators will know learners’ response to certain task and which tasks will produce what knowledge and understanding”.

E2T2x: response “experience and CAPS information plays a big role”.

E3T2x: response “experience have different approach on every topic with adequate competence and confidence”.

Question 11: Which contextual (circumstantial) factors do you take into consideration when selecting formative assessment tasks?

E1T2xi: response “There are number of contextual factors one taking into consideration when selecting formative assessments: The size of the class of learners, Materials for conducting practical work, photocopying facilities to produce worksheets for the big classes and workload in terms of number of period per day, becomes impossible to select formative assessment tasks”

E2T2xi: response “The following contextual factors influence selection of formative assessments tasks: The situation of the learners, Lack of learners’ skills and capabilities in English and Maths and learners struggle with English language”

E3T2xi: response “The contextual factors influencing selection of formative assessment tasks: past exam question papers”

TEMPLATE FOR COLLECTING DATA ON CONTENT OF FET, PHYSICAL SCIENCES FORMATIVE

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School Code	**1**					**2**					**3**				
Educator Code	**E1T2**					**E2T2**					**E3T2**				
Grade	**12**					**12**					**12**				
Question Numbers	**Alignment of formative Assessment items with term 2 content**														
	Impulse and Momentum	Organic Compounds	Organic Reactions	Projectile motion	None	Impulse and Momentum	Organic Compounds	Organic Reactions	Projectile motion	None	Impulse and Momentum	Organic Compounds	Organic Reactions	Projectile motion	None
1.1		1				1								1	
1.2		1								1				1	
1.3			1							1				1	
1.4			1							1	1				
1.5					1					1	1				
2.1.1		1								1	1				
2.1.2		1								1	1				
2.1.3		1				1							1		
2.2		1				1						1			
2.3		1				1							1		
2.4			1							1					1
3.1.1		1								1					1
3.1.2		1								1					1
3.2.1		1								1					1
3.3.1			1							1					1
3.3.2			1							1				1	
3.3.3			1							1				1	
3.3.4			1							1				1	
3.5.1		1								1				1	
3.5.2			1							1	1				
4.1.1			1			1					1				
4.1.2			1							1			1		

	4.2			1							1		1			
	4.3		1								1			1		
	4.4		1								1			1		
	4.5			1							1			1		
	5.1					1					1			1		
	5.2					1	1						1			
	5.3					1	1						1			
	%	**0**	**45**	**41**	**0**	**14**	**20**	**0**	**0**	**0**	**80**	**14**	**30**	**28**	**16**	**12**

Template for collecting data on **Authenticity of FET**, Physical Sciences formative assessments

Researcher	Thabang Molise														
School Code	**1**					**2**					**3**				
Educator Code	**E1T2**					**E2T2**					**E3T2**				
Grade	**11**					**11**					**11**				
Question Numbers	**Alignment of formative Assessment items with REAL LIFE SITUATION**														
	Expert 1	Expert 2	Expert 3	Expert 4	None	Expert 1	Expert 2	Expert 3	Expert 4	None	Expert 1	Expert 2	Expert 3	Expert 4	None
1.1					1					1					1
1.2	1					1									
1.3	1					1					1				
1.4					1					1	1				
1.5					1					1	1				1
2.1					1					1					
2.2.1	1					1					1				
2.2.2	1					1					1				
2.2.3	1					1					1				1
2.2.4	1					1									1
										1					1
3.1.1					1					1					
3.1.2					1					1	1				1
3.2	1									1					1
3.3	1					1									1
3.4.1	1				1	1									
3.4.2	1				1					1	1				1
3.5.1	1				1	1									1
3.5.2	1				1	1									1
3.5.3	1				1	1					1				
3.5.4					1					1					
4.1					1					1	1				
4.2	1				1	1					1				1
5.1					1					1	1				

	5.2.1	1				1					1					
	5.2.2	1				1					1	1				
	5.2.3										1	1				1
	%	**43**	**0**	**0**	**0**	**57**	**45**	**0**	**0**	**0**	**55**	**47**	**0**	**0**	**0**	**53**

Template for collecting data on **Alignment of FET, Physical formative assessment with revised Bloom's cognitive levels**

Researcher	Thabang Molise							Thabang Molise							Thabang Molise								
School code:	**1**							**2**							**3**								
Teacher code:	**E1T2**							**E2T2**							**E3T2**								
Grade:	**10**							**10**							**10**								
Question number	**Alignment of Formative assessment Items with term one content**																						
	Remembering	Understanding	Applying	Analysing	Evaluating	Creating		Remembering	Understanding	Applying	Analysing	Evaluating	Creating		Remembering	Understanding	Applying	Analysing	Evaluating	Creating			
QUEST.1	1.1	1						1.1	1						1.1	1							
	1.2			1				1.2	1						1.2	1							
	1.3	1						1.3	1						1.3		1						
	1.4			1				1.4	1						1.4	1							
	1.5	1						1.5	1						1.5	1							
	1.6	1						1.6	1						1.6	1							
	1.7	1						2.1.1		1					1.7	1							
	1.8	1						2.1.1		1					1.8		1						
	1.9	1						2.1.2	1						1.9		1						
	1.10	1						2.1.3		1					1.10	1							
	1.11		1					2.2.1		1					2.1.1	1							
QUEST.2	2.1			1				2.2.2		1					2.1.2	1							
	2.2.1	1						2.2.3		1					2.2	1							
	2.2.2			1				3.1.1		1					2.3.1		1						
	2.2.3	1						3.1.2			1				2.3.2		1						
	2.2.4			1				3.1.3		1					2.3.3		1						
	2.3		1					3.2.1		1					2.3.4		1						
	2.4.1		1					3.2.2		1					2.4		1						
	2.4.2		1					3.2.3		1					3.1	1							
QUEST.3	3.1.1		1					3.2.4		1					3.2.1	1							
	3.1.2		1					3.2.5		1					3.2.2	1							
	3.2		1					3.2.6		1					3.2.3	1							
	3.3	1						3.3.1			1				3.2.4	1							
	3.4	1						3.3.2			1				4.1	1							
	3.5		1					4.1.1		1					4.2	1							
	3.6			1				4.1.2		1					4.3	1							
	3.7		1					4.1.3		1					4.4	1							
	3.8	1						4.2.1		1					4.5	1							
	3.9		1					4.2.2			1				4.6	1							
	3.10						1	4.3			1				5.1		1						
QUEST.4	4.1	1						5.1		1					5.2		1						
	4.2.1	1						5.2		1					5.3	1							
	4.2.2		1					5.3			1				5.4		1						
	4.3			1				5.4			1				5.5		1						
	4.4.1		1					5.5.1		1					6.1	1							
	4.4.2		1					5.5.2		1					6.2.1		1						
	4.4.3		1					5.5.3			1				6.2.2		1						
	4.4.4		1												6.2.3		1						
	4.4.5		1												6.3			1					
	4.5		1												6.4		1						
	4.6	1													6.5			1					
	4.7			1											6.7.1		1						
	4.8	1													6.7.2		1						
	4.9			1											7.1	1							
QUEST.5	5.1		1												7.2.1		1						
	5.2	1													7.2.2		1						
	5.3	1													7.2.3		1						
	5.4	1													7.3		1						
	5.5.1	1													8.1.1		1						
	5.5.2	1													8.1.2		1						
	5.6		1												8.2			1					
QUEST.6	6.1			1											8.3		1						
	6.2			1											8.4			1					
	6.3		1																				
QUEST.7	7.1		1																				
	7.2			1																			
	7.3	1								1													
	7.4	1																					
	7.5			1																			
	7.6			1																			
TOTALS	**40**	**35**	**23**	**0**	**0**	**2**		**19**	**59**	**22**	**0**	**0**	**0**		**45**	**47**	**8**	**0**	**0**	**0**			

Template for collecting data on **Alignment of FET, Physical formative assessment with revised CAPS OBJECTIVES**															
Researcher		Thabang Molise					Thabang Molise					Thabang Molise			
School code:		**1**					**2**					**3**			
Teacher code:		**E1T2**					**E2T2**					**E3T2**			
Grade:		**10**					**10**					**10**			
Question number		**Alignment of Formative assessment Items with term one content**													
		OBJECTIVE 1	OBJECTIVE 2	OBJECTIVE 3	OBJECTIVE 4		OBJECTIVE 1	OBJECTIVE 2	OBJECTIVE 3	OBJECTIVE 4		OBJECTIVE 1	OBJECTIVE 2	OBJECTIVE 3	OBJECTIVE 4
QUEST.1	**1.1**	1				**1.1**	1				**1.1**	1			
	1.2	1				**1.2**		1			**1.2**	1			
	1.3	1				**1.3**			1		**1.3**	1			
	1.4	1				**1.4**			1		**1.4**	1			
	1.5	1				**1.5**			1		**1.5**	1			
	1.6	1				**1.6**			1		**1.6**	1			
	1.7	1				**2.1.1**			1		**1.7**	1			
	1.8	1				**2.1.1**			1		**1.8**	1			
	1.9	1				**2.1.2**			1		**1.9**	1			
	1.10	1				**2.1.3**			1		**1.10**	1			
	1.11	1				**2.2.1**				1	**2.1.1**		1		
QUEST.2	**2.1**					**2.2.2**				1	**2.1.2**		1		
	2.2.1		1			**2.2.3**				1	**2.2**		1		
	2.2.2		1			**3.1.1**		1			**2.3.1**		1		
	2.2.3		1			**3.1.2**			1		**2.3.2**		1		
	2.2.4		1			**3.1.3**	1				**2.3.3**		1		
	2.3		1			**3.2.1**		1			**2.3.4**		1		
	2.4.1		1			**3.2.2**		1			**2.4**	1			
	2.4.2		1			**3.2.3**		1			**3.1**	1			
QUEST.3	**3.1.1**		1			**3.2.4**		1			**3.2.1**		1		
	3.1.2		1			**3.2.5**		1			**3.2.2**		1		
	3.2		1			**3.2.6**		1			**3.2.3**		1		
	3.3		1			**3.3.1**		1			**3.2.4**		1		
	3.4		1			**3.3.2**		1			**4.1**	1			
	3.5		1			**4.1.1**		1			**4.2**		1		
	3.6		1			**4.1.2**		1			**4.3**		1		
	3.7		1			**4.1.3**		1			**4.4**		1		
	3.8		1			**4.2.1**		1			**4.5**		1		
	3.9		1			**4.2.2**			1		**4.6**		1		
	3.10		1			**4.3**			1		**5.1**		1		
QUEST.4	**4.1**		1			**5.1**		1			**5.2**		1		
	4.2.1		1			**5.2**		1			**5.3**		1		
	4.2.2		1			**5.3**		1			**5.4**		1		
	4.3		1			**5.4**		1			**5.5**		1		
	4.4.1		1			**5.5.1**		1			**6.1**		1		
	4.4.2		1			**5.5.2**		1			**6.2.1**		1		
	4.4.3		1			**5.5.3**		1			**6.2.2**		1		
	4.4.4		1								**6.2.3**		1		
	4.4.5		1								**6.3**		1		
	4.5		1								**6.4**		1		
	4.6		1								**6.5**		1		
	4.7		1								**6.7.1**		1		
	4.8		1								**6.7.2**		1		
	4.9		1								**7.1**		1		
QUEST.5	**5.1**	1									**7.2.1**		1		
	5.2		1								**7.2.2**		1		
	5.3		1								**7.2.3**		1		
	5.4		1								**7.3**		1		
	5.5.1		1								**8.1.1**		1		
	5.5.2		1								**8.1.2**		1		
	5.6		1								**8.2**		1		
QUEST.6	**6.1**		1								**8.3**		1		
	6.2		1								**8.4**		1		
	6.3		1												
QUEST.7	**7.1**		1												
	7.2		1												
	7.3		1												
	7.4		1												
	7.5		1												
	7.6		1												
TOTALS		**20**	**80**	**0**	**0**		**5**	**57**	**30**	**8**		**25**	**75**	**0**	**0**

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