An Exploration of Science Teachers' Attitudes towards Assessment

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DECLARATION

I hereby certify that this work has not been and is not in the process of being accepted for any other degree other than this degree of Doctor of Education currently studied at the University of Greenwich. I also declare that the content of this work except where otherwise specified by the inclusion of references, is as a result of my own investigation and I have not plagiarised the work of others.

Student …… (Signature) Date ……

Supervisor ……(Signature) Date……

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DEDICATION

In memory of my mum Lady Christiana Ijeoma Obiodu, an educator.

ABSTRACT

Assessment, as an integral part of teaching and learning, is carried out for various reasons. Like every other educational practice, variations tend to occur in the perception of its purpose and how it is carried out. Science teachers' attitudes towards assessment were investigated in this study by scrutinising their actions in relation to the three components of attitude: the affective, the behavioural and the cognitive, and their conceptions of teaching and learning. This involved the collection of both quantitative and qualitative data from two groups of science teachers. Data were collected through questionnaires and semi-structured interviews from a convenience sample of science teachers who often take part in a science teachers' online forum. In-depth semi-structured interviews were carried out with a sample of science teachers working in East London secondary schools. Science teachers' beliefs in assessment were deduced by looking at their conceptions of assessment. Their expressions of feelings toward assessment were gathered from their views on the value of different assessment practices. Their views on the assessment practices they utilise gave an indication of their assessment behaviour.

This study reveals that science teachers have multiple assessment conceptions which include: assessment for improvement, for accountability, for learning, and as an unnecessary and imprecise process. Assessment was discussed as a teacher-centred process for teacher benefit, a teacher-centred process for student benefit and a student-centred process for student benefit. Respondents' discussions about the different assessment practices demonstrated that assessment for learning is their common assessment practice, assessment as learning is their hidden assessment practice and assessment of learning is their key assessment practice. Science teachers' attitudes towards assessment were also found to be evolutionary, and factors centred on teachers' experiences, the assessment practices and the school influenced their attitude towards assessment. The concept of the evolutionary nature of their assessment attitudes in addition to the factors that affect them is the key hypothesis revealed by this study, however this could only be generalised to the sampling frame.

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Chapter 1 - Introduction

1.1 Introductory statement

Assessment plays a key role in education as it can unveil both the recognition of attainment and the areas of improvement in learning, thereby allowing subsequent interventions to be implemented (Berry, 2008). Assessment involves the collection and utilisation of 'evidence of learning' (Harlen and Deakin Crick, 2002). Teachers play an important role in students' learning. This is not limited to the transfer of knowledge, but extends to the development of the skills that equip learners for the future. Teachers can only ascertain the extent to which students have acquired these skills and knowledge through assessment (Berry, 2008). Assessment is one of the key responsibilities of teachers and this can be considered as a 'fact of life' for them (Lambert and Lines, 2000; Cohen and Cowen, 2006). In some ways, it often appears to be the most demanding aspect of teaching (Absolum, 2011). It is the tool that provides teachers with the information needed to monitor learning progression and plan subsequent learning activities (Absolum, 2011).

1.2 Background of Problem

Different types of assessment in secondary schools in England are carried out at different levels: classroom levels and high-stake tests. These assessments have different goals, such as summative, evaluative, formative and diagnostic purposes (Harlen and Deakin Crick, 2002; Hornby, 2003; Kelly, 2009). The extent to which assessments are used for these purposes varies amongst teachers and can be influenced by different factors (Berry and Adamson, 2013). A good assessment system is paramount for effective teaching and learning. The teachers' standards (DfE, 2013a) stipulate that 'teachers need to make accurate and productive use of assessment'. This broad statement, according to the Department of Education (DfE, 2013a), indicates that teachers need to understand the assessment system applicable to their subject area; employ summative and formative assessment strategies to enhance students' progress; and effectively utilise assessment information for target setting and the development of further learning activities for students. This kind of sound

knowledge of the assessment system has been referred to as assessment literacy (Popham, 2004; Webb, 2002 and Stiggins, 1995).

Assessment of students in science with the view to support effective teaching and learning can be a challenge (Pellegrino, 2013). Research shows that science teachers' belief about the key learning contents and how learning occurs influences what they assess and as such, the knowledge of what and how to assess are key to science teachers (Abell and Siegel, 2011). This key knowledge also includes topic-specific assessment knowledge (Edwards, 2013), yet in the education of science teachers there seems to be a focus on the content knowledge of the subject – together with teaching strategies – without adequate link to associated assessment practices (Abell and Siegel, 2011). This creates a gap in the assessment knowledge of science teachers, thereby necessitating the need to explore science teachers' assessment literacy.

There are variations in levels of teachers' assessment literacy (Mertler, 2003; Arce-Ferrer *et al*, 2001, Plake *et al*, 1993). In-service teachers show a higher level of assessment literacy than pre-service teachers, because they are often more experienced (Mertler, 2003; Mertler and Campbell, 2005), yet research shows no clear consensus on the relationship between level of assessment literacy of teachers and their teaching experience (Gotch, 2012). Gotch and French (2014) found that there is weak psychometric evidence to support available assessment literacy measures. Research also shows that current assessment literacy measures have a more predominant representation of assessment processes with constant focus on summative assessment (DeLuca *et al*, 2015). DeLuca *et al* (2015) recommend the need to establish assessment literacy measures which cover the different dimensions of assessment, and thereby accommodate the premise of up-to-date assessment standards. There is also a need for the adoption of subject specific assessment literacy measurement tools (Newfields, 2006). These take into consideration the idea that the development of assessment literacy requires the knowledge of different aspects of assessment as well as content knowledge (Torrie and Van Buren, 2008).

Teachers' knowledge alone may not provide a full explanation of their behaviour, due to the complex nature of teaching, and so, there is a need to explore teachers' beliefs (Zheng, 2009). Moreover, there is a constant interaction between belief, knowledge

and practice (Richardson, 1996). One's belief can be considered to be a 'complex and dynamic system that consists of a set of subsystems that are loosely related but allow an individual to form new beliefs and take actions in a wide variety of circumstances' (Spector, 2012: 442). Griffiths *et al* (2006) report that teachers' beliefs have more impact on their practices than their teaching experience and teaching environment. Similarly, Dixon *et al* (2011) found that teachers' espoused and tacit beliefs can influence their assessment practices, yet, most research into ways of boosting assessment competence did not consider this factor (Remesal, 2011).

Belief forms part of one's conception (Thompson, 1992; Philipp, 2007). Conception is what one thinks of an object, subject or phenomena, which includes its structure and functions (Brown and Gao, 2015). There is evidence to suggest that teachers' assessment practices are often influenced by their conception of assessment (Samuelowicz and Bain, 2002; Postareff *et al*, 2012), yet discrepancies have been found between teachers' conception of assessment and their thoughts about assessment practice (Wang *et al,* 2010). Wang *et al* (2010) found that pre-service science teachers' views of assessment practices vary from their views of teaching and learning, even though their conceptions of assessment tally with their views on teaching and learning. Although this finding is limited to pre-service science teachers – and there is the need to explore this with practising science teachers – it still exposes the fact that there are possibly other factors that play a more significant role in forming teachers' assessment attitude. Teachers' conceptions of assessment are considered to be 'ecologically rational', related to the structures of the educational system and influenced by the role of assessment in teaching and learning (Brown, 2011; Remesal, 2011). Factors such as lack of teachers' professional development and low qualifications have been identified as the factors that can affect teachers in their teaching and assessment processes (Kitiashvili, 2014), yet Sach (2015) points out the need to identify the facilitators and constraints that affect teachers' effective implementation of pedagogical practices. This suggests that there may still be a gap in the understanding of the factors that affect teachers' behaviours.

Belief has also been described as 'a set of conceptual representations which store general knowledge of objects, people and events, and their characteristic relationships' (Zheng, 2009:74). Its expression is the cognitive response mode for

inferring attitude (Ajzen, 1989). 'Attitude' constitutes one's feelings, thoughts, beliefs, values and disposition to respond positively or negatively to an object or subject (Ajzen, 1989; Ricketts and Ricketts, 2010). It is presumed to be more likely to have an impact on one's behaviour than one's general belief (Ashford and LeCroy, 2009). Research has demonstrated the relationship between attitude and behaviour, although this relationship has been found to be inconsistent (Ashford and LeCroy, 2009). Factors such as attitude towards educational measurement and self-perceived confidence in educational measurement have been shown to have an effect on assessment literacy (Alkharusi, 2011). It has been found that there is a conflict between teachers' value of assessment practices and their rate of use of these practices (James and Pedder, 2006; Kitiashvili, 2014). Hence, there is a need to understand teachers' attitude towards assessment.

Although there is evidence to suggest that teachers' belief about assessment influences their assessment behaviour (Samuelowicz and Bain, 2002; Postareff *et al*, 2012), there is also evidence to suggest that there are conflicts between their value of assessment practices and their assessment behaviour (James and Pedder, 2006; Kitiashvili, 2014). This necessitates the need to understand the relationship between teachers' assessment belief and their assessment value. This is with the view to understanding their assessment attitude. Also, if it is believed that attitudes have the capacity to predict or inform future actions (Coon and Mitterer, 2015), and there is the need to review teachers' assessment attitude as part of their professional development (Kitiashvili, 2014), then it is important to understand teachers' assessment attitudes and the factors that affect them.

1.3: Purpose of study

This study will explore secondary school science teachers' assessment attitudes, which include their conception of assessment, the value they accord to different assessment practices and their rate of use of different assessment practices. The study includes the survey of a sample of science teachers in Continuing Professional Development (CPD) group through questionnaire and interviews and the in-depth interview of a sample of secondary school science teachers in East London schools.

This is mixed method study aimed at using a pragmatic approach to unravel the research findings.

The purpose of this study is to understand science teachers' assessment attitude by looking at the relationship between their assessment conception, assessment value and assessment behaviour, in order to understand the cognitive, affective and behavioural component of their attitudes consecutively. These components of attitude are required for the thorough description of one's attitude (Hewstone, 2011). To achieve this, their assessment conception will be explored by considering their different beliefs of assessment through both interviews and questionnaires. This will give an insight into their belief of what assessment and assessment practices are or should be. Their assessment value will be investigated by identifying and discussing how teachers rate different assessment practices. This will provide information on their perceptions of the value of different assessment practices and its place in their attitude towards assessment. Finally, their assessment behaviour will be explored by looking at how often they utilise different assessment practices. This will contribute to the description of their attitudes by providing information on their actions and possibly future actions. In addition, the relationship between these components of attitude and their conception of teaching and learning will be considered. This is with the view to understand the role of teaching and learning in the formation of teachers' assessment attitude.

This study is carried out with the view to developing a better understanding of science teachers' assessment attitudes and the rationale for the variations that exist between the different aspects of their assessment attitudes. Considering that teachers' educational beliefs have been shown to affect their classroom practices (Zheng, 2009), and as Kagan (1992:73) argues, 'most of teachers' professional knowledge can be regarded more accurately as belief', then there is a strong argument to look at science teachers' assessment literacy by considering their attitude towards assessment. This takes into account the idea of 'attitude' as a form of knowledge structure, which one either stores in their memory and has inferred from past experience or constructs on the spot (Fabrigar *et al*, 2005; Oskamp and Schultz, 2005). In view of the argument that attitudes have the same importance as aptitudes (Ricketts and Ricketts, 2010), studying teachers' assessment attitudes becomes a suitable option. This will possibly

accommodate the multifaceted nature of science assessment. As such, understanding what affects the assessment attitude of science teachers will throw more light on the factors that can impact their assessment literacy.

Science as a school subject aims to develop scientifically literate learners (DeBoer, 2000). Science is one of the core subjects of the English education system up to the age of 16. Its contents over the years have changed with the latest changes in Key Stage 3 (KS3) implemented in 2014, and in key stage 4 implemented in 2016. Science in English schools is mostly taught as a multidisciplinary subject comprising physics, chemistry and biology – especially at KS3. Science teachers, on the other hand, are usually more grounded in one or two of the subjects creating a weak link in their science teaching. Teaching and learning in science can be considered as 'a multifaceted process' (Fensham, 2013:23; Broekaert, 2005:59) given that they both involve theoretical and practical activities. Assessment, in this case, will also be multifaceted (Fensham, 2013). Science teachers not only assess students' understanding of the scientific concepts but also assess their ability to apply their knowledge and the skills to engage in different scientific processes (Farmery, 2002). It has been argued that the external assessment system influences the assessment process in science and in doing so influences its teaching and learning process (Corrigan *et al,* 2013). This leads to a variety of assessment practices which have different values and ratings. This makes the understanding of science teachers' attitude towards assessment more complex, therefore necessitating the need for this study.

1.4: Research questions

This research will aim to understand science teachers' assessment attitudes. This will be done by answering two main research questions:

- What are science teachers' attitudes towards assessment?
- What are the factors that affect science teachers' attitudes towards assessment?

These questions will be answered by exploring sub-questions in each area. For the first question, the following sub-questions will be investigated:

- What are secondary school science teachers' conceptions of assessment?
- How do secondary school science teachers view and use different assessment practices?

While the following sub-questions will be explored in the second question:

- What is the relationship between secondary school science teachers' attitudes toward assessment and their conceptions of teaching and learning?
- How do secondary school science teachers' experiences affect their attitudes towards assessment?

1.5: Significance of study

Change in students' behaviour is one of the goals of education and the amount, type and level of the cognitive, affective and psycho meter skills developed by students are the key features of this change (Thomas, 2012). Education is important, as it prepares learners for modern life (Green, 2014). Understanding the place of assessment in the current educational system will enable a more robust implementation of the process, and therein better educational outcomes. Besides, the proper implementation of assessment in schools would promote effective teaching and learning, as assessment is essential to all learning (Absolum, 2011). However, if assessment is poorly performed, it would inhibit effective teaching and learning (Pellegrino, 2013). Hence, there is the need to understand teachers' attitude towards assessment. Understanding science teachers' attitude towards assessment in order to understand their assessment knowledge is important. Assessment knowledge is a part of science teachers' pedagogical content knowledge (Magnusson *et al*, 1999), which is one of the key characteristics of effective teaching (Cole *et al*, 2014). Teachers' pedagogical content knowledge has the tendency to evolve as teachers are exposed to different experiences, which make it dynamic in nature (Cochran *et al*, 1993).

Studies on teachers' assessment literacy have been centred on quantitative analysis (Beziat and Coleman, 2015; Mertler, 2003; Yamtim and Wongwanich, 2014). The current changes in the assessment literacy standards are not fully represented in the

current measures (DeLuca *et al*, 2015). This has prevented the discovery of unseen elements of teachers' assessment literacy. It has also narrowed down the profile of teachers' assessment literacy to the framework provided by the researcher. Studying science teachers' attitudes towards assessment with the view to unravel their assessment knowledge may possibly provide an avenue for the unlimited exploration of teachers' knowledge, which will enable a better description of their assessment literacy.

1.6 Professional context

Over the years, the assessment system used in secondary schools in England has continued to evolve. The changes in the school curriculum over the years have played a part in this. The Education Reform Act of 1988 brought about the introduction of the National curriculum, and this came along with a model of assessing students at the end of the different key stages (Gillard, 2011). This model includes the use of teacher assessment complemented by a nationally-administered key stage tests (House of Commons, Children, Schools and Families Committee, 2009). The KS3 Standard Assessment Tests (SATs) were however, finally abolished in 2009 leading to the variations in the end of KS3 assessment tasks among schools. The introduction of the non-statutory Assessing Pupils' Progress (APP) framework in 2008 was well timed. Its rationale was to boost teachers' confidence and ability in reducing their reliance on national testing as the main source of evidence for achieving the national standards (Fox and Surtees, 2010). It was anticipated that the results generated will be fair, accurate, reliable, useful and focused (Fox and Surtees, 2010). Although it had its merits, it was found to be too demanding for teachers (Smith 2016).

The 2014 changes in the National curriculum brought an end to the level system used in primary and secondary schools in England (DfE, 2013b). This system was viewed as ideally unsuitable for assessing learners with the tendency to distort the effective implementation of other assessment systems, and as being misused, resulting in a negative effect on teaching and learning (Commission on Assessment without levels final report, 2015; Smith, 2016). The removal of the National Curriculum levels has led to the individualisation of school assessment system. This comes at a time when

there is also a change in the GCSE assessment system. Grades in science GCSE examined in 2018 are been changed from A* - G to 9 - 1.

In view of these changes, schools are trying to develop robust assessment systems which suit their needs. The introduction of school-based systems comes with different challenges which could be from the system or the users of the system. In this case, teachers are at the forefront of this change – either as users or as developers. To this end, there is the need to develop teachers' assessment literacy with the view to effectively develop or utilise the new assessment system. The development of teachers' assessment literacy can only be worthwhile if their current assessment literacy level is understood. Studying teachers' assessment attitude with a view to understanding their assessment literacy level will not only unveil their assessment literacy level, but also give an insight into what informs their assessment related decisions. This will help schools to understand teachers' assessment behaviours, thereby enabling them to effectively launch and implement their new assessment initiatives.

As a secondary school science teacher, part of my role involves the assessment of students' learning in order to make informed decisions. In addition, as a key stage coordinator, it includes the development and management of robust assessment systems, which will enable the effective assessment of students across the key stage. Such responsibilities require a good understanding of teachers' assessment literacy in order to know how best to support them in the effective implementation of the assessment systems. This study is therefore driven by a keen interest in the understanding of science teachers' attitudes towards assessment with the view to better understand the impact on the effective implementation of assessment systems. This will not only aid the development of personal skills but the skills required for effective staff development in order to ensure the effective implementation of assessment systems.

1.7: Organisation of study

This thesis is made up of 6 chapters. Chapter one is the introduction with the research questions. In this chapter, the basis of this study is set out and its relevance to my role as a teacher discussed. It is rounded up by giving a brief description of the different chapters. Chapter 2 is a review of the literature surrounding assessment. The definitions of assessment are given in addition to a brief discussion on assessment as a process and product. Assessment literacy as a term – and its importance to both students and teachers – is also discussed. The link between assessment literacy and assessment knowledge is highlighted in addition to the knowledge required to be assessment literate. The discussion on assessment extends to the main types of assessment based on their functions. In this section, the links between these assessments, their benefits and their limitations are reviewed. This review also covers the discussion on teachers' conception of assessment, with the relationship between belief and conception raised. Attitude as a concept and factors affecting teachers' attitude to assessment are discussed in this chapter. Finally, science as a subject of interest is defined and the issues with assessment in science highlighted.

In Chapter 3, the mixed method approach used in this study is discussed. An explanation is given for the choice of the pragmatic paradigm, and the use of questionnaires and interviews as research tools. The choice of sample, data collection and data analysis techniques are also discussed in this chapter.

Chapter 4 presents the qualitative data from interviews and quantitative data from the questionnaire, whilst chapter 5 discusses the data and makes inferences from them with the view to answer the research questions. This work is concluded with chapter 6, which provides a summary and examines the extent to which the research questions have been answered. In addition, the chapter discusses the limitations of the study and further recommendation.

Having set out the basis of this study, the relevant literatures that surround assessment will now be discussed in the next chapter.

Chapter 2 - Literature review

2.1 Introduction

This study is centred on teachers' attitudes towards assessment and can be supported by a body of literature covering the field of education with special reference to assessment, teaching and learning, and the field of psychology. This chapter reviews the literature surrounding assessment in education with a particular reference to assessment in science education. Topics identified to be relevant to this study will be discussed. These topics were decided after the review of literature surrounding assessment related studies. They include: assessment as a tool or process, belief, knowledge and conception, teachers' attitudes, conceptions of teaching and learning and science as a school subject.

2.2 Defining assessment

2.2.1 What is assessment?

The word 'assessment' is derived from the Latin word 'assidere' meaning to 'to sit beside' (Wiliam, 2007:1053; Charlton, 2005:12). This implies that assessment is a review process involving at least an individual. The term is commonly used in the United Kingdom to refer to 'judgement of students' work' (Taras, 2005: 466). The outcome can be used to improve students' work or be an end in itself. This supports the previous argument of human involvement and also extends the argument to include the review of things which generate outcomes. Assessment can also be described as an integral element of teaching and learning (Allanson *et al,* 1990; Bell and Cowie, 2001; Absolum, 2011) and requires the comparison between two or more things (Allanson *et al*, 1990). This involves teachers reviewing and making judgements about students' knowledge, and using the information gathered to inform their next step (Absolum, 2011; Allanson *et al*, 1990). The presentation of assessment as a teachers' tool for making judgements on students' work, and their use of these judgments, centres more on the role of teachers in the teaching and learning process. Taking into account the existence of other participants in this process, assessment should involve more than the given description.

Absolum (2011) further presents assessment as part of a learning process. He describes it as the process of acquiring information on the gaps in the learning process and believes that learning will not be possible without learners engaging in some sort of assessment of their learning. This suggests that if learning is assumed to be individual and social (Earl, 2013), undeniably, assessment as part of the learning process should also be. In essence, assessment can be viewed as a social process involving interaction between teachers and students (Bell and Cowie, 2001). This interaction can also be between students, as in the case of peer assessment, or with oneself as in the case of self-assessment. Thus, classroom assessment can be described as 'a social construction accomplished by teachers and students through social and pedagogic interaction' (Torrance and Pryor, 1998: 20). This perhaps suggests that classroom experience as a social process plays a part in the construction of students' identities, and assessment is used to identify or describe students' identities. The focus on individuals who have different characteristics creates variations in assessment. Besides, it has been argued that assessment practices are not simple or transparent, although they are not free from positive effects (Torrance and Pryor, 1998). This raises the issue of the complexity of assessment and opens up the discussion on the variations in the assessment field.

2.2.2 Assessment as a process

The review of assessment related literature reveals that assessment can be discussed as a process. Although various authors have described assessment in different forms, they are all centred on the common theme of 'making a judgement'. The variations in the descriptions are influenced by the rationale for the assessment. For instance, Pellegrino *et al* (2001) define assessment as the means of measuring educational outcomes and students' achievements of the important competencies. These important competencies can be the curriculum requirements which students are judged against. Assessment, in this case, can be considered as a measuring tool or a measuring process. Furthermore, Pellegrino (2012: 82) views assessment as a 'tool designed to observe students' behaviour and produce data that can be used to draw reasonable inferences'. He argue that the process is not as uncomplicated as measuring height or weight, as the features to be assessed are not apparently visible given that they are

mental representations and processes. The definition clearly defines assessment as a tool to make judgement on students' accomplishment.

On the other hand, Swaffield and Dudley (2015) view assessment as a stock-taking process of a learner's progression. In this instance, assessment has been presented as a review process. Similarly, Taras (2005) describes assessment as those procedures or steps needed to bring about a judgement. This presents classroom assessment as an act that involves 'professional judgement' (McMillan, 2000). It also characterises assessment as a process. Further description of assessment as a process includes assessment as an information gathering and interpreting process of students' achievement (Brookhart, 1999). This process involves the gathering of evidence and the utilisation of the outcomes in a decision making process (Harlen, 2007). Such outcomes, Harlen (2007) believes, could be student oriented or teacher oriented. This supports Berry's (2008: 6) description of assessment as an 'information gathering' process in which the information collected is centred on the purpose of the assessment. Her description of assessment not only includes the analysis and interpretation of information gathered and the utilisation of the outcomes to make rational decisions, but it includes the application of the appropriate strategy to enhance teaching and learning.

The strategy utilised in the information gathering process correlates with its purpose. This probably explains why Berry (2008: 6) describes assessment as 'a conscious and systematic activity'. However, one can argue that this is not always the case with every assessment. Kelly (2009) believes that teachers, even by an informal means constantly assess their students either consciously or unconsciously. Assessment can be argued to be a natural process that permeates every part of our existence (Rowntree, 1987). Nonetheless, every assessment will involve the collection of data (Cohen and Cowen, 2006) and some sort of interpretation of findings against a set standard (Harlen *et al,* 1992). Essentially assessment is a two-part process consisting of the collection of evidence and analyses of evidence to make useful judgements. If teaching is considered to involve a set of bidirectional relationships and assessment is part of the instruction model (Brookhart, 1999), undoubtedly assessment should be considered as a process.

Another angle of this discussion is the description of assessment as a product. Besides viewing assessment as a process, Swaffield and Dudley (2015) describe it as that which takes place when students sit for formal tests. This can be interpreted as the outcome of a process or the process itself. Similar uncertainty in the categorisation of assessment was seen in Sadler (1989:120) description of assessment as 'any appraisal of student's work or performance'. In this context also, assessment can be considered to be the result of a process or the process itself. These possibly show that description of assessment cannot be limited to an outcome but rather involves more than the result of an action.

On this account, there are bases to suggest that assessment should be considered as a process. Thus, in this study, assessment will be considered as the process that leads to a professional judgement. Simply put, assessment can be a planned or unplanned process involving the review of learning and the utilisation of the outcome for various purposes.

2.2.3 Purpose of assessment

The utilisation of the outcome of assessment varies depending on the motive of the stakeholder. Freeman and Lewis (1998:10) grouped the different purposes that underlie assessment under five headings: to select, to certificate, to describe, to aid learning, and to improve teaching. The first two centre on assessment for selection and certification with outcomes for judgemental purposes and external use, whilst the remaining three form the purpose of assessment for learning with outcomes for personal and developmental use aimed at improving students' learning (Freeman and Lewis, 1998). The roles of assessment can also be summarised under the headings of formative, summative, certification and evaluative purposes (Harlen and Deakin Crick, 2002; Hornby, 2003). In some literature these purposes are further summarised into larger categories. For instance, Gardner *et al* (2008) summarises the purposes of assessment to include the improvement of students' learning and the reporting of students' learning. Millar (2013), however, believes that the role of assessment is not limited to the summative and formative but includes a quality assurance role. He argues that assessment is key in the clarification of learning designed to occur in a given situation.

The purposes of assessment are always influenced by the interest of the stakeholders. Kelly (2009) discusses the purposes of assessment for political, educational and administrative uses. He believes that educationally, assessment can serve as a quality control tool, curriculum evaluation tool, diagnostic tool for students and an extrinsic motivational tool. Similarly Pellegrino (2013) believes that assessment has to be the statements of expectations of educators, policy-makers and parents for students. Assessment in a classroom context is, thus, a flexible process that can be adapted by practitioners to suit their different purposes. Such purposes vary and will be influenced by different factors. Earl (2003) recognises this and discusses classroom assessment as Assessment of learning, Assessment for learning and Assessment as learning. These paradigms of assessment revolve round the relationship of assessment with students' learning which includes measuring their learning, to improve their learning or to be a learning process for them. In line with the same idea, James and Pedder (2006) discuss the three dimensions of assessment as 'making learning explicit', 'promoting learning autonomy' and 'performance orientation'. These categorisations of assessment draw attention to the link between assessment and learning. Therefore, at the heart of the discussion of the purposes of assessment is learning and this explains why assessment has been described as an integral part of teaching and learning. These varied purposes of assessment present it as a dynamic process with varied motives and with students at the centre of the process. However, these functions will influence the structure of the assessment but not the process (Taras, 2009).

Nevertheless, it is obvious that regardless of their purposes and the contexts in which they are carried out all assessment share a common principle, which is the 'process of reasoning from evidence' (Pellegrino *et al* 2001: 53). They should also be valid, reliable, practicable, and have a positive effect on teaching and learning (Assessment reform group, 2006). It has been emphasised that assessment for young learners should cover learning required in preparing them for the ever-changing society (Assessment reform group, 2006). As the society evolves so would the knowledge and skills required to fit into it. In light of this, learning contents and their associated assessment can be characterised as dynamic. This argument further presents assessment as flexible tools or processes that should adapt to the evolving society.

Another line of discussion on the purposes of assessment can be centred on its impact on the teaching and learning process. Timperley *et al* (2007) in her review of 27 core studies on the uses of assessment found that the common factor among the studies was that assessment information provides the analysis of the teaching-learning relationship with the view to improve it. Three key purposes of assessment were revealed in the review and these include: the use of assessment to inform the next teaching step, to review the effectiveness of the teaching process and as a motivator for teachers to engage in their professional learning (Timperley *et al,* 2007). These key purposes support the argument made by different authors (e.g Bell and Cowie, 2001; Absolum, 2011) that assessment is an integral part of teaching and learning, although it can be argued that this finding is only centred on the direct effect on teachers. It also presents assessment as a reflection tool for teachers. Teachers need to understand how their students are progressing and also recognise the challenges in their students' learning in order to adapt their actions to meet students' varied needs (Black and Wiliam, 1998). This explains why the use of assessment information to inform subsequent teaching steps was found to be popular among teachers, unlike the argument that assessment is a motivational tool for teachers (Timperley *et al,* 2007). This evidence suggests that the use of the outcome of an assessment process depends on its purpose of which teachers have varied views on.

Although teachers often centre the assessment process on the students and use the outcome to improve students' learning, it can be argued that teachers can still learn through the assessment process (Abell and Siegel, 2011). Their involvement in multiple types of assessment – in a bid to provide a more complete overview of students' learning – exposes them to different types of knowledge and levels of thinking (Abell and Siegel, 2011). The same applies to any form of evaluation of the assessment process. It is clear that there are different functions of assessment and they are centred on some sort of reflection of evidence. Also they are somehow linked to the teaching and learning process. Variations, which may be caused by various factors, exist in the purposes and applications of the outcome of assessment. Understanding the values and applications of assessment is vital in the development of assessment literacy.

2.3 Assessment literacy

2.3.1 What is Assessment literacy?

Assessment can be viewed as a complex and dynamic concept, which deserves to be understood in its complexity (Earl, 2003). The level of understanding of the complexity of assessment defines one's assessment literacy. Newfields (2006) believes that the definition of assessment literacy varies from one group to the other. For instance, what assessment literacy is for a classroom teacher will vary from what it is for a professional test developer (Newfields, 2006). The same applies to the definition of literacy in general, as Ade-Ojo (2009) argues, literacy can be viewed as a cognitive or social term. Webb (2002:1) describes assessment literacy as 'the knowledge of means for assessing what students know and can do, how to interpret the results from these assessments, and how to apply these results to improve student learning and programme effectiveness'. This definition focuses on the knowledge of how to assess, how to interpret assessment information and how to apply assessment information. This is comparable to Ainsworth and Viegut's (2006) description of assessment literacy as ones' ability to comprehend the different assessment processes and their purposes, with the view to choose the most suitable in a given situation. Although there are similarities in the two definitions, Anisworth and Viegut (2006), unlike Webb (2002), acknowledge the need to understand the various purposes of assessment.

Lyon (2013), on the other hand, describes the ability to understand and apply assessment as assessment expertise. He believes that teachers' assessment understanding and facility are key constructs when studying their assessment expertise. He further describes assessment understanding as 'the teachers' beliefs about and knowledge of assessment', and assessment facility as 'how teachers use their assessment understanding while planning assessment, assessing in day to day teaching, or reflecting on/critiquing assessment practices' (Lyon 2013: 444). Assessment literacy, in this case, therefore includes both the knowledge and the application of the knowledge. Popham (2011) elaborates on the knowledge to be gained by defining assessment literacy as comprised of ones comprehension of key assessment concepts and processes considered to likely inform educational decisions.

This definition extends the idea of assessment literacy to include the understanding of the concept of assessment, which is not limited to how to assess. Thus, assessment-literate teachers will understand the principles of assessment so as to select and apply the most appropriate assessment in any given scenario.

Given that one of the key purposes of assessment is to inform learning (Gardner *et al*, 2008; Black *et al*, 2003), there is the need for teachers to understand how students value and use assessment to improve their learning (Absolum *et al*, 2009). There is also the need for students to develop their assessment capabilities, which include 'their ability and motivation to access, interpret, and use information from quality assessment in ways that affirm or further their learning' (Absolum *et al*, 2009:19). Booth *et al* (2014) describe assessment capable teachers as those with the necessary curricular and pedagogical ability together with the motivation to develop students' assessment capabilities. The focus on students is to enable them to develop their self-monitoring skills. They argue that assessment capability differs from assessment literacy, as the latter often fails to refer to student agency in its description of effective assessment systems. Knowledge and disposition are key elements of teacher assessment capability (Absolum *et al*, 2009), and this shows a similarity with assessment expertise as described by Lyon (2011). It also includes teachers' comprehension and abilities to utilise both generic and subject specific assessment knowledge (Edwards, 2013). The concept of assessment capability extends the purpose of assessment for students and role of teachers' assessment practices for students. Therefore, the idea of assessment capability adds new factors to the concept of assessment literacy, and these include the disposition and the development of assessment capable students.

Further work carried out on assessment literacy can be seen in Abell and Siegel (2011)'s model of science teachers' assessment literacy. This model highlights the assessment knowledge and skills they believe will aid teachers in the development of an assessment-centred learning environment (see fig 2.1). Teachers' views of learning are at the centre of the model, and these interact with their knowledge of assessment purposes, knowledge of the assessment strategies, knowledge of what to assess and knowledge of how to interpret and act on assessment information (Abell and Siegel, 2011). This suggests that without the knowledge of the different aspects of

assessment, an effective assessment system cannot be developed. Therefore, this emphasises the role factors, such as 'knowledge' play in the characterisation of teachers' assessment literacy. Similarly, it highlights that there are possibly effects of assessment knowledge on teachers' conception of learning. If teachers' practical knowledge is believed to influence their practices (Golombek, 1998), then the above arguments further call attention to the need to understand teachers' assessment literacy.

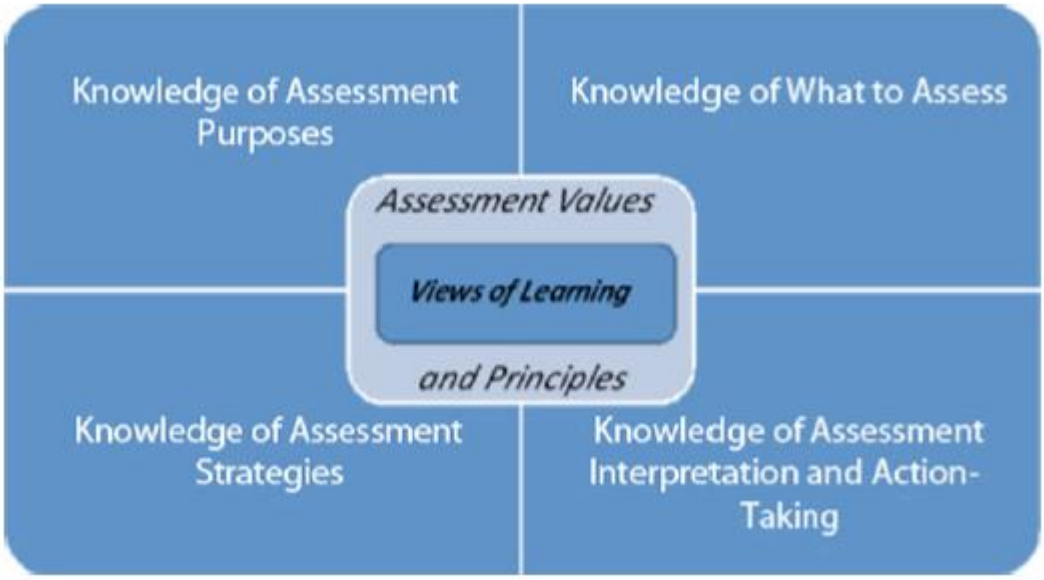

Fig 2.1: A model for science teacher assessment literacy (Abell and Siegel, 2011:212)

2.3.2 Importance of Assessment literacy

Teachers' assessment literacies are considered to be a key part of their role. Sloan (2012) summarised some of these skills which have been considered to reflect teachers' assessment literacy as: the ability to develop valid and reliable means to assess student learning; the ability to effectively combine assessment methods; the ability to analyse and utilise both qualitative and quantitative data of students' achievement; the ability to provide for students a suitable and effective feedback; the ability to utilise the results of an assessment process to improve learning; and the ability to involve and motivate students in the assessment process. The ability to display these skills shows control over the assessment process. For this reason, as the extent to which teachers exhibit these skills varies so will their assessment literacy.

Newfields (2006) believes that assessment literacy is important because assessment is a common feature of most educational systems, and the development of assessment literacy enables teachers to effectively communicate their classroom findings with others. He also believes that there is the necessity for teachers to have knowledge of educational literatures which assessment literacy helps with. These can be supported by the idea that if every educational system has the responsibility to educate learners, and effective learning cannot occur without assessment, then there is the need for teachers to develop their assessment literacy. Teachers play a key role in the assessment of students, and so it is imperative that they are grounded in assessment skills and knowledge, which are constituents of assessment literacy. Moreover, the characteristics of the data gathering tools or procedures and the nature and use of feedback are based on individual teacher's judgement (Kahl *et al,* 2013).

The implementation of different assessment practices involves a sort of communication between individuals who may not have the same level of assessment literacy (Booth *et al,* 2014). The ability to effectively communicate assessment results to others – be it students or other teachers – is vital because the classroom setting is a learning environment for both learners and teachers. Consequently there is, as Broadfoot (2007) suggests, the urgent and essential need to develop a higher level of assessment literacy among educational practitioners, so that they are able to utilise and do utilise the available tools.

Based on above arguments, I present the concept of assessment literacy as the comprehensive knowledge of the assessment process, which will include both the theoretical knowledge and practical skills required by teachers to improve students' learning, and develop theirs and their students' assessment capabilities. Although the extent of knowledge acquisition can be determined using quantitative means, the application of the skills acquired cannot be accurately done through this process. As a discernible concept, teachers' level of assessment literacy will be reflected in their practices. Such possibility therefore suggests that a look at teachers' assessment attitude or assessment behaviour will give an insight into their assessment literacy.

2.3.3 Assessment knowledge

Assessment knowledge informs one's assessment literacy, which may be reflected in one's actions. Knowledge as described by Calderhead (1996: 715) is 'the factual propositions and the understandings that inform skilful action'. In this regard, knowledge of an object or subject can affect the behaviour towards it. As there are many skilful actions, so will there be many categories of knowledge. Shulman (1987:8) describes the seven different categories of knowledge vital for teachers as: content knowledge, general pedagogical knowledge, curriculum knowledge, knowledge of learners, school knowledge, pedagogical content knowledge and knowledge of educational contexts. The acquisition of these categories of knowledge is fundamental in the formation of a teacher.

The pedagogical content knowledge is distinctive to teachers as it centres on their content knowledge and their general pedagogical knowledge (Cochran 1997). It represents the merger of content and pedagogy to generate a sound understanding on how different topics or skills are organised and delivered to meet the needs of individual student (Shulman, 1987). This may perhaps be considered as dual professionalism, which the IFL (2012) describes as the possession of sound knowledge of effective teaching and learning process supported with a strong subject specific knowledge. The impacts of the latter on teachers' professionalism draw attention to the limitations of non-subject specific study and the importance of subject specific study. Pedagogical content knowledge has also been considered as one of the key characteristics of effective teaching (Cole *et al*, 2014). This form of knowledge has the tendency to evolve and for this reason is dynamic in nature (Cochran *et al*, 1993). Magnusson *et al* (1999) summarises the components of pedagogical content knowledge for science teaching as:

> Orientation towards science teaching; knowledge and beliefs about science curriculum; knowledge and beliefs about students' understanding of specific science topics; knowledge and beliefs about assessment in science; and knowledge and beliefs about instructional strategies for teaching science (p.96-97).

This might suggest that pedagogical content knowledge in science includes every aspect of science teaching and learning. This includes what to learn, how to teach, what to teach, how to assess and what to assess. It might also imply that the pedagogical content knowledge in science teaching will differ from those of the other subjects thereby conveying the importance of studying teachers' assessment knowledge in different subjects.

As previously mentioned, assessment plays an integral part in the mission for an improved education (Pellegrino *et al*, 2001). This explains the inclusion of an assessment-focussed component in the discussion of pedagogical content knowledge. The essential knowledge of assessment can be summarised in the assessment triangle (see fig 2.2) by Pellegrino *et al* (2001). They discuss each vertex of the triangle as a representation of a key element of assessment. These include:

> A model of student cognition and learning in the domain of the assessment; a set of assumptions and principles about the kinds of observations that will provide evidence of students' competencies; and an interpretation process for making sense of evidence (p.44).

This shows the relationship between learning models and how to gather and interpret assessment related evidence. There is an argument that all three vertex must be connected in a meaningful way and work together in synchrony for the effective implementation of an assessment process (Pellegrino, 2009).

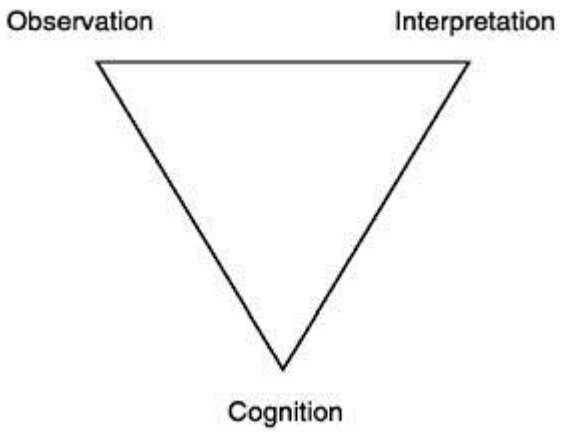

Fig 2.2: The Assessment triangle (Pellegrino *et al*, 2001:44)

It has been argued that teachers' expected knowledge of assessment depends on factors such as the key stage they teach, the content of the subject they teach, the assessment system used in their school and the government requirements on assessment (Webb, 2002). If assessment knowledge is part of the pedagogical content knowledge (Magnusson *et al*, 1999), and this differs among teachers even when they are teaching the same curriculum or topic (van Driel *et al*, 1998), then assessment knowledge of teachers will differ. This suggests that teachers' assessment knowledge may possibly vary as they move from one school to another. The different pedagogies developed in the different schools may well have shaped their pedagogical content knowledge. Thus, there is the need to understand the key components of teachers' assessment knowledge. McMillan (2000) lists such key knowledge, which will result in effective teaching and learning, as the understanding that:

> Assessment is inherently a process of professional judgment: assessment is based on separate but related principles of measurement evidence and evaluation; assessment decision-making is influenced by a series of tensions; assessment influences student motivation and learning; assessment contains error; good assessment enhances instruction; good assessment is valid; good assessment is fair and ethical; good assessment uses multiple methods; good assessment is efficient and feasible; and good assessment appropriately incorporates technology

Such knowledge is centred on the components of assessment and characteristics of effective assessment. The possession of such knowledge contributes to the development of sound assessment literacy leading to the ability of teachers to select and utilise appropriate methods in the assessment of their students. Similarly, an understanding of how assessment can affect both the teacher and students' learning process is important. This takes into account the belief that effective assessment should aim to assess how students are able to apply the knowledge gained rather than just provide a description of the knowledge gained (Brown, 2004a). Knowledge gained varies from subject to subject and as such variation will also occur in assessment knowledge. Magnusson *et al* (1999) discuss assessment knowledge in science under two categories: knowledge of what to assess and knowledge of the assessment method.

2.3.3.1 Knowledge of what to assess

Assessment can become futile if what needs to be accessed is unclear. In an effective assessment process, teachers elucidate the assessment criteria for students. This can only be possible with a good knowledge of what to assess. Abell and Siegel (2011) include it as a key part of their assessment literacy model. An effective assessment requires a comprehension of the constructs intrinsic in each standard, and with adequate consideration given to the depth of knowledge unpacks these standards into intended learning outcomes (Kahl *et al,* 2013). The judgement resulting from an assessment process cannot be made in a vacuum; consequently the need for criteria (Taras, 2005). Every subject learning is aimed at: 'learning with understanding and understanding learning' (Assessment reform group, 2006: 8). Assessment will therefore measure students' level of acquisition of these key goals. This can be viewed as common to assessment within all subjects. However as earlier discussed, the variations in the big ideas within each subject personalise assessment in each subject and justify the need to study assessment in individual subjects. This explains why Pellegrino (2009) suggests that teachers should lay more emphasis on creating opportunities for the application of concepts being taught. He further suggests that assessment should focus on whether students have the ability to comprehend the time, place and means to utilise their knowledge. Teachers' sound knowledge of their subject area can therefore be a key factor in high level of assessment literacy.

However, the role of students in determining what to assess should not be overlooked. Brown *et al* (1997) discuss the role of assessment in enabling students determine what is important. They point out that students take clues of what is important more from what is assessed rather than what the educator relay as important. Although it can be argued that this view is applicable to higher education, the use of past exam papers as a teaching and learning resource may perhaps exemplify this in secondary and primary schools settings. This idea suggests that what to assess will more likely be subjected to changes resulting from curriculum modifications unlike the knowledge of how to assess.

2.3.3.2 Knowledge of how to assess

The knowledge of what to assess cannot make any useful impact without the knowledge of how to assess. Although different assessment strategies are available to, and utilised by teachers, it is imperative that teachers know the assessment approach that will enable them to elicit the knowledge and skills they aim to assess (Brookhart, 2011). Given that there is not a single assessment strategy that can meet all assessment purposes (Ainsworth and Viegut, 2006), a good understanding of the different assessment methods becomes vital.

It is common knowledge that assessment can be carried out at any stage of the teaching and learning process. However, since assessment is integral to teaching and learning (Earl, 2013; Absolum, 2011), considering the assessment process during the planning stage of a lesson provides a better platform for assessment (Edwards, 2013). There is an argument that anything that is not worth assessing is not worth being included as part of the curriculum (Dake and Weinkein, 1997). This may explain why it is a good practice for lessons to be planned with the learning outcomes in mind and assessment linked to these outcomes (Whitehouse, 2013). Irrespective of this, lessons are not and should not be restricted to the contents of the curriculum or assessable contents. Avenues for the development of skills which are not necessarily assessed should be made available; for instance, the inclusion of the Spiritual Moral Social and Cultural development (SMSC) in school curriculum.

Furthermore, assessment as an integral part of teaching and learning (Earl, 2013; Absolum, 2011) requires the utilisation of varied assessment practices such as standardised testing, interviews with students to discuss their learning, analysis of student work and classroom observation (Timperley, 2008). It also requires a level of knowledge transparency that allows students to develop the skills which enable them to analyse and use information that aid the achievement of their learning goals (Booth *et al,* 2014). Such a level of transparency is required in both low stake less formal and high stake more formal assessment practices (Booth *et al,* 2014). Due attention to the ethical considerations in the assessment system, and ensuring that assessment

processes are valid and reliable also contribute to a good assessment system (Brown, 2004a; McMillan, 2000). Brookhart (2011:10) considers the need for teachers to understand and implement their legal and ethical responsibilities in assessment whilst carrying out their job as one of the assessment knowledge and skills vital for teachers. She indicates that these areas of understanding include the 'test preparation, confidentiality of information, opportunity to learn, due process, and making decisions based on multiple appropriate assessments' (p.10).

Different assessment practices can be used for varied uses. The purpose for which they are used is the differentiating factor. Pellegrino *et al* (2001) believe that the assessment purpose drives its priorities, while its context of use drives its design. They argue that it is vital to recognise that no assessment practice can fulfil all assessment purposes because individual purposes are compromised the more purposes the assessment practice aims to serve. Yet there are similarities among all assessment practices. Harlen and Deakin Crick (2002) believe that the similarity between all types of assessment is the involvement of some sort of interpretation of students' work against the expected or required standard. The information gathered in this way can be used to enhance teaching and learning, or for recording and reporting purposes (Harlen, 2005). A good knowledge of the different assessment strategies can therefore be considered to be essential, as it enables teachers to select the most appropriate assessment approach for a given learning objective (Gottheiner and Siegel, 2012). Equally, the comprehension of the learning progressions is an essential part of the process (Edwards, 2013). Teachers need to tie in their assessment tool with the learning goals, so as to create high quality data that show evidence of learning and learning gaps (Brown, 2004a; Kahl *et al*, 2013). Taking this into account, a complete picture of students' achievement and progress is better ascertained using multiple methods (McMillian, 2000). This allows the limitations of one to be counterbalanced by the benefits of the other. Besides, when assessment information is not used for the purpose it was designed for, it may have an unintended effect.

Knowledge of assessment strategies is not limited to the type of assessment task but extends to the questions within the task. Brookhart (2011) points out the need for

teachers to have the skills that enable them to analyse different assessment tasks with a view to identify the essential knowledge and thinking skills students need to complete them. She maintains that these skills will enable them to create appropriate questions in different scenarios, evaluate questions from other sources for potential use, and plan future instruction using the result of assessment. Abell and Siegel (2011:214) extend the knowledge of what to assess to include 'teacher knowledge of response strategies such as learner-centred methods of grading, effective and efficient forms of feedback, and ways to facilitate student use of feedback' In addition, carrying out an assessment that can be deemed to be inclusive is important. This will prevent any cohort of students from being disadvantaged by the creation of fair opportunities for all students to flourish (Brown 2004a).

The existence of varieties of assessment methods can be a challenge for teachers. Kahl *et al* (2013) believe that teachers should be aware of the implications of overemphasizing an assessment method and the strength and weaknesses of different assessment methods. Broadfoot (2007) also believes that this problem was left too long without attending to it. She presents her reasons as the lack of assessment literacy among educational practitioners, more so teachers, with underdeveloped assessment knowledge. She, however, points out that there are now more research evidence in the area of assessment which can provide insight into more effective assessment systems (Broadfoot, 2007).

One can thus conclude that the knowledge of the different aspects of assessment, be it what to assess and how to assess, is imperative in the formation of one's assessment literacy. This can manifest in one's implementation of different assessment practices.

2.4 Assessment practices

2.4.1 Summative assessment

Summative assessment can be described as an assessment with some sort of finality (Benjamin, 2008; Swain, 2010). This definition perhaps categorises summative

assessment as a fact-finding machine. Summative assessments are usually used to sort and rank students, report to parents and judge the effectiveness of individual teachers or school as a whole. These assessments that satisfy summative purposes show individual students' achievement at a certain time (Harlen, 2006). The Assessment Reform Group (ARG, 2006) did not limit the outcome of summative activities to grades or marks. They gave a broader definition based on their findings from teachers and professionals as follows:

> Summative assessment by teachers is the process by which teachers gather evidence in a planned and systematic way in order to draw inferences about their students' learning, based on their professional judgment, and to report at a particular time on their students' achievements (Assessment Reform Group 2006: 4).

They summarise the purposes of summative assessments as the appraisal process for monitoring, evaluation, keeping records and reporting to all stakeholders, certification and selection purposes. Such assessments can also be used to predict future achievement of students (Swain, 2010). These characterisations locate summative assessment within the realm of Assessment of Learning (AoL) practices. This type of assessment satisfies the need for accountability and serves as a response to external pressure and constraints (Brookhart, 2001). The accountability purpose can be internal or external to the school depending on the end users of the assessment information (Harlen, 2005).

AoL approaches tend to assess a broad range of skills and knowledge, thereby failing to indicate the mastery of one (Earl, 2003). They place strong emphasis on comparing students and presenting feedback as grades or marks with little guidance on how to progress (Earl, 2003). Yet, one can argue that the provision of feedback in books which students do not utilise in improving their learning, and those that teachers sometimes merely give in order to fulfil the school marking policy, may play more of a summative role, and as such possibly limit this idea. Birenbaum *et al* (2006: 64) summarises the characteristics of AoL practices as: 'one dimensional, summative, separate from the curriculum but drives the teaching, are inauthentic, context independent and inflexible'. Thus, one can describe the AoL practices as the tool to

ascertain students' learning. It is suggested that the outcome of a summative assessment can be influenced by the students' state of mind and body, such as nervousness and illness, which could negatively affect their result (Butt, 2010). For this reason, AoL practices may present limited information on students' learning than formative assessments.

There is evidence to suggest that the excessive utilisation of AoL practices can influence students' attitudes towards learning. As Broadfoot (2007: 215) argues that 'there is considerable evidence that *high-stakes*, summative examinations encourage an instrumental, *trading for grades* mentality that is profoundly inimical to genuine educational engagement'. This can affect students directly through the effects of low scores on their self-efficacy and their anxiety over the test process (Harlen, 2005). An indirect impact on students can take place through its effects on the teacher and the curriculum (Harlen, 2005). The low achieving students are the most affected, as their self-esteem is weakened (Harlen and Deakin-Crick, 2003; Butt, 2010; Stiggins, 2004).

The impact of summative assessments also extends to teachers and the learning environment. It drives the learning environment and promotes the transmissive teaching style in teachers (Harlen and Deakin-Crick, 2003; Wilson and Kendall-Seatter, 2010). Assessment becomes high-stake when its information is used to make decisions that are important to students, teachers and the school (Harlen, 2005; Wilson and Kemdall-Seatter, 2010). This results in pressure on teachers, thereby impacting students' learning experiences and the nature of the assessment (Harlen, 2005). Such practices can hinder teachers from 'teaching for learning' but rather promote 'teaching for the tests' (Birenbaum *et al*, 2006).

The role of other stakeholders, such as parents, cannot be ignored. Teachers believe that both parents and the school authorities' interest in the results of external tests leads to their increased focus on test preparation – despite its impact on the quality of teaching – as they believe that their reputation depends on the results of the external tests (Black *et al*, 2011). Although one can limit the generalisation of these findings to the sampled group, the underlying issue remains the pressure that the other

stakeholders in education exert on teachers constantly. For instance, the media seems to view this assessment as the dominant indicator of achievements of schools (Wilson and Kendall- Seatter, 2010).

Despite its impact on students' learning, there are still test rich assessment regimes in most countries (Broadfoot, 2007). These government campaigns to promote high-stake tests affect schools by making it difficult for both schools and practitioners to adjust their practices (Broadfoot, 2007). There is the perception among teachers that the school management mirror their schools' summative assessment regime with external tests as they are more interested in the results of such tests or similar ones (Black *et al*, 2011). This can be explained by the variations in summative assessment tasks found between teachers and subject areas in the same school and with another school (Black *et al,* 2011). In other words, AoL can be viewed as a teacher, subject or school influenced process.

In spite of these effects, the positive impact of summative assessment on the learning environment cannot be overlooked. Stiggins (2004) argues that teachers are presented with the assurance that good teaching will result in better performance when tests are well developed. In addition, an argument can be made that these tests provide avenues for a more uniform form of assessment with fewer opportunities for teachers' subjective views. These benefits will further explain why they are still promoted in schools. The Assessment Reform Group (2006) puts across the argument that summative assessments should be reliable, valid, practicable and have a positive impact on teaching and learning. Black *et al* (2011) have discussed ways of promoting a constructive interaction between formative and summative assessment practices. They argue that teachers will be better placed to do so if they have control over the creation and implementation of the summative assessments in conjunction with a sound knowledge of the process of appraising students' work. Harlen (2005) proposes that negative impacts of testing can be reduced at classroom level by explaining the purposes of assessment processes to students, by enhancing students' self assessment skills and through the provision of feedback that enhances students' learning. The latter suggests the use of summative assessments for formative purposes in what can

be viewed as a paradigm shift. This can be achieved when teachers use the outcome of test to adapt the teaching and learning process (Black *et al*, 2003), although it can be argued that this may not be limited to the assessed group, as the use of summative assessment information in adapting the teaching and learning process of another group has a formative role (Bell and Cowie, 2001). There may be instances where teachers use the outcome of a summative assessment for formative purposes and formative assessment for summative purposes. Harlen (2012) in acknowledgement of these scenarios proposes the categorisation of assessment practices into informal formative, formal formative, informal summative and formal summative. She argues that assessment may perhaps 'be better described as a "dimension" rather than a "dichotomy" ' (98). 'Formal formative', which is when assessment is mostly formative but has some summative use, and 'informal summative', which is mostly summative with some formative use (Harlen, 2012) shows how an assessment practice can serve multiple purposes. This may possibly lead to the difficulty of categorising assessment processes.

Harlen (2005), in her discussion on the use of teachers' assessment for summative purposes, concludes that there is an overlap between the actions needed to develop summative assessments, and those needed for practising formative assessments. Some of those actions include:

> The importance of providing non-judgemental feedback that helps students know where they are in relation to learning goals; the need for teachers to share with students the reasons for, and goals of, assessment; the value to teachers of using assessment to learn more about their students and to reflect on the adequacy of the learning opportunities being provided; teachers and students placing less emphasis on comparisons among students and more on individual development; and helping students to take responsibility for their learning and work towards learning goals rather than performance goals (Harlen, 2005:215).

These show that a disparity between summative and formative assessment can be minimised. Further definition of a summative assessment describes it as 'one which

has a pre-defined purpose and will produce data on an individual or individuals, at some point in time, which can then be used both to inform and to enhance the teaching and learning of future cohorts of students' (Swain, 2010: 236). Although this suggests that summative assessment can fail to have immediate impact in the teaching and learning process (Black, 1998; Sadler, 1989), it supports the idea of the use of summative assessments for formative purposes (Swain, 2010). Moreover, if one intends to develop new concepts and skills by building on previous instructions there is the need to ascertain where students are with these instructions (McKenzie, 2005).

From the above discussion, it is clear that AoL practices aim to present a summary of learning accomplishments which are used for two main purposes. These include - the use for accountability and for reflection purposes. Whilst the accountability purposes serve the needs of all stakeholders, the reflection purposes aid teachers in the provision of suitable learning for their students. The latter, in other words, is considered to be a formative role, thereby presenting the AoL practices as the prerequisite of the formative assessment practices.

2.4.2 Formative assessment

Formative assessment can be described as a continual cycle of proceedings involving teachers and students utilising the findings from on-going activities to inform the next stages of learning (Harlen, 2007). This form of assessment allows teachers to close the gap in students' learning by providing guidance on how to improve (Shavelson *et al*, 2008). This definition presents assessment as a teacher-led student-focussed process. Popham (2008) describes formative assessment as a planned process, which involves the use of students' assessment-elicited information by teachers to adjust their teaching, or by students to adjust their learning. He believes it is a planned process – and not a product – since it involves carefully considered tasks by the users.

The entire process of formative assessment may not necessarily be described as planned given that assessment–elicited evidence can be generated during a learning

process without prior planning. This assessment can be referred to as interactive, on account of the fact that teachers are responsive to assessments that arise during the interaction between themselves and their students (Bell and Cowie, 2001; OECD, 2005a). They can also be referred to as 'on-the-fly-formative assessment' describing an unplanned assessment in which teachable moments are discovered and utilised (Shavelson *et al,* 2008:23). Kahl (2005:11) complements the argument by describing formative assessment 'as a midstream tool to identify specific misconceptions and mistakes while the material is being taught'. Black and Wiliam (2009) further characterise this interaction; they explain that 'a formative interaction is one in which an interactive situation influences cognition, i.e., it is an interaction between external stimulus and feedback, and internal production by the individual learner' (p.11). These arguments suggest that formative assessments are embedded in the teaching and learning process.

Although assessment can result in the generation of information useful for the improvement of teaching and learning, it only becomes formative when this information is used to modify teaching in order to meet students' needs (Black and Wiliam, 1998). This presents formative assessment as a two-stage process – the collection and interpretation of data, and the utilisation of the outcome to improve learning. In other words, this form of assessment can be categorised as a process. The first stage is considered to be the generation of summative judgment which formative assessments cannot exist without (Taras, 2005). This further shows the link between summative and formative assessments. This also presents an argument that what separates the two is the use of the end product. Therefore, one can conclude that formative assessment is an ongoing process which is integrated into the learning process with a view to improve the learning process; it 'is not an end in itself' (Shermis and Di vesta, 2011:88).

Formative assessment practices can range from informal to formal processes with the position dependent on the planning input, formality of practice and the nature of feedback (Shavelson *et al,* 2008). Whilst formal formative assessments are usually intentionally planned, and the outcome can be used for curriculum issues, informal formative assessments are usually 'unplanned or loosely planned' with the intention of establishing the extent of learning in the classroom and making the necessary

adjustments (Shermis and Di Vesta, 2011:89). This categorisation of formative assessment can be considered as an alternative form of characterising them into planned and unplanned assessments. The inclusion of both planned and unplanned – or formal formative and informal formative – will vary in different classrooms and among different teachers creating variations in teachers' assessment behaviours.

Furthermore, the effectiveness of formative assessment depends on whether students recognise the gap between their current and expected attainment, and what they are doing about it (Biggs, 1998). This presents formative assessment as the learners' process. Sadler (1989:121) describes it as one where:

> The learner has to (a) possess a concept of the standard (or goal, or reference level) being aimed for, (b) compare the actual (or current) level of performance with the standard, and (c) engage in appropriate action which leads to some closure of the gap.

This definition is similar to that offered in Popham (2008) – as stated earlier – although the idea of a planned process is not included. This implies that Sadler's definition accommodates instances where the gathering of evidence or the reviewing of students' level against the required standard is carried out without prior planning. This is often instigated by teachers' observations during the learning process. Such a view suggests that the evidence of students' mastery of the assessed knowledge and skills should inform the decisions made during the assessment process, rather than decisions based on impulse (Popham, 2008). Sadler's definition also emphasises the role of the learner in the assessment process. One can thus describe formative assessment as either a 'teacher-led–student-focussed' process or a 'student-led–student-focussed' process aimed to improve learning. Whilst the former can be viewed as the assessment of students' learning, the latter is the student using the assessment process as their learning process. This is in line with Clark (2012: 208)'s description of formative assessment as one which 'is connected by two contiguous assessment objectives: assessment for learning and assessment as learning'. In light of this, formative assessment as part of teaching and learning process can be planned to elicit permanent evidence or be interactive to generate ephemeral information (Bell and Cowie, 2001).

2.4.2.1 Assessment for Learning (AfL)

The Assessment Reform Group (ARG, 2002) describes AfL as the process that involves the search and interpretation of evidence with the view to determine students' current achievement and how best to improve their learning. It is not a stand-alone practice or an add-on to classroom activities, rather it is at the core of classroom activities (DCSF, 2008). The initiative is based on the belief that students will make better progress if they understand the learning objectives, how far they are from achieving them and how they can achieve them (DCSF, 2008). It can be viewed as a shift of assessment purpose from summative to formative, and from making judgements to creating information that could be applied in the next stage of learning (Earl, 2003). This information is what Taras (2005) refers to as feedback, which she believes reflects the gap between level of work being assessed and the required standard. Because there are students who exceed their required standard, Taras's assertions may appear to be limited. Students who produce work of the required standard will need feedback as part of a formative assessment, and such feedback will contain information for attaining higher standards. Moreover, feedback can also be utilised by teachers for their own development; for instance, using feedback to inform their training needs. The use of feedback by learners is what Taras (2005) argues differentiates AoL from AfL practices.

Sadler (1989) describes feedback in terms of information and effects. He is of the view that it can be the information revealing what is currently being done or how something was done (Sadler, 1989). It can also be information on the gap between what has been done – and what could have been done – which can be used to change the gap (Ramaprasad, 1983 in Sadler, 1989). Sadler's definition widens the scope of the term 'feedback' by suggesting that all the information collected during assessment should be classified as feedback. As such, some actions in AoL practices such as sharing test results, reporting levels can be classified as feedback. Ramaprasad, on the other hand, insists that the information on the gap becomes feedback only when it is used change the gap (Sadler, 1989). Hattie and Timperley (2007) hold a similar view; they describe feedback as the information presented to show one's performance in – or level of – understanding of a given concept, or process. This definition allows the

use of feedback in every learning circumstance, be it when standards have been met or not met. They argue that the agents can be teachers, peers, parents, oneself, experience or books, and the feedback could be through affective processes; for instance, enhanced effort, engagement or through cognitive processes. Again, these add another layer to the concept of feedback. Feedback can take varied forms and is not the presentation of information based on hierarchy, such as feedback from teachers to students; it can be from teacher to student, student to teacher or student to student (Atjonen, 2014). It is the information, as described by Winne and Bulter (1994: 5740), 'with which a learner can confirm, add to, overwrite, tune, or restructure information in memory, whether that information is domain knowledge, meta-cognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies'. In other words, feedback must be acted upon by the receiver, and this can take varied forms in the teaching and learning process. Pickford and Brown (2006:13) point out that if 'assessment is the engine that drives learning, then feedback is the oil that lubricates the cogs of understanding'. This highlights the importance of effective feedback in the teaching and learning process.

Although it is obvious that the use of feedback is the underlining principle for AfL practices, they also have other characteristics. Birenbaum *et al* (2006: 64) summarises the characteristics of AfL practices as 'multi-dimensional, formative, integrated into the curriculum, authentic, context embedded and flexible'. The Assessment Reform Group (ARG) describes the characteristics of AfL practices as such:

> It is embedded in a view of teaching and learning of which it is an essential part; it involves sharing learning goals with students; it aims to help students to know and to recognise the standard they are aiming for; it involves students in self-assessment; it provides feedback which leads to students recognising their next steps and how to take them; it is underpinned by confidence that every student can improve; it involves both teacher and students reviewing and reflecting on assessment data (ARG 1999: 7).

These characteristics present AfL practices as student-centred and interactive assessment practices that promote the integrated nature of teaching, learning and assessment (Dixon *et al,* 2011). The AfL assessment initiative has the capacity to

benefit all the stakeholders in the school community. Students watch themselves develop through AfL thereby increasing their motivation and interest to boost their progress (Chappuis *et al*, 2004). In addition, they understand the process of learning, and by doing so, develop themselves as independent learners (Chappuis *et al*, 2004; Flórez and Sammons, 2013; Broadfoot, 2007). Besides, it is evident that assessment types that are designed to promote 'intrinsic motivation' instead of 'extrinsic motivation' positively impact students' learning (Broadfoot, 2007). The underpinning principle of AfL, however, is not limited to student learning but extends to organisational and professional learning; therefore, the effects of the transformation of the teachers who embrace the AfL initiative are not restricted to the classroom (DfES, 2007; Swaffield, 2009). This can transform the school culture in a way that enables teachers to view themselves as learners (Swaffield, 2009). Learning in this case brings in reflection, which subsequently leads to the better practices. This possibly explains why Black *et al* (2004) argue that the continual use of the AfL initiative will yield positive results, and an improvement in the system will produce a commensurate improvement in students' achievement. Teachers also benefit through the increased motivation seen in students, the existence of accurate information to necessitate further progression in students, and a shift in their role from solely an instructor to a learning facilitator (Chappuis *et al*, 2004; Flórez and Sammons, 2013). Parents benefit by noticing both the progress their children have made – and the increased motivation they show towards their learning – while the school authority and government benefit by the increased student progression, which satisfies the accountability benchmark (Chappuis *et al*, 2004). These suggest that the AfL strategies can prepare and contribute to students' success in high-stake exams – but in a less tense way.

The process of AfL can be summarised in the AfL learning cycle (Minstrell *et al*, 2008) which includes: the collection of data on students' learning, the interpretation of the data to hone in on the key issues to address and the actions aimed at addressing these key issues. Although this cycle places learners at the centre of the AfL process, it fails to delineate the role of the learner in the process. One can argue that the roles stipulated by the learning cycle can be carried out by both the teacher and the students. Harlen (2007), in her description of AfL as a cycle of events, elucidated the role of learners in the AfL process. Students are not only the receivers of feedback but also providers of information and participants in the decision process, where fitting

(Harlen, 2007). Such roles can also be applicable to teachers, and so the question of how AfL helps teachers to develop themselves becomes relevant.

Other descriptions of AfL include Wiliam (2006)'s description of the territory of AfL as a collection of 5 key general strategies, which he believes can be implemented using various techniques. These include:

> Clarifying and sharing learning intentions and success criteria; engineering effective classroom discussions and tasks; providing feedback that moves learners forward; activating students as owners of their learning; and activating students as instructional resources for one another (p. 17).

AfL, in this instance, is shown to be integral to the teaching and learning process (Bell and Cowie, 2001). Swaffield (2009) further limits the AfL process to classroom activities. She points out that the main interest is with the 'here and now of learning', and as such, focus should be on the students' current learning whilst allowing some considerations to be given to their future learning (p.8). This view may somewhat be limited, as the AfL process may not always be completed in a lesson taking into account the high teacher–student ratio in state-funded schools in England. Moreover, students' books are not usually marked in the classroom during lessons Therefore, AfL can be better described as a 'student-centred' and 'teacher-initiated' process aimed at boosting students' progress by closing the gap between their current knowledge and the desired knowledge (Clark, 2011). It encourages dialogue between both teacher–student and student–student. Although it is a learner-centred assessment, teachers are central to its design and analysis, with the role of using the knowledge of their students, the context of assessment and curriculum goals to identify individual learning needs (Earl, 2003). The process better represents the phase 'to sit down beside', from which the word 'assessment' is derived (Swaffield, 2009). Berry (2008: 6) considers AfL to be a 'social interaction between teacher and students and among students who have a shared vision of learning'. The inclusion of 'social' in Berry's description poses the question of the reliability and validity of the assessment information gathered. The individuality of the assessor may lead to the generation of subjective views, and in the case of limited subject knowledge – or assessment literacy – limit the validity of the assessment process.

On the downside, AfL approaches could be time-consuming (OECD, 2005b), and its application one may argue, could be difficult in a mixed-ability learning environment. It could be argued theoretically that teachers differentiate their learning activities, in order to cater for the needs of all. However, in practice, personalised AfL in a mixed ability classroom seems unattainable. It is not surprising that Popham (2008) argues that the process is unrealistic for both teachers and students in the real world. I would argue that this may depend on the classroom size. Furthermore, research has shown a significant impact of formative assessments on students' learning, though these effects vary due to the sensitivity of the measures (Wiliam, 2011a). Similarly, Torrance and Pryor (1998:151) suggest that formative assessment will always have an effect on students' learning, though 'complex and multifaceted', and not typically as positive as teachers intended it to be or as other promoters of formative assessment make us believe.

Despite teachers' beliefs on the impact of AfL practices, the extent of usage is still impeded by the demands of external factors, such as the National Curriculum (Hargreaves, 2005). It has been suggested that assessment can deflect from its role of generating feedback for developmental purposes (Sowe and Ade-Ojo, 2014). There is also an argument that AfL cannot be introduced in the classroom by simply 'bolting on' specific practices to the classroom programmes already in place (Dixon *et al*, 2011: 365). These suggest the possibility of the misinterpretation of the AfL initiative. Swaffield (2009) recognises this and points out that it is mistaken to focus an AfL strategy on summative assessment. Moreover, as Black *et al* (2003: 122) suggest, 'clarification is important because the claimed advantages only apply to authentic interpretations'. What is required, therefore, is a thorough review and reform of the existing part teachers and students play in the learning and assessment processes (Dixon *et al*, 2011).

From the above discussion, it is clear that AfL practices are learner-centred and mostly teacher-controlled. Its advantage lies in its ability to improve learning. There are limitations in the effective use of such assessment resulting from different factors. Consequently, there is an obvious need to further improve the effectiveness of this assessment process in schools. Understanding teachers' current views of AfL may help to unravel the factors that impede its effective implementation. This will possibly

lead to a better understanding of the assessment processes resulting in improved assessment literacy for both teachers and students.

2.4.2.2 Assessment as learning (AaL)

Torrance and Pryor (1998) describe formative assessments as mainly teacher controlled but should essentially be student managed. They argue that both are not mutually exclusive, as teachers on one hand provide constructive feedback with advice on how students can improve their work, whilst students reflect on their achievement and its route. The student-led end of the spectrum can be viewed as a learning process and so could be considered as an Assessment as a Learning (AaL) process (Earl, 2013). Berry (2008) views students as active information providers who, besides engaging in teaching and learning activities, use assessment information to make improvement-led decisions, and develop an understanding of the nature of an exemplary piece of work. They can engage in self/peer assessment. Students' abilities to assess their own work contribute to the materialisation of personalised learning.

Self-assessment involves students' review of their learning and achievement based on evidence from themselves or others (Boud, 1995). Glasson (2009: 92) points out that it involves three questions: 'Where am I going?' 'Where am I now?' and 'How can I get there?' These essential questions categorise self-assessment as a learning process. Self-assessment requires the development of 'evaluative and productive knowledge and expertise', both of which can be developed through experience gained in an authentic setting through the appraisal of a peer's work (Dixon *et al*, 2011: 366). This supports Black and Wiliam's (2006) argument that students' abilities to comprehend the criteria of their work increases if they peer-assess each other's work alongside their own. Notwithstanding this, Black and Wiliam's view may not be applicable in respect of the use of some summative assessment strategies, such as quiz and tests. The marking of multiple-choice questions represented by letters is an example.

Peer assessment occurs when students consider and comment on the characteristics of work completed by other learners of similar status (Topping, 2009). It provides the opportunities for students to develop their ability to make evaluative judgement (Booth *et al*, 2014). Such strategies develop students' understanding and skills of self-

monitoring by exposing them to the varied outcomes that can be achieved in a particular task, difficulties faced in achieving a given goal, the various approaches implemented by others and how they can apply some of these strategies in their own work (Dixon *et al*, 2011). These processes/activities make peer assessment a learning process for students. The positive implications include enhanced students' motivation, easier communication of feedback and its ability to aid students in the development of the essential skills for self-assessment (Black *et al*, 2003). The easier communication of feedback may, on the downside, appear to be unfavourable, as peers could present low-status feedback. In addition, social processes such as friendship can have an impact on the reliability and validity of peer assessment (Topping, 2009). Students may also be unsure of their capability or that of others in assessing the given work (Loddington, 2008). This may affect the status of the assessment and influence teachers' attitude towards it.

Given that self and peer assessments are students-led processes, usually aimed at developing students' evaluative skills, they can both be considered as learning processes, and as such, assessments with formative roles. Clark (2011) describes AaL as the aspect of formative assessment in which peer assessment is structured and independent learning and assessment encouraged. It involves the act of 'collaborative and individual reflection on evidence of learning' (Clark 2012: 208). The strategy has a positive effect on students' ability to self-monitor, self-assess, self-evaluate and self-correct, therefore making it a metacognitive process (Berry, 2008). Students are kept on their feet in this process, as they are active and engaged in the assessment process, not only as contributors, but as 'the critical connector' linking assessment to their learning process (Earl, 2003: 25). This assessment as Earl (2003:47) states 'is the ultimate goal where students are their own best assessors'. Although student-centred, AaL will barely manifest without an external input, teachers can enhance AaL by creating activities that pave the way for self and peer assessment (Berry, 2008). Both assessment practices make a key contribution to the development of meta-cognitive skills in the learning process (Isaacs *et al*, 2013). Yet, all self-assessments do not result in AaL, as not all self-assessments involve self-reflection. Summative assessment tasks – such as tests and quizzes – could be typical examples. However, it can be argued that students can use the outcome to ascertain what they know and the areas they need to work on. This somehow suggests a formative role. Besides, an

actively engaged student employs self-assessment in one way or the other to identify and minimise the learning gap (Absolum, 2011).

Whilst AaL places special emphasis on how assessment can be used to develop independent learners who are able to control their learning, AfL places emphasis on the role of teachers in improving the learning process (Berry, 2008). However, the role of the teacher in AaL cannot be overlooked. Sadler (1989:141) argues: 'if anything, the guild knowledge of teachers should consist less in knowing how to evaluate student work and more in knowing ways to download evaluative knowledge to students'. Such knowledge, he argues, will develop students' independence in their engagement and monitoring of their learning. This highlights the role of teachers in the development of students' metacognitive skills necessary for the effective evaluation of their work (Booth *et al*, 2014; Baker, 2008). This is vital, as it aids students in the regulation of their learning (Abell and Siegel, 2011). Research findings on the development of metacognitve skills lay emphasis on the value of teachers' role in setting a clear lead and gradually passing on this responsibility to the students (Baker, 2008). Such a responsibility will be better understood by students in an authentic setting, which can involve the evaluation of each other' work (Dixon *et al*, 2011).

AaL practices like other assessment practices are limited by different factors. It could be assumed that the ability to evaluate students' work is a non-transferable skill held by teachers due to the lack of opportunities provided for students to self-evaluate their work (Sadler, 1989). Teachers drive the teaching and learning process, which assessment is a part of. Transferring control of a part of this process may seem uncomfortable for some teachers, as Sadler (1989) argues that some teachers feel threatened by the idea that students can be actively involved in self-evaluation. Assessment for them is the teachers' prerogative, given that it is part of the skill and knowledge required for the role and distinguishes them from students and the other stakeholders (Sadler, 1989). The teachers' understanding of the required skills and the ability to pass on these skills to students also contributes to the limitation of AaL practices. This necessitates the need to create opportunities for teachers to enhance their knowledge of feedback techniques, which are able to develop students' self-regulatory/self-monitoring behaviours (Dixon *et al*, 2011). This will enable students

to become more active participants in the learning and assessment processes (Dixon *et al*, 2011); this, in the long run, will be beneficial to teachers. Isaacs *et al* (2013) summarise the benefits of peer assessment for teachers as follows:

> Peer assessment provides the opportunity for a shift of responsibility from teacher to learner; the affordance of time for the teacher to stand back from delivery and observe; higher levels of motivation and independence in learners, which reduces the need for people-management tactics versus teaching (p.100).

Therefore, I can summarise AaL as the student-centred and student-led assessment process, which has the capability to improve learning and develops one's independent and reflective skills.

To conclude this section, an assessment practice can either be for learning, of learning or as learning. There are similarities in them, as they all involve data collection from the learner. They are dissimilar in how the information is used in the teaching and learning process, which can be formative or summative. The dissimilarity between the formative assessments – AaL and AfL – is dependant on who uses the information. The comprehension of these assessment strategies ensures the effective development of the knowledge of 'how to assess' which forms part of the assessment literacy model, as described by Abell and Siegel (2011). The limitations in their effective use results from both the influences of external factors and possibly a limited knowledge of these processes. In view of this, there is reason to believe that there is the necessity to understand teachers' conceptions of assessment.

2.5 Assessment conception

2.5.1 Belief vs Knowledge

Belief is one of the more difficult concepts to describe (Mansour 2009). Pajares (1992: 307) describes it as a construct that 'does not lend itself easily to empirical investigation'. He further describes it as a construct that:

> Travels in disguise and often under alias-attitudes, values, judgements, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practical principles, perspectives, repertories of understanding, and social strategy (Pajares, 1992: 309).

This implies that there are possibly diverse meanings accorded to this term by different authors. For instance, Zheng (2009:74) characterises 'belief as a subset of a group of constructs that name, define and describe the structure and content of mental states that are thought to drive a person's actions'. As such, it is an intrinsic and unique characteristic of humans. Beliefs as Loucks-Horsley *et al* (1998:27) argue 'are more than opinions: they may be less than ideal truth, but we are committed to them'. It represents the experience that takes place in people's mind and bodies (Braden (2008), and therefore is subject to change. It is also, as Braden (2008:83) describes it, 'the acceptance that comes from what we think is true in our minds married with what we feel is true in our hearts' They are not likely as Pajares (1992:321) states 'to be replaced unless they prove unsatisfactory and unlikely to prove unsatisfactory unless they are challenged and one is unable to assimilate them into existing conceptions'. It can, therefore, be argued that experience can affect belief. Whitcomb (2003:543) cites Richardson's (1996:104) argument that 'belief … describes a proposition that is accepted as generally true by the individual holding the belief. It is a psychological concept and differs from knowledge which implies epistemic warrant'. This implies that knowledge is free from varying degrees of conviction, unlike belief, and must fulfil standards of evidence (Whitcomb, 2003). The distinction between belief and knowledge can be seen to be based on one's conceptualisation of knowledge as a subset of belief and vice versa (Murphy and Mason, 2006).

Alexander *et al* (1991:317) assert that knowledge 'encompasses all that a person knows or believes to be true, whether or not it is verified as true in some sort of objective or external way'. This definition is limited and has not been widely accepted in the teaching and learning literatures (Woolfolk-Hoy and Murphy, 2001). Murphy and Mason (2006:306) on the other hand, believe that knowledge is 'all that is accepted as true that can be externally verified and can be confirmed by others on

repeated interactions with the object'. As such, it can be seen as belief, affirmed as true, based on objective evidence or agreement of views (Kagan, 1992). Knowledge is not an idea that one has and disbelieves in; rather, there is an element of one's belief in the idea. In essence, knowledge can be considered as verifiable belief. Human knowledge, as Plato suggests, comprises 'belief, truth and justification' (Woolfolk-Hoy and Murphy, 2001:3). Goldman (1986:42) argues that unless it is a 'justified belief', true belief cannot be considered as knowledge. Knowledge can, therefore, be considered to be a 'justified true belief' (Nonaka and Takeuchi, 1995: 58). The concept of justification can be a complex issue to establish and factors such as the causal factors, which consider the rationale for the belief, and causal processes, which generate the cause, can be crucial in qualifying knowledge (Goldman, 1986).

Kagan (1992) is of the view that the majority of teachers' professional knowledge can be more accurately considered as their belief. Hence there is an argument that knowledge and belief are difficult to separate as concepts. It is evident in literature that some researchers avoid differentiating between the two, instead they are used interchangeably or in some cases by referring to one or the other (Murphy and Mason, 2006). Golombek (1998) argues that teachers' professional knowledge informs their practice. However, research shows that knowledge on its own will not provide a clear meaning for teachers' behaviours and action due to the complex nature of teaching, consequently, the need to explore teachers' beliefs (Zheng, 2009). In essence, studying teachers' knowledge of the different aspects of their work, for example assessment, may not explain their behaviour towards them. Understanding their belief system may possibly provide more insight. Belief comes from our innermost self, and so can influence what we do. It is believed that belief can act as a filter which allows the screening of fresh knowledge and experiences for meaning (Zheng, 2009). This can include teachers' perceptions, interpretations and decisions on how to deal with different classroom issues (Whitcomb, 2003). Mansour (2009:26) summarises belief as 'a concept used to characterise a teacher's idiosyncratic unity of thought about objects, people, events and their characteristic relationships that affect his/her planning and interactive thoughts and decisions'. Consequently, an argument can be made that belief plays a part in the structuring of teachers' classroom practices, and as such understanding teachers' beliefs will throw more light on their behaviours.

The restructuring of one's beliefs occurs whilst reflecting on said beliefs (Telese, 1996). A philosophical perspective is developed when an individual possesses varied degrees of conviction about particular beliefs (Telese, 1996). This could be influenced by various factors: personal influences, education and formal knowledge (Richardson, 1996). On that account, teachers' beliefs can be defined by a compendium of experiences they have been exposed to. Woolfolk-Hoy and Murphy (2001) list the personal influences as follows:

> One's belief about self and others; one's viewpoint on the relationship between the society and schooling; personal, family and cultural values and attitudes; and the impact of gender, ethnicity, socioeconomic status, religion, geography, and life events (p.7).

Research indicates that teachers' educational beliefs influence their classroom practices and professional development (Zheng, 2009). Teachers often acquire their knowledge of the teaching process from their experience as students, teacher training process and working as a qualified teacher. Research shows that teachers' practices are more influenced by their beliefs than their teaching experience and their teaching environment (Griffiths *et al*, 2006**).** However, most research into ways of boosting assessment competence has failed to consider this factor (Remesal, 2011). As Gregoire (2003:149) suggests, the knowledge of the way teachers relate to their pedagogies and to their students' outcomes could be the 'missing link' between the effective implementation of school reforms by teachers and the call for such reforms. This suggests that belief plays a key role in teachers' behaviour.

It is evident from the discussion above that belief and knowledge are two separate concepts, yet too related to avoid the influence of one on the other. There is evidence to suggest that different factors can affect one's belief. It is also argued that belief plays a role in shaping ones behaviour towards an object or concept. An argument can, therefore, be made of the need to understand teachers' assessment beliefs with the view to better understand their assessment literacy. This takes into account the idea that assessment literacy involves one's knowledge and knowledge can be shaped by belief.

2.5.2 Teachers' Assessment conception

Beliefs form part of one's conception of an idea (Thompson, 1992; Philipp, 2007). They form the personal pedagogy that guides teachers' action. Thompson (1992:141) describes teachers' conceptions as 'the general mental structure encompassing both beliefs and any aspect of the teachers' knowledge that bears on their experience, such as meanings, concepts, propositions, rules, mental images, and the like'. Brown (2004b:303) describes conceptions as 'the organising framework by which an individual understands, responds to, and interacts with a phenomenon'. He believes that teachers' conceptions seem to be multifaceted and interconnected and not uniform and simple. This implies that an individual does not have one conception of each phenomenon, but rather different conceptions, which are influenced by the exposure to these phenomena. Brown and Gao (2015:4) further describe conception as 'the ideas, values and attitudes people have toward what something is, i.e what they think it is and how it is structured, and what it is for, i.e its purpose'. Teachers' conceptions, therefore, include their descriptions of pedagogical processes and purposes, of which assessment can be one. In other words, a conception of assessment can be described as an individual's understanding of the nature and purposes of assessment (Brown and Gao, 2015).

It is believed that teachers appear to have their own assessment policies which mirror their idiosyncratic values and beliefs about teaching, and informs their assessment practices (Cizek *et al*, 1995). This indicates that teachers' conception can affect their pedagogy. Thompson (1992) argues that studies that focus on teachers' conception rather than just teachers' belief appear to be more beneficial to researchers. Although, Sethusha (2012) reveals that teachers' conceptions of assessment are influenced by personal pressures such as time management and workload management, and external pressures resulting from parents' and authorities' inputs; belief on its own is still not free from influences. If belief forms part of one's conception of an idea and belief is intertwined with knowledge, then determining teachers' conception of assessment will be a key factor in understanding their assessment knowledge. This knowledge reflects their assessment literacy and may inevitably influence their assessment practice. Besides, knowing teachers' conception of assessment can give an insight into why there are variations in the implementation of government or school assessment

innovations (Segers and Tillema, 2011), and in teachers' assessment literacy. This may well imply the existence of different conceptions of assessment by teachers.

2.5.3 Models of Assessment conceptions

Teachers can possess multiple and conflicting conceptions of assessment (Brown, 2011 and Postareff *et al* 2012). This can be attributed to the argument that teachers' beliefs are 'ecologically rational' (Brown 2011:3). Both their personal experiences of assessment and the educational and social context they work in have an effect on their conception of assessment (Sethusha, 2012). Equally, as Brown and Remesal (2012) argue, that there is possibly a chance that teachers' conceptions of assessment may change during their teaching career. These arguments suggest the likelihood of a dynamic process in assessment conception. Karaağac and Threlfall (2004) in their study found out that teachers can carry out classroom practices that conflict with their beliefs when goals are imposed on them. Their study also shows that such goals are of such significance that it can result in practices that clash with their beliefs. Yet, there are arguments that if the constant promotion of certain assessment practices by the assessment gurus or policy makers is at odds with the teachers' beliefs or competences, this may result in a little effect on their practices (Dixon *et al*, 2011). This, perhaps, emphasises the role of teachers' belief in their assessment practices.

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Brown (2011:15), in his study on the comparison of primary and secondary school teachers' conceptions of assessment, generated a hypothesis – 'teachers' conceptions of assessment will be ecologically rational in that they will reflect the legal, cultural, or social priorities placed on assessment for their work environment'. This implies that teachers are therefore more likely to take on the conception of assessment that allows them to work successfully within their system (Brown, 2011). Accordingly, their conceptions of assessment are linked to their assessment practices (Postareff *et al*, 2012).

Different categories of teachers' conceptions of assessment have been discussed by different scholars. Postareff *et al* (2012) categorises teachers' conception of the purposes of assessment into reproductive and transformational conceptions. The

reproductive conceptions focus on assessment as a tool to measure the recall and application of knowledge while the transformational conceptions focus on assessment as a tool to develop students' thinking and knowledge (Postareff *et al*, 2012). Whilst the reproductive conceptions relate to use of assessment for measuring concepts which can be used for accountability purposes, the transformational conceptions relate to use of assessment as an improvement tool. Brown (2002; 2004b), on the other hand, discusses teachers' assessment conception as assessment for improvement, for school accountability, for student accountability and as irrelevant. Teachers' conceptions, in this case, are also based on the purposes of assessment. These focus on assessment as a tool to 'improve teaching and learning'; a tool to 'evaluate and hold school and teachers accountable'; a tool to 'certify students' learning and hold them accountable'; and a tool that is 'irrelevant' (Brown, 2011: 3). Hui (2012) went further to identify three other conceptions of assessment, which he referred to as the missing conceptions of assessment. These include 'assessment as a way to change students' learning attitude, assessment as identifying students' potentials and using assessment to prepare students for future challenges' (Hui, 2012:381). Brown (2002, 2004b) and Hui (2012)'s assessment conceptions models reflect the different forms and purposes of assessment. However, I would argue that the additions from Hui (2012) are more linked towards using assessment as a learning tool or process. Therefore it is logical to argue for the existence of conception of assessment as a learning tool or process.

Another view on the discussion of assessment conceptions is offered by Segers and Tillema (2011). They found that teachers' conceptions of the purposes of assessment can be summarised as – assessment as a tool to inform performance and learning (using assessment to consider what students have learnt and what the next step in the learning process will be); assessment as a 'school accountability' tool; assessment as 'bad quality' tool (considering assessment as an inaccurate and unreliable tools with measurement errors); and assessment as a 'good quality' tool (assessment results in the adaptation of pedagogies as well as serves as a measuring tool for higher order thinking skills) (Segers and Tillema, 2011: 52). There are similarities between these conceptions and that of Brown (2002; 2004b), as both discuss assessment as an improvement and accountability tool as well as considers the limitations of assessment. Segers and Tillema's findings, however, show that teachers viewed

classroom assessment as fulfilling both the formative and summative goal in their conception of assessment as a good quality tool (Segers and Tillema, 2011). This possibly shows that there may be difficulty in the characterisation of summative and formative assessments by some teachers. There also seem to be an overlap between assessment as a 'tool to inform performance and learning'and assessment as a 'good quality' tool as both consider the next step in learning. This may create difficulty in the characterisation of one's conception as an improvement tool.

Further discussions on assessment conception are presented in Remesal (2011)'s work on assessment conceptions. This classifies assessment beliefs based on the following four dimensions: *the learning process, the teaching process, accreditation of learning and accountability of the professional teaching activity*. She argues that teachers' beliefs in the four dimensions interweave to construct their conceptions of assessment, and these are based on a two pole continuum relating to these dimensions (p.480). In this model, a teacher's conception of assessment is discussed as more pedagogically inclined if the conception focuses more on teaching and learning, and more societal inclined if it focuses more on the accountability and certification of achievement (Remesal, 2011). As teachers have been shown to have multiple conceptions of assessment (Brown, 2011), this model will better accommodate the description of their conceptions. However, this model fails to consider teachers' conception of assessment as a limited process, unlike Brown's (2002; 2004b) conception of assessment as irrelevant, and Segers and Tillema's (2011) conception of assessment as a bad quality tool. This means that the negative conceptions of assessment may not be revealed by this model.

From the above discussion, it can be argued that the key themes of assessment conceptions revolve around the need to improve learning and the need to report learning. Thus, it is reasonable to argue that the descriptions of teachers' assessment conceptions as a tool for improvement and accountability are central. One could, therefore, summarise teachers' conception of assessment as assessment for improvement and accountability purposes. Failure to recognise these two conceptions may, therefore, consign the conception of assessment as irrelevant. These varieties of conceptions, as revealed by the studies discussed in this section, indicate that perhaps teachers' assessment conceptions are not fixed. This might be an indication of the

limitations of identifying teachers' conception of assessment through a quantitative process.

2.6 Assessment and Teacher attitude

2.6.1 Teacher attitude

Thoughts are inherent in humans and cannot be seen or felt without a medium. Attitude can be described as one's belief, feeling, 'the disposition to respond positively or negatively to people', object, institution and situations (Ricketts and Ricketts, 2010; Ajzen, 1998). In that regard, humans can exhibit an attitude towards every object or concept they encounter. The definition of attitude is not restricted to belief but extends to the values accorded to the object or concept in question. Attitude can also be described as the summary of evaluation, which includes positive or negative evaluation of an object of thought (Bohner and Wänke, 2002; Oskamp and Schultz, 2005; Weiten, 2013). It is as Osgood *et al* (1957: 190) describes it – 'a learned implicit process, which is potentially bipolar, and varies in its intensity.' This characteristic justifies the quantitative measurement of attitude. Attitude can be viewed as a form of knowledge structure, which is either stored in the memory and inferred from or constructed on the spot (Fabrigar *et al*, 2005; Oskamp and Schultz, 2005). There is the belief that future actions can be predicted or directed by attitude (Coon and Mitterer, 2015). Attitudes also include one's belief that originates from one's value of the object of thought and the expression of views of what should happen in different situations (Fien, 2007). Therefore, the manifestation of one's attitude can be described as the reflection of their belief of what something is or should be, used for or should be used for, how something works or should work and how favourable or unfavourable something is. Simply put, attitude guides the decisions and actions individuals take in different situations that arise in their daily life (Fien, 2007). They have the capability to change one's life. This is in the context of the idea that the existence of positive attitudes will generate a wave of positivity, which can give rise to success (Ricketts and Ricketts, 2010).

To understand teachers' attitudes requires the knowledge of the characteristics of attitudes in general. Attitude as a concept is made up of three components: 'affective',

which is centred on one's feelings and emotions; ‘behavioural’, which is centred on one's actions towards attitude objects; and ‘cognitive’, which is centred on one's thoughts, beliefs and ideas (Johnson and Boynton, 2010; Olson and Maio, 2003; Bordens and Horowitz, 2002). Responses from these components can come together to form one’s attitude towards an attitude object (Eagly and Chaiken, 1998). There is evidence to argue that these three components are related but different (Olson and Maio, 2003; Hewstone 2011), and that one could possibly affect the others. Although the components of attitude often work together to create an experience; there is a strong indication that each component is a stronger determinant of attitude at certain times (Olson and Maio, 2003; Hassanein, 2015). The three components of attitude can sometimes conflict (Maio and Haddock, 2015). Attitude formation is not limited to the link between the components of an attitude towards an object (intra-attitudinal), but can also be formed by creating linkages between the attitude object in question and other attitude objects (inter-attitudinal) (Eagly and Chaiken, 1998). This implies that often one's attitude towards an object is not only influenced by the characteristics of the object in question, but rather includes that of other related objects. This presents attitude as a complex concept.

The supposed complexity of attitude can be seen in its formation process. Attitude as a concept relies on a process which is within the subject, and so is impossible to observe directly (Moliner and Tafani, 1997). Attitudes can be inferred from observable responses, and, as such, are referred to as 'inferred constructs' (Oskamp and Schultz, 2005:12). The evaluative response manifested by an individual on the object of attitude serves as the observable part of the process. Attitudes can be measured in different ways. This includes the use of verbal and non-verbal indicators. The verbal indicators include the use of self-report on the object in question (Olson and Maio, 2003). This can be achieved using the expectancy-value model, which involves measuring how desirable an attribute is, and the probability that the object in question will possess it (Olson and Maio, 2003). This method of measuring attitude is limited to the identified attribute and may possibly fail to identify new attributes. The use of an open-ended thought-listing method involves the listing of the attributes of the object in question and the rating of their desirability (Olson and Maio, 2003). This is limited, as only the 'consciously retrievable' explicit attitudes from the memory are assessed (Olson and Maio, 2003:305). It is suggested that there may be differences

between the unconscious implicit attitudes which affect one's actions without conscious thoughts, and conscious explicit attitudes which operate within one's state of consciousness (Bordens and Horowitz, 2002; Gawronski *et al*, 2006), thereby suggesting the need to measure both for a more valid conclusion. The unconscious implicit attitude can be measured using memory tasks, indirect questionnaires and by using non-verbal indicators such as the use of response latency (Trafimow, 2004). It has been argued that the verbal means through participants' self-report on the object or subject in question is the most appropriate measure for attitude in many circumstances (Banaji and Heiphetz, 2010). This is, however, limited by the existence of non-socially desirable attitudes which individuals may not be comfortable to discuss, and the belief that attitudes people commonly express are those that they often try out (Banaji and Heiphetz, 2010). Other forms of expressions, such as intentions and actual behaviours, can serve as attitude indicator tools (Fishbein and Ajzen, 2010). The suitability of each response tool is not always the same; however every suitable response tool must show an evaluation of the object in question in an unambiguous manner (Fishbein and Ajzen, 2010). Although the sum of the evaluative beliefs of the object in question results in attitude, beliefs when less certain play a lesser role (Olson and Maio, 2003). Evidently, considering only one's belief as a measure of their attitude will present a limited response.

To summarise, attitude is undeniably the sum of an individual's evaluation of an object or a subject, which can be measured by quantitatively or qualitatively. Such evaluations are shaped by one's relationship with the object/subject in question, and in some instances other related objects.

2.6.2 Characteristics of attitudes

There are variations in the attitude towards different objects of thought. Attitude accessibility can be viewed as the rate at which attitudes are thought about and how fast they come to mind (Weiten, 2013). Increased accessibility can increase the amount of working knowledge (Fabrigar *et al*, 2005), which is also referred to as 'attitude embeddedness' (Maio *et al*, 2003). Attitudes have different degrees of 'embeddedness', which reflect the amount of relevant information available when an attitude is encountered by an individual (Olson and Maio, 2003). An increase in the

amount and complexity of working knowledge may enhance accessibility, as this is more likely to increase attitude activation which increases accessibility (Fabrigar *et al*, 2005). Inevitably, an increase in one's exposure to an object or subject informs the characteristics of the resulting attitude. Simply put, experience plays a part in the formation of a person's attitude. Attitudes with a high level of embeddedness are more resistant to change (Wood *et al*, 1995; Eagly and Chaiken, 1998), and are more likely to reflect behaviour (Kallgreen and Wood, 1986). There is a higher tendency for such attitudes to be activated as a result of the extensive information or structure associated with it (Fabrigar *et al*, 2005). This factor can be influenced by the evaluative consistency of the attitude in question (Olson and Maio, 2003; Fabrigar *et al*, 2005). Evaluative consistency reflects the extent to which the different components of attitudes mirror the overall attitudes (Olson and Maio, 2003; Eagly and Chaiken, 1998). Attitudes with a high evaluative consistency are therefore more likely to be described by their components. This, however, can be impeded by the ambivalent nature of some attitudes (Olson and Maio, 2003; Fabrigar *et al*, 2005). Attitudes that are ambivalent tend to have conflicting positive and negative elements (Fabrigar *et al*, 2005; Visser *et al*, 2006). This is possible, as one's attitude may be dominated by one component of attitude, be it beliefs, feelings or intentions (Hassanein, 2015). This inevitably draws attention to the importance of using suitable processes in the identification of an individual's attitude.

Furthermore, attitude accessibility can also be influenced by the other dimensions of attitude. Attitudes that are highly accessible have the tendency to be strong (Oskamp and Schultz, 2005; Weiten, 2013). Attitude strength is the degree of the resistance of an attitude to change and the extent to which it influences behaviour (Krosnick and Smith, 1994). Strong attitudes have a greater stability over time and stronger effect on the processing of information (Krosnick and Smith, 1994), thus making them more accessible. Such stability can be encouraged by the continual access to the attitude object.

In addition, the accessibility of an attitude can be influenced by its extremity. Attitude can be extreme with the extremity developed over time (Olson and Maio, 2003). Attitude extremity is the deviation of an attitude from neutrality or the centre of the attitude scale ranging from a positive extreme – e.g highly favourable – to a negative

extreme – e.g highly unfavourable (Krosnick and Smith, 1994; Visser *et al*, 2006). When an attitude is repeatedly activated or expressed, it strengthens the association with the features that form the basis of the initial evaluation of the object or subject in question resulting to a greater extremity (Fabrigar *et al*, 2005). Again, the role of experience in attitude formation is brought to light.

Following on from this, attitudes can be developed from direct or indirect experience with the object in question, with the attitudes emerging from direct experiences stronger (Olson and Maio, 2003; Hassanein, 2015). It is fair to say that every attitude exhibited reflects in one way or the other a past experience – or past experiences – thereby suggesting that attitudes are learned (Holmes and Singh, 2012). It has been shown that attitudes are dependent on a person's thoughts at any given time, and as such fluctuate over time (Erber and Hodges, 1995; Eagly and Chaiken, 1998). This is to suggest that attitudes can be evolutional. Attitude can be formed in different ways. Irrespective of the component of attitude, observational learning, which occurs when we observe and imitate others, is the way by which we acquire many of our attitudes (Holmes and Singh, 2012). This suggests that past learning and experiences tend to shape our attitude (Holmes and Singh, 2012). This may possibly explain why people working in the same setting may have different attitudes to the object/subject in question (Holmes and Singh, 2012). It also suggests that there is a relationship between one's knowledge of an object/subject and one's attitude towards it.

Attitude can also be acquired through associative learning, such as classical and observant conditioning (Holmes and Singh, 2012). Associate learning takes place when learners make connections between different stimuli and/or responses (Coon and Mitterer, 2015). Classical conditioning creates learning when an association is developed between two things that might not be naturally linked, such as the association of a reflex response to a new stimulus (Holmes and Singh, 2012; Banaji and Heiphetz, 2010). Operant conditioning, on the other hand, occurs when the consequences of behaviour affect its future occurrences (Coon and Mitterer, 2015). This can be seen in the effect of positive reinforcement on students' attitude to learning (Snowman and McCown, 2013; Hoque, 2013). Unlike the classical conditioning, in which the responses are involuntary and inflexible, the operant conditioning generates voluntary and flexible responses (Coon and Mitterer, 2015;

Fazio *et al*, 1989). Whilst attitude in classical conditioning is a function of what precedes it, it is a function of what comes after it in operant conditioning (Coon and Mitterer, 2015). It is fair to argue that both processes can form teachers' attitudes to the different aspects of their profession.

It has been established that attitudes have different characteristics, one of which an individual's experience can influence. In their daily role, teachers are subject to different experiences, thereby presenting the possibilities of variations in the characteristics of their attitudes. This raises the question of the role of different factors in shaping teachers' experiences, which subsequently may impact their attitude formation.

2.6.3 Factors affecting teachers' assessment attitude

Assessment is a process aimed at ascertaining and improving learning, and can be subject to varied attitudes. Teachers engage in assessment at different levels (Rea-Dickens, 2004). Such engagements may be influenced by individual teacher's values and the role they play in the assessment process. The different levels at which the engagement occurs, as Rea-Dickens (2004:255) states, include 'the individual teacher(s), the cultural context of the classroom and the professional and institutional levels', and these define the characteristics of a teacher's workplace. In other words, teachers are involved in assessment at a personal, classroom and school levels.

Deep educational changes are usually challenging and assessment is one of them (Carless, 2005). The choice of an assessment practice is something that teachers have to make. Carless (2005: 52) describes assessment cultures as 'impervious to transformation'; a characteristic worsens by the overload of reforms and previous unsuccessful assessment reforms attempts. Such reforms could be national reforms which stream down to schools or school reforms resulting from the action of Ofsted or high stake exam results. Yet, at the centre of this are learners who are being assessed. Hill (2011) found that changing from a traditional summative assessment regime in the classroom is neither quick nor uncomplicated. The same can be said for the other assessment regimes. Teachers have to make difficult decisions on their pedagogy and often these may be based on and reflect long-used practices. Different factors affect

the extent of these changes. If an assessment, no matter the type, involves a 'process of professional judgement' (McMillan, 2000), then it can be argued that any factor that has the capacity to affect this judgement influences assessment. There are possibilities that these factors lie within the teacher's control or beyond it (James and Pedder, 2006). Jones and Leagon (2014: 830) point out that factors such as teachers' 'prior knowledge and experience, self-efficacy, epistemic belief and the sociocultural context of the teacher and school' affect the construction and change in teachers' behaviour. This is to say teachers' assessment behaviours are influenced by their experiences, abilities, beliefs and their school community. Carless (2005) grouped these factors into levels based on their proximity to the teachers' innermost self. These include: the individual's domain, the micro-level, such as the local school forces, and the macro-level consisting of the wider external forces (Carless, 2005). Teachers' understanding of the principles of assessment and its practices, and the congruence with their beliefs and values constitute the personal domain (Carless, 2005). Factors such as the school culture, availability of resources and the effect of stakeholders such as parents are part of the micro-level factors, and the effect of government policies and high-stake assessment practices are considered the macro-level factors (Carless, 2005). Factors within these categories have the potential to influence a person's conception in varied degrees, thereby resulting in a change in attitude. These factors are subsequently discussed.

2.6.3.1 Teachers' experience**s**

Teachers' experience is a determining factor in the formation of their beliefs about learners, learning and the learning process (Thomas, 2012; Ricketts and Ricketts, 2010). Such factors lie within the teachers' personal domain. Teachers' personal lives play a part in the formation of their identities (Gu, 2007). These personal factors as Miller *et al* (2015:37) suggest, include: 'personality structure, past conflicts, cultural norms, religion, gender, migratory experiences and family.' The impact of these factors can either be positive or negative and is subject to change (Gu, 2007). Teachers adapt their practices due to various reasons, yet the ability of a teacher to adapt their practice is not the only issue, rather their ability to develop self-regulatory skills that will enable them to monitor and evaluate the effectiveness of the adapted practice (Timperley, 2008). Teachers, by the virtue of their profession, play the

unique role of bridging the gap between the current, the future and the past policies, and as such the process of change subjects their knowledge and belief to constant re-evaluation (Gu, 2006). Therefore, the best attitude towards assessment lies between one's affection for the system and one's indifference to the system (Black, 1998). Teachers' belief of the need for a change can also play a part in shaping their attitude. For instance, their participation rate in professional development processes is influenced by their belief in teaching and learning, with higher participation rate encouraged by a more student and subject matter inclined teacher profile (De Vries *et al*, 2014).

Factors within the personal domain are closest to the individual, and so will be the most resistant to change. Teachers' experiences as young students, student teachers and practising teachers can be part of these factors. The impact of early experience cannot be overlooked. This is reflected in Pajares' comment (1992:317) that 'early experiences strongly influence final judgement which becomes theories (beliefs) highly resistant to change'. He explains that previous beliefs affect the processing of new ones, and so the earlier one is exposed to a belief the more difficult it will be to make a change. This suggests that teachers' prior experiences contribute to the formation of their pedagogy. Yet one can argue that the impact of this earlier belief may play a limited role as time goes on. As Richardson (1996) argues, although beliefs are considered able to drive actions, such beliefs can be altered by human beings' experiences or reflections on their actions. This implies that current experiences affect attitude and present an uncertainty on the main influences of teachers' attitudes. Based on Richardson (1996)'s argument, one can further argue that teachers with longer years of teaching experiences may possibly have more varied attitude.

2.6.3.2 Teacher-Assessment relationship

Teachers' attitude towards assessment can also be influenced by the belief they hold in respect of their role in the assessment process, as well as the teaching and learning process in general; this also lies within their personal domain. Griffiths *et al* (2006) found that teachers' belief played a greater role in influencing their practices than their experience and the socioeconomic context of the school they work in. Abell and

Siegel (2011) relate a teacher's view of learning in science to those sets of values and principles centred on learning and assessment that guide assessment-related decisions. Teachers' perception that assessment is solely their prerogative in the teaching and learning process will influence their attitude towards certain assessment practices (Sadler, 1989). Dixon *et al* (2011) found that teachers' espoused and tacit beliefs can influence their assessment practices. Teachers who are advocates of personalised learning and learners taking ownership of their own learning tend to exhibit positive attitudes towards AfL (Sebba *et al*, 2007). Yet, discrepancies have been found between teachers' conceptions of assessment and their thoughts of assessment practice (Wang *et al*, 2010). This possibly explains why Dixon *et al* (2011) recommend that as part of teachers' CPDs, there is the need to present teachers with the opportunities to evaluate how their beliefs influence their daily classroom practices, and the impact these might have on their students. Wang *et al*'s (2010:528) findings show that although pre-service science teachers have assessment conceptions that can be grouped into 'content knowledge, processes of inquiry and attitude', their thoughts of assessment practices tend to centre on recalling or understanding scientific concepts. These discrepancies were not only found between their thoughts around assessment and assessment practices; Wang *et al* (2010) also found that although pre-service teachers' thoughts of assessment tally with that of teaching and learning, their thoughts of assessment strategies vary from that of teaching and learning. These findings suggest the possibility that there are other factors that play a more significant role in teachers' attitude towards assessment. Although, it can be argued that this inference is limited to pre-service teachers as the impact of teaching experiences may influence this finding with experienced teachers.

Teachers' pedagogical knowledge of assessment also impacts on their attitude towards assessment. This could be because there is a lack of clarity about what to assess especially when the curriculum statements are vague (Millar, 2013). This often results in teachers' dependence on past exam papers for the key learning focus (Millar, 2013). Booth *et al* (2014) in their discussion of assessment-capable teachers, talked about the need for teachers to have the right language of assessment, understand the ideas they aim to develop in students, and avail themselves of the resources and opportunities they need to develop the intended skill. Such knowledge

can be developed through professional learning. Murray (2013a: 212) describes effective professional learning as involving:

> reflective dialogue, observing and reacting to one another's teaching, working together to implement new strategies, sharing teaching approaches and materials, and engaging in collective action research focused on common issues of practice.

Effective professional learning is therefore demonstrated through reflective practices, collaborative work and action research. These reflective practices play a crucial role in sustainable change (Maughan *et al*, 2012) and the development of teachers. Self-led reflective practices allow teachers to mull over their pedagogy with the view to stimulate an improvement (Maughan *et al*, 2012). This is beneficial, as Goldschmidt and Phelps (2007) found that teachers who already knew the most benefited more from professional learning. The professional learning embedded in teachers' normal routines tend to make a more positive impact on the school community (Murray, 2013a); possibly because it forms part of their daily teaching experience which is constantly repeated.

Clearly, the arguments presented above show the role of experience in the teacher-assessment relationship. Given the fact that teachers' experiences change, it is expected that this relationship will modify.

2.6.3.3 The School structure

Teachers do not operate in isolation; rather their actions are influenced by local and national policies (Maughan *et al*, 2012). School factors are influenced by the school policies and will vary from school to school. Schools usually have their individual assessment policy, which guides their assessment practices. These policies are designed to ensure the development and implementation of an effective system. Black (1998) maintains that an ill-designed system may initiate hostility. It is obvious that this argument may not be restricted to a school assessment system, but can also apply to an individual teacher's assessment system; although, an argument can be made that these can be controlled by the same external force. The school factors are not limited

to the assessment policies. Hill (2011) found that although the change in AfL practices in a large complex secondary school can be influenced by the school factors, the tailoring of schools' professional learning to the school personal context plays a key role. In other words, it is believed that school personalised CPDs are crucial in the development of an effective system. This suggests that teachers attitude to assessment may possibly change as they move from one school to the other. Hill (2011) also argues that the school-level factor plays a crucial role in the link between the wider external forces and the teachers' personal domain. Any change in this relationship will, therefore, have an effect on the teachers' identity, which may possibly affect their attitude.

Schools can be considered to be complex institutions. The complexity of schools can be contributed by the multiple departmental structures found in secondary schools. Elmore (2003:197) describes similar schools as:

> Typically large, complex and loosely coupled organisations…They don't just deal with the problem of how to teach the content for which they are responsible, but they must also cope with the accumulated successes and failures of all prior years of schooling…They are also places where major life decisions are made about students in their transition to adulthood and further education

It could, therefore, be argued that variations exist between the different stages of schooling, as schools deal with different challenges in the development of students. Secondary education, by the virtue of its position in the schooling timeline, has to deal with issues surrounding previous learning and the further development of young learners. This brings about complexity in the professional learning needs of teachers in this phase of education. In addition, it possibly adds more complexity to the various conceptions of assessment different teachers may have due to the variation in the subject and key stage they teach, thereby creating tensions within the school, department or individual teachers. These tensions have the potential to lead to more effective assessments as the assessment judgment are more likely to be made with a good understanding of the effects of the different factors (McMillan, 2000); possibly

resulting from a reflection before action. On the other hand, it can lead to confusion and an unstable system.

Leadership at whole school level is thus vital in ensuring that the professional learning to be promoted across the school gains traction and acceptance with the stakeholders such as teachers, parents and the community (Hill, 2011). Maughan *et al* (2012) found that sound leadership is required for positive changes in schools. Such leadership is characterised by leaders with the flair to inspire others with their vision, and the ability to implement the change whilst carrying others along (Maughan *et al*, 2012). In addition, the role of a knowledgeable expert in the field cannot be overlooked, as teachers need to understand the new idea, learn the skill and evaluate their existing practices (Timperley, 2008). In the case of assessment, the assessment literacy of the leadership team plays a key part. A well-informed leadership team equipped with the contemporary knowledge of assessment and learning will enhance the change in teachers' culture, from sorting students to improving their learning (Kaser and Halbert, 2009 in Hill, 2011). In the same token, an ill-informed leadership team can enhance a counter-productive effect. This suggests the role of school authorities in shaping teachers' assessment attitudes. Timperley (2008) argues that both the prescription of desirable behaviours and allowing teachers to develop good practices on their own without clear learning purposes impede their self-regulated inquiry skills. This further indicates the role of an external force in the effective adoption of a new practice. This, therefore, emphasises the need for assessment literate teachers, both as school leaders to support other teachers, and as classroom teachers to develop students' assessment capabilities.

It can be argued that the school structure has the tendency to influence teachers' attitude. This possibly results from the complexity of the school system and the roles of the assessment policies, school CPD and the school leaders in the development of a robust assessment system. Therefore, the school culture should be considered.

2.6.3.4 The School culture

The pressure to use summative assessment outcomes as evidence of progress can influence teachers' attitude to assessment. The pressure from both parents and the

school authorities to produce good results adds to the influencing factors. Black *et al* (2011) found that teachers believe the pressure to achieve good results in external tests leads them to put more emphasis on test preparation, in spite of its negative effects on quality teaching and learning. This inhibits their motivation to develop their own assessment skills – including the skills to develop test questions – as they can utilise ones from the external testing systems (Black *et al*, 2011). This could also encroach on the time teachers could have devoted to other forms of assessment, thereby impacting the use of multiple assessment methods. As McMillan (2000) argues, it is necessary for the efficiency of assessment methods to be considered as well as the balance between assessment needs and the available time and resources when choosing assessment methods, since good assessment is both efficient and feasible.

Teachers' responses to changes in the system may also affect their assessment attitude. The resistance to change the assessment system – often exhibited due to variation in subjects – can be mitigated by collaborative inquiry both within and across the different subjects (Hill, 2011). These provide several opportunities for teachers to develop in-depth knowledge of the practice (Timperley, 2008). They can achieve this by discussing the issues surrounding the area of change and using their findings to evaluate their current practices (Black *et al*, 2011). This reveals the positive effects of collaborative work among teachers on their professional development. However, this does not ignore the fact that such changes are required to take place over a sustained period in order to effect the changes at both teacher and student level (Hill, 2011). Hence, it can be suggested that the effects of school experiences may not be limited to the teachers' current school experiences.

The opportunities schools provide for teachers' professional development also play a part in shaping teachers' attitude towards educational issues. Such opportunities include the nature of the CPD and the time available for it. CPD programmes are mostly designed to tackle the connection between teachers' belief, knowledge, attitudes and their classroom practice (Jones and Leagon, 2014). Yet the effectiveness of most professional development can be questioned due to their inability to deal with these connections. As a result, there is very little change when a new initiative is introduced (Jones and Leagon, 2014). Although teachers pick up pedagogies through

CPD, the inability to evaluate adopted practices makes the process of adopting practices a closed-ended process (Timperely, 2008). Such actions cloud the essence and effectiveness of the adopted practice. This may be why Booth *et al* (2014) promote the idea of providing avenues for teacher research and development, through the provision of time and mental space for self-reflection, and development of new ideas. In addition, longer CPDs give rise to more time for teachers to engage in the trial of new strategies in their classroom and hence receive feedback on the outcome (Murray, 2013a). Van Driel (2010) highlights the importance of programmes that allow teachers to experiment with new strategies – in addition to external inputs – and opportunities for professional interactions with colleagues on the development of science teachers' pedagogical content knowledge. Other factors, such as cost, human resources and teaching equipment can also influence an effective practice change (Maughan *et al*, 2012).

In conclusion, teachers' attitude towards assessment is subject to both external factors and factors inherent in the teachers. All of these can be influenced by their experience. The above discussion raises the question of the extent of the impact of teachers' experience on their assessment attitude. Simply put, is teachers' experience the fundamental factor that affects their assessment attitude?

2.7 Assessment and Learning

2.7.1 The assessment and learning link

According to Pellegrino *et al* (2001), assessment is not an isolated part of the curriculum, as what is assessed and the use of the information gathered are dependent on the curriculum delivered and the method of instruction used. The purposes of assessment and types of assessment that take place are greatly influenced by the view of knowledge held by the assessor (Hargreaves, 2005). In addition, for effective assessment to take place, teachers must have a good understanding of the principles of how students learn (Brookhart, 2011). This will enable them to plan the assessment process that suits the learning process. Boud (1988) explains that the assessment process, along with its associated requirements, presents a greater effect on what

students learn and how they learn than any other factor. He further points out that this influence could be of more significance than the effect of teaching materials. In other words, it is fair to argue that teaching and learning will become unattainable without assessment (Absolum, 2011). This, therefore, suggests a link between assessment and learning.

Furthermore, Millar (2013) argues that one of the fundamental purpose of assessment is its role in the clarification of learning planned to occur. He maintains that this function of assessment is essential as it precedes and underpins other assessment purposes, yet it is often excluded in the discussion of the functions of assessment. Whitehouse (2013) supports this argument and explains that by considering the assessment items as part of the lesson planning process, learning outcomes are made more specific and clearer. Besides, assessment plays a part in shaping the quality of instruction in a learning environment (McMillan, 2000) by minimising or eliminating the vagueness of the planned learning outcomes (Millar, 2013). These arguments further indicate the link between assessment and learning. The relationship between assessment and learning can also be seen in the discussion of the planning process that focuses on evidence of learning by Whitehouse (2013) as shown in Fig 2.3

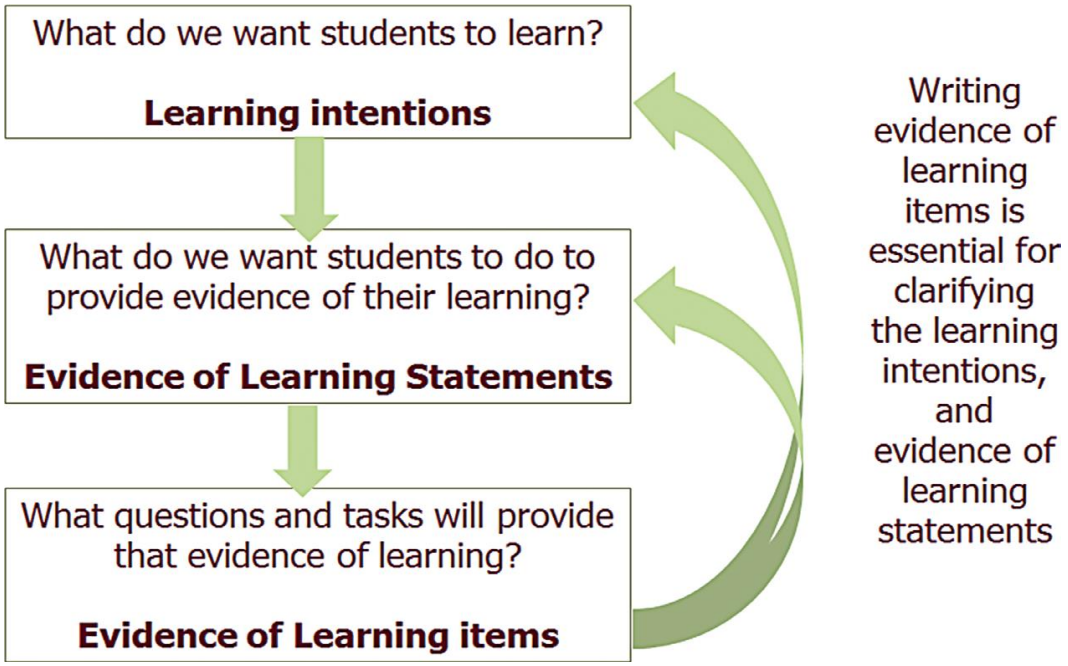

Fig 2.3: A planning process that focuses on evidence of learning (Whitehouse 2013:52)

In line with the definition of assessment discussed earlier, the provision of evidence upon which judgement is made is imperative. Considering the format and content of the evidence as a key part of planning for a learning process, and the making of the standards of the evidence clear to the students indicate that there can be an inseparable bond between assessment and learning. This is relevant because the development of independent skills in students can be facilitated by teachers sharing their understanding of the required standards, thereby making the knowledge to be gained clear (Booth *et al*, 2014). By doing so, students' abilities to effectively judge their work are enhanced therefore limiting their dependency on their teachers (Booth, *et al* 2014). An assessment that promotes learning promotes intrinsic rather than extrinsic motivation, enhances learners' confidence and develops their sense of ownership and control (Broadfoot, 2007). Teachers need sound assessment skills, so as to identify the level of their students' learning in comparison to valued outcomes, and the knowledge that they (the teachers) require to improve students' learning (Timperley, 2008). Such an assessment practice cannot be carried out in isolation but needs to be embedded in the teaching and learning process (Timperley, 2008). Giving consideration to the teaching and learning process, it can be argued that learning is likely to involve the consideration of the inherent assessment practices.

Learning as a process leads to the acquisition of new knowledge or skill, which can be acquired through study, teaching, instruction or experience (Pritchard, 2014). Absolum (2011: 103) views learning as 'an attempt to reduce gaps'. Learning in this sense takes place when the gap between what the learners know and can do and what the learners should know and do is made apparent (Absolum, 2011). Absolum (2011:28) summarises learning as about:

> Making and testing attributions about the world, increasing the 'discussability' and testability of propositions, and creating the conditions to make informed choices that reduce the gap between where the learner is and where the learner wants to be.

In other words, learning is any process that modifies existing knowledge or skills, or develops new knowledge or skills.

Teachers' knowledge of the subject matter alone is not adequate in the implementation of effective instructional practices, but rather the knowledge of the learning theories and their application in classroom instructional practices are also essential (Yilamz, 2011). There are varied views of what learning entails for teachers. This is affected by the teachers' philosophy of what learning is (Pellegrino *et al*, 2001; Shepard, 2000). An individual's belief of what learning entails will have an effect on the type of assessment data they tend to gather, and the series of inferences made from them (Pellegrino *et al*, 2001). In other words, teachers' views of learning consequently influence their teaching and assessment strategies (Bell, 2005; Berry, 2010). This argument takes into account the view that assessment, alongside planning and teaching, is considered to be part of instruction (Brookhart, 1999). In view of these arguments, it is obvious that understanding teachers' views of learning will possibly provide an insight into their attitude towards assessment.

2.7.2 Learning theories and Assessment

Research shows that there are different learning theories which shape the views of learning for teachers. Behaviourists believe that individuals are able to acquire various complex behaviours when provided with suitable environmental conditions, and these can include the reinforcement of suitable behaviours (Taylor and MacKenney, 2008). They discuss learning under the premise that it is focussed on observable behaviours and discount any mental activity (Pritchard, 2014). Similarly, they view learning as something that is studied objectively and believe that the absence of a change in behaviour indicates that learning has not taken place (Taylor and MacKenney, 2008). This, perhaps, suggests the possibility of an accurate measure of learning achieved by individuals. Assessment for them aims to ascertain if learners have achieved the requirements set for them (Berry, 2008). It is mainly centred on the outcome of learning, and by this very nature considered as an assessment of learning (Berry, 2008). This assessment can be the measuring of learners' facts and skills independently, or using the number of correct items answered in a test as a measure of learners' level of knowledge or learning (Berry, 2008). In other words, assessments can be linked to learners' abilities to recall information. Teachers that view learning as an act of memorising information tend to focus on summative assessment (Abell and Siegel, 2011). As teachers prepare students for high-stake exams, the question

arises as to whether this affects their views of learning which can influence their assessment attitude. Simply put, are teachers' views of learning seasonal, which may possibly lead to a seasonal assessment attitude?

Contrary to behaviourists, who tend to lean towards teacher-centered instruction, the cognitivists and constructivists tend to lean towards student-centered instruction (Yilamz, 2011). Cognitivists view learning as 'a relatively permanent change in mental associations as a result of experience, changes that are internal and cannot easily be observed' (Pritchard, 2014:32). For them, learning is essentially the product of mental activities induced by experience. Considering that mental activity is key to effective learning (Pritchard, 2014), assessment for cognitivists is aimed at developing independent learners by making them conscious of the basic ingredients required for self-monitoring and self-assessment in the learning process (Berry, 2008). Assessment tasks, in this case, should provide opportunities for the expression of complex understanding and enhanced intellectual abilities developed by learners (Toohey, 1999). The active role of the learner in the learning process places assessment under this theory of learning as assessment as learning (Berry, 2008).

On the other hand, constructivists believe that learners are able to construct their knowledge from their experiences (Bell, 2005; Berry, 2008). As Bell (2005:22) states, constructivists see learning as: 'a conceptual change, the construction and acceptance of new ideas or the restructuring of existing ideas'. Learning, in this case, can therefore be described an experience-induced process in which learners construct new ideas or refine existing ones. Assessment, in this context, is an opportunity for teachers to understand in what ways learners learn, what they can or cannot do and then reflect on the outcome in order to boost learning (Berry, 2008). This belief is a reflection of assessment for learning (Berry, 2008).

Pellegrino *et al* (2001) explain that any learning model underlying an assessment is a reflection of the assessor's thoughts, and the social setting of the assessment process. This could be an indication that one's belief and experience of assessment can influence one's view of learning. In other words, the assessment process can give an insight into one's view of learning. Teachers who view student learning as 'an incremental process' are more likely to be users of formative assessment, than

teachers with the mindset that 'learning ability is a fixed, inherent, entity' (Shermis and Di Vesta, 2011:106). Nevertheless, there is an argument that assessment practices – such as the AfL practices – can only be effective when there is congruence between teachers' and students' conception of assessment, and teaching and learning (Segers and Tillema, 2011). These arguments further emphasise the role of the relationship between learning and assessment; although it suggests that effective assessment can be hindered without the involvement of students. This raises the question of the role of students in shaping teachers' assessment attitude.

The relationship between assessment and learning can also be seen in teachers' conception of the feedback system. The influence of teachers' views of learning on the feedback system could be a contributing factor to the formation of teachers' assessment attitudes. Dixon *et al* (2011) suggest that teachers can be categorised as technicians, pragmatists and empowerers depending on their perception of their role and that of their students in the feedback process. They described the technicians as those who coordinate the whole feedback process with students as just recipients of the feedback information, who as such, have limited opportunities to develop their own evaluative skills. They presented the pragmatists as those who acknowledge the need for students to take an active role in the process, yet this is not often shown in their practices, as there is the sense that they still control the feedback process. Furthermore, they described the empowerers as those who provide opportunities for students to develop their evaluative skills and consider self-monitoring as a vital part of the feedback process. Although the different groups hold different views of giving feedback, the ideas are still centred on the role of the student in the process. Undoubtedly, this demonstrates the learner's role in the relationship between assessment and learning.

A broad understanding of the impact of assessment on learning has been provided by research on assessment for learning (Broadfoot, 2007). By the same token, the current research on teachers' pedagogy is limited in its ability to positively link the different roles assessment plays to a model of pedagogy (Black and Atkin, 2014). Osborne (2007: 180) describes teaching and learning as the 'product of curriculum, pedagogy and assessment.' Similarly, assessment, together with curriculum and instruction, is considered to be a central component of educational practices, and as such is not, and

should not, be a stand-alone practice in the system (Pellegrino and Wilson, 2015). Inevitably, the discussions on assessment cannot take place without considering the teaching and learning process. This, therefore, justifies the argument that a study of teachers' attitude to assessment should consider their conception of teaching and learning. This also probably explains why Black and Atkin (2014) suggest the need for the development of new models of assessment and pedagogy, which they propose should enable schools to meet the following goals:

> Nurture and build on students' natural appetites for curiosity and inquiry; help the social development of all, including constructive involvement in social learning; encourage students to express their thinking and to then reconstruct their ideas through dialogue with others; guide students to take increasing responsibility for their own learning, thereby empowering them to develop as mature and reflective learners (Black and Atkin 2014:780).

These goals are centred on the development of independent learners with the ability to gain the knowledge and skills required in society. Although these goals are applicable to students in general, variations may still exist on what they mean in individual school subjects. This implies that variations will exist in their assessment model suggesting the need to study assessment in the individual school subject.

2.8 Science Education

2.8.1 Science as a school subject

Science as a school subject can be viewed as an enquiry based subject. It is the only subject where learners are able to develop some unique abilities through experimentation and reasoning (Das, 1985). It is also the subject that continuously creates new knowledge (Das, 1985). School science can be considered different from 'science' as a concept although it is based on 'science' and informed by the knowledge which science educators or curriculum developers want learners to acquire (Kind and Taber, 2005). According to Reiss (2004:4):

> Science consists of a body of knowledge about the world. The facts that comprise this knowledge are derived from accurate observations and careful experiments that can be checked by repeating them. As time goes on, scientific knowledge steadily progresses.

This implies that scientific knowledge is evolutional and more will continue to evolve as further experimentation and observations take place. Essentially, this indicates that science taught at school may possibly evolve as general scientific knowledge evolves.

The Qualifications and Curriculum Authority (2004) describes science as a subject with the potential to stimulate students' curiosities about phenomena and events around them, and at the same time satisfy these curiosities with knowledge – it aims to promote scientific literacy (Chin *et al*, 2004). The key role of school science is not limited to students knowing the different scientific ideas; rather, it extends to their appreciation of the importance of these ideas, their link to other ideas and how they were derived (Osborne, 2010). There is the belief that students usually attend science lessons with the knowledge of the meaning of different phenomena, and the explanations of how or why they behave in a certain way (Bell, 2005). Thus, it can be argued that learning in science is not about filling a void with concepts, but redeveloping or changing the existing concepts (Bell, 2005; Osborne, 2014). I would argue that this view may be somehow limited in secondary education. The existence of students without basic understanding of scientific concepts as well as the complex nature of some scientific phenomena introduced in secondary education could be the limiting factors. On the other hand, I would agree that secondary school students may have an explanation of some scientific phenomena prior to their study in school and sometimes these may be misconceptions.

Science education has been discussed as consisting of three major elements which are: learning science, learning about science and doing science (Hodson, 1998). Whilst 'learning science' is the acquisition and development of conceptual and theoretical knowledge, 'learning about science' centres on enhancing students' understanding of the nature and methods of science, and their knowledge of the complex interactions between science, technology and the society (Hodson, 1998:191). 'Doing science', focuses on the development of students' scientific enquiry and problem-solving skills

(Hodson, 1998). Besides contributing to the development of scientific literate students, these elements also present science as some sort of multifaceted subject. This is supported by the findings of Ofsted (2013) in which the best teaching lessons were seen when firm leadership place scientific enquiry at the centre of science teaching. This, in other words, refers to lessons where students' scientific literacy is enhanced.

Scientific literacy as a concept has failed to get a unified definition (Holbrook and Rannikmae, 2009; Osborne, 2007). The various meanings given to the concept centre on the ability to acquire the knowledge and skills required to function in a modern society. The 2015 Programme for International Student Assessment (PISA) study refers to scientific literacy as 'the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen' (OECD, 2013: 7). Therefore, a scientifically literate individual possesses the skills to engage in activities involving the explanation of phenomena, data and evidence scientifically, and the design and evaluation of scientific enquiries (OECD, 2013). The definition of scientific literacy for the PISA study has varied over the years. The 2000 study saw it as the capacity to use scientific knowledge, whilst the 2006 study saw it as the capacity to identify scientific issues (Robert and Bybee, 2014; Holbrook and Rannikmae, 2009). This implies that there is some sort of evolution in science teaching and learning or in people's perception of scientifically literate individual– consequently suggesting that there will be some sort of evolution in the assessment of science. Robert and Bybee (2014) summarises the differences between the scientific literacy competencies in PISA from 2000 to 2015 in table 2.1.

In conclusion, science as a school subject is multifaceted, with its contents subject to changes resulting from new findings and the demands of the twenty-first century. This, in essence, suggests that teaching and learning in science may not be a straightforward process. Similar inference can be made for assessment in science, taking into account the link between assessment and learning.

2000 competencies for Scientific Literacy	2006 competencies for Scientific Literacy	2015 competencies for Scientific Literacy
• Use scientific knowledge • Identify questions • Draw evidence-based conclusions	• Identify scientific issues • Explain phenomena scientifically • Use scientific evidence	• Explain phenomena scientifically • Understand scientific inquiry • Interpret scientific evidence

Table 2.1: Scientific Literacy Competencies 2000 to 2015 (Adopted from Robert and Bybee 2014:552).

2.8.2 Teaching, Learning and Assessment in Science

Science teachers have been viewed as the key to quality science education (Jones and Leagon, 2014). Their ideas of how science is to be delivered vary. Wang *et al* (2010) discusses teachers' views of methods of instruction in science as learning science through: listening and reading, watching and doing, interaction and communication, and thinking processes. The first two, they argue, are centred on empiricism, while the others focus on constructivism. The advocates of each of these views present them as beneficial pedagogies. Settlage and Southerland (2012) argue that science teachers are like ambassadors with the role of developing the culture of science in students. This culture, they believe, is developed by providing a more supporting role to students, rather than allowing them to absorb information by immersion. This supports Cakir (2008: 202)'s idea of 'learning science as a process of enculturation rather than discovery', with the aim of making concepts meaningful to students at a personal level. However, it can be argued that irrespective of the teaching philosophy, the teacher's role in these processes is to develop scientifically literate citizens. Such citizens are not only endowed with the knowledge of scientific concepts, but the ability to apply them (Settlage and Southerland, 2012). This forms the basis of the 2014 National Curriculum for science, which states:

> A high-science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science (DfE 2013c.2)

This development of scientifically literate citizens is often faced with the fundamental tension between the 'training of future scientists' and the 'educating of future scientists' (Osborne, 2007:173). The minority group as Osborne (2007:173) suggests, is individuals trained to be the future scientists and these individuals will turn out to be the 'producers of scientific knowledge', while those educated to be future scientists will continue to be the 'critical consumer of scientific knowledge'. The presence of both categories of students in a classroom is a common feature in a typical secondary school. This may explain, in part, the diverse needs of students in a classroom. This may also have an impact on the assessment system, although Ofsted (2013) in its report suggests that when students are exposed to concepts through scientific enquiry and provided with the appropriate platform for scientific investigations, their chances of a continual study in science increases. Robert and Bybee (2014:556) express the need for the focus to be on students' science education needs, rather than 'the ideological purity or attractiveness of a vision' that will only suit the needs of a minority of students. This suggests that science should be taught in a way that all students acquire at least a certain level of scientific literacy. Similarly, Osborne (2007:177) promotes the need for science education that pursues 'depth rather than breadth, coherence rather than fragmentation, and insight rather than mystification'. He argues that such system should aim to develop students' conceptual skills which develop their understanding of the scientific concepts and phenomena, and their cognitive abilities which allow them to scientifically review data or evidence. He also considered the understanding of how ideas about science were developed and their implications, as well as an understanding of the collaborative nature of scientific work.

Simply put, learning in science is more than understanding the meaning of different scientific concepts; it involves the appreciation of the role of science, the application of science and the development of students' scientific enquiry skills and ability to

engage in collaborative work. Meaningful learning in science occurs through constructive learning in science, which is a dynamic system of developing, coordinating and building on pre-existing or new knowledge (Glynn and Dult, 1995). This, as Glynn and Dult (1995:5) explains, occurs when 'existing knowledge is activated, existing knowledge is related to educational experiences, intrinsic motivation is developed, new knowledge is constructed, and new knowledge is applied, evaluated and revised'. This belief supports the argument that the development of learners' scientific literacy and their ability to engage in high order thinking skills activities are considered the two key goals of science education (Avargil *et al*, 2012).

It can be argued that the extent of the development of these skills varies in students. Taking into account the students' varied characteristics due to their different experiences, the process of meaningful learning will vary in each student in view of the existing knowledge each brings to the lesson (Glynn and Dult, 1995). In addition, the ability of students to learn science can be limited by the abstract nature of some elements of the subject and/or teachers' lack of connection to students' common experiences (Magnusson *et al*, 1999). Equally, instruction based on problem solving, which students often find difficult to comprehend, and the existence of misconceptions, which are more relevant to student everyday experience than the proper scientific knowledge, could also be contributing factors to the limitations of learning science (Magnusson *et al*, 1999). In other words, the ability to learn science is limited due to the complexity of the subject.

A different way to discuss learning in science can be Bell and Cowie (1997)'s discussion of science learning in a classroom as involving personal, social and science development of students (Bell and Cowie, 2001; Bell, 2005). Personal development relates to students learning about themselves as learners of science, whilst social development relates to their interaction with others, be it peers or teachers (Bell and Cowie, 2001; Bell, 2005). This presents science learning as an academic and social process, thereby excluding the existence of a single pathway to science learning. Science development is all about students' development of their knowledge and skills in science (Bell and Cowie, 2001; Bell, 2005). These aspects of science learning, as described above, are not independent of each other (Bell and Cowie, 2001). Taking

into consideration the idea that assessment is an integral part of teaching and learning (Earl, 2013; Absolum, 2011), then assessment in science can be viewed as a multi-faceted system.

Furthermore, given that science learning involves more than learning the scientific contents, assessment in science will not be restricted to assessing scientific contents. Bell (2005:120-121) describes the aspects of science assessed as consisting of: the assessment of *science content*， which includes the concepts and ideas of science; the assessment of *science context*, which is the centred on the context wherein the science is learnt and utilised; and the assessment of *science processes*, which are the skills and processes employed by scientists in the investigation of different phenomena. In view of these, students' proficiencies in science are portrayed by their ability to explain and apply scientific phenomena, identify and evaluate scientific evidence, understand how scientific knowledge is developed and engage effectively in scientific activities (Duschl *et al*, 2007). This suggests that assessment in science should not be limited to the measure of scientific concepts students are able to recall, but should extend to the understanding and application of these concepts. This can be achieved through different assessment practices.

The sound and timely use of assessment to ascertain students' acquisition of new knowledge and skills, with a view to adapt learning, was cited by Ofsted (2013) as a characteristic of good teaching in science. In spite of this, assessing the proficiency of students in science in a bid to support and not jeopardise teaching and learning can be a challenge (Pellegrino, 2013). The frequent changes in policies, whether in relation to assessment or curriculum put other pressures on effective assessment in science. The interpretation of these policies is influenced by the science teachers' attitudes and beliefs towards the policies (Jones and Leagon, 2014). Teachers' belief of how learning occurs and the important things to learn together with the curriculum objectives influence what they assess (Abell and Siegel, 2011). This explains the use of varied assessment practices by science teachers taking into account teachers' various beliefs. Despite this, the knowledge of summative assessment strategies, such as designing test items, and formative assessment to improve students' learning in a lesson is key to science teachers as it is with other subjects (Abell and Siegel, 2011).

In addition to these non-subject specific assessment practices, science teachers should have knowledge of topic-specific assessment practices (Edwards, 2013). However, there is an argument that in the education of science teachers, emphasis has been placed on the content knowledge and teaching strategies often without link to the allied assessment practices (Abell and Siegel, 2011); this therefore, reinforces the need to explore science teachers' assessment literacy.

In summary, school science can be viewed as a multifaceted subject, which involves the study of both the understanding of scientific concepts and their application. It also extends to the development of students' enquiry skills and ability to involve in collaborative work. As a subject prone to changes influenced by new discoveries and changes in views of what students should learn in each particular key stage, it may be described as an evolutional subject. Understanding teachers' attitude towards assessment in general, with the view to understand their assessment attitude in science, may therefore be limited due to the multifaceted nature of the subject and possibly its likelihood to evolve. This therefore justifies the need to explore assessment in science as a separate study.

2.9 Theoretical Framework

2.9.1 Assessment literacy models

As discussed earlier in this chapter, assessment can be described as the process of gathering evidence and the utilisation of the outcome in teacher-centred or student-centred decision-making process (Harlen, 2007) or rather a process that entails professional judgement(McMillan, 2000). The varied uses of the outcomes can be summed up as the improvement of students' learning and the reporting of students' learning (Gardner *et al*, 2008), or in another instance, as an assessment for learning, of learning and as learning tools (Earl, 2003). The focus on learning in all instances, explains why assessment is considered to be at the heart of the teaching and learning process (Bell and Cowie, 2001; Absolum, 2011). Although, there are varied objectives for assessment, they all involve the gathering of data (Cohen and Cowen, 2006) and some sort of inference from the data (Harlen *et al*, 1992). In other words,

the purposes will not influence the process but the structure (Taras, 2005). I would, therefore, describe assessment as the process of understanding the changes in one's learning and the utilisation of the outcomes.

As a complex concept (Earl, 2003), the assessment process needs to be understood by users for effective implementation**.** An insight into and the understanding of teachers' assessment literacy which reflects their comprehensive knowledge of the assessment process can be measured using different models. DeLuca *et al* (2015) reviewed the different models used in measuring teachers' assessment literacy. Indeed, the literature offers various models that have been utilised in studies relating to assessment. In the subsequent section, I shall explore three of these models which are broadly representative of the typology of models available in the literature. I shall then identify the model preferred in this study, and offer justifications for its selection while highlighting the rationales for rejecting the other models.

One of the most commonly used models is the Classroom Assessment Literacy Inventory model (CALI) (Mertler 2003). This model is based on the 1990 Standards for Teacher Competence in Educational Assessment of Students and has been used to measure teachers' assessment literacy (Mertler 2003, Mertler and Campbell, 2005; Yamtim and Wongwanich, 2014). In this model, assessment literacy is measured by using the responses given to questions developed from five scenarios created in relation to the Standards for Teacher Competence in Educational Assessment of Students. One key feature of this model is that it is specifically based on the assessment standards in the United States. In addition, it also centres more on measuring teachers' aptitude in summative assessment. This, in my view, constitutes a limitation largely because it limits the comprehensive exploration of teachers' assessment literacy to summative assessment – when assessment purposes are broadly summative or formative in nature. In addition, the standards underpinning the tool have been described as a bit obsolete, as they fail to consider the formative elements of assessment, and the knowledge and skills required by teachers to work effectively in the current educational era (Brookhart, 2011). For this study which utilises a mixed methods approach purely because of the desire to track nuanced rationales and motivations, there is an inherent conflict in using a model that is essentially quantitative in outlook. This, in a way, subdues the element of convergence between

research methods and theoretical models that has been advocated as a useful outlook in research (Ade-Ojo, 2011).

Another frequently used model is the Assessment Practices Inventory (API) (Zhang and Burry-stock 1994). This tool was devised based on literature relating to classroom assessments and the 1990 Standards for Teacher Competence in Educational Assessment of Students, and has been used to study teachers' assessment practices and the perceptions of their assessment skills (Zhang and Burry-Stock, 1994; Zhang and Burry-Stock, 2003). It considers teachers' responses on their competence in the use of the different assessment practices given in the tool and the rate at which they use them. Although this tool can give an insight into one's assessment practices, it explores more assessments that are summative in nature with less focus on the formative assessment. Because assessment broadly serves these two purposes – summative and formative – it becomes inevitable that the API tool will offer a limited understanding of teachers' assessment knowledge. Although its ability to give an insight into one's assessment behaviour makes it a useful tool, its focus on the quantifiable components of assessments suggests that it might be less useful in measuring assessment elements that are not summatively inclined. Non-quantifiable elements of assessment such as attitude and belief are inevitably lost because they are less quantifiable.

A third model is the Teachers' Conception of Assessment tool (Brown, 2002) which examines teachers' level of agreement or disagreement to different purposes of assessment. This tool considers teachers' perception of what assessment is and its uses. Underpinning this model are a number of principles. First, if beliefs are constituents of one's conception of an idea (Thompson, 1992; Philipp, 2007), then this tool explores teachers' beliefs. Second, if knowledge is argued to be a 'justified true belief' (Nonaka and Takeuchi, 1995: 58) then measuring teachers' belief alone as a means of measuring teachers' knowledge may be limited. The overall ramification of these principles is that, while this model can be considered as acknowledging and including elements that are necessary for exploring teachers' assessment knowledge, it is not to be considered as a sole and sufficient tool.

Developing on my recognition of the fact that each of these commonly used models has some form of limitation or the other, I propose a modification which draws on a number of principles. In specific, I draw on the previously established argument on the dynamic nature of the educational system – as well as the argument presented in Gotch and French (2014) regarding the inadequacies of psychometric evidence – to argue that none of these models can be considered suitable for this study as a sole instrument. This position echoes the argument of DeLuca *et al* (2015) who recommend the development of a framework that acknowledges the different dimensions of assessment literacy as essential components of any model that aspires to meet the requirements of current educational standards. Apart from the argument above, the rejection of the discussed models is also informed by the fact that none of them focussed on the school assessment standards in England which fairly highlights the importance of formative assessments. It is fair to argue, in line with DeLuca *et al*'s (2015) review of the assessment literacy measures, of the non-existence of a measure based on the school assessment standards in England. Therefore, there was the need to develop a suitable model for considering teachers' assessment literacy in this study.

2.9.2 Development of the Assessment attitude model

As already discussed in this chapter, teachers' assessment literacies reflect their knowledge of assessment. Golombek (1998) argues that teachers' personal practical knowledge informs their practices by filtering their experiences and reconstructing them in order to respond to a particular teaching demand. It has been argued by Kagan (1992) that the majority of teachers' professional knowledge can be more accurately considered as their belief. Therefore it is logical to suggest that an understanding of teachers' belief of a concept can reveal their knowledge of the concept. Besides, research shows that teachers' classroom practices and their professional development are influenced by their educational beliefs (Zheng, 2009; Griffith *et al*, 2006). Despite the role of belief in exposing one's knowledge, attitude has been suggested to have more impact on ones' behaviour than their general belief (Ashford and LeCroy, 2009). Alkharusi (2011) concludes in his study on teachers' assessment literacy that attitude towards educational measurement influences one's

assessment literacy. This suggests that an insight into teachers' attitudes toward assessment will possibly give an insight on their assessment literacy. For the above reasons, I can argue that the study of attitude will present an alternative opportunity for understanding teachers' knowledge. Therefore I propose an attitude-driven model of measuring assessment literacy. This model has four components which include teachers' assessment conception, assessment value, assessment behaviour and conception of teaching and learning, and these reflect the measurement of concepts that inform one's attitude (fig 2.4).

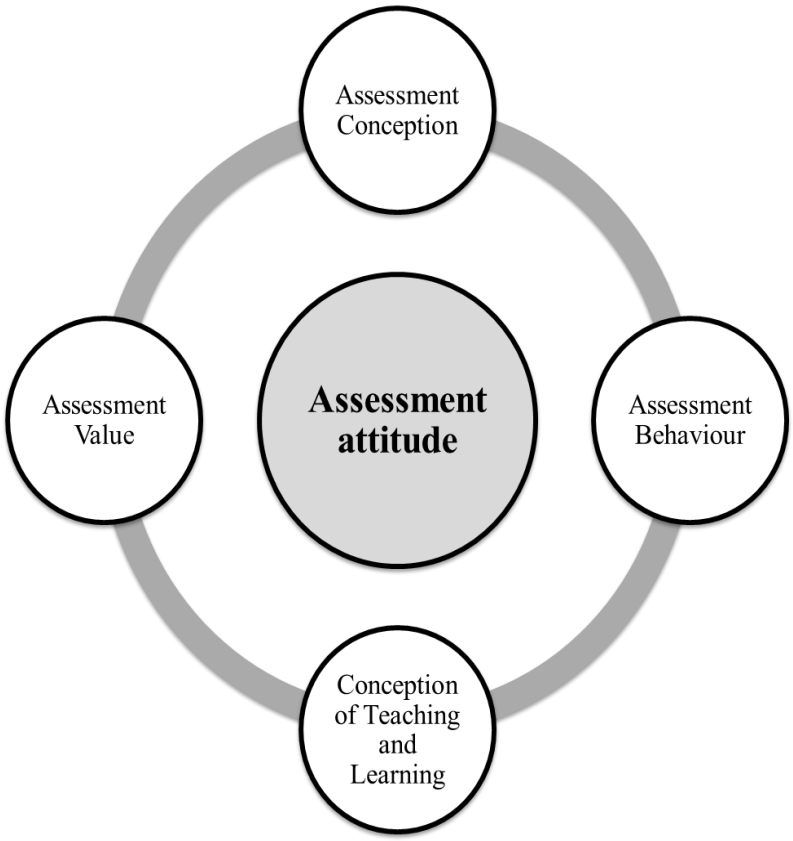

Fig 2.4: A model for teachers' assessment attitude

As already explained in this chapter, attitude consists of three components - cognitive, affective and behavioural - which are related yet different (Olson and Maio, 2003; Hewstone 2011). Each of these components underpins one element of the proposed model. The first element is the teachers' assessment conception. This represents the cognitive part of attitude which reflects one's thoughts, beliefs and ideas (Johnson and Boynton, 2010; Olson and Maio, 2003). If one's belief reflect their conception, then measuring teachers' conception of assessment will explore the cognitive component

of their assessment attitude. The assessment conception element of my proposed model is designed to unravel teachers' assessment beliefs by exploring their views on assessment and its purposes. In the context of this study, this element will be investigated using the Teachers' Conception of Assessment tool (Brown 2002, 2004b). Research with this tool shows that teachers have multiple and conflicting conceptions of assessment on the grounds that belief systems are ecologically rational (Brown 2011). This is in line with Thompson's (1992:149) assertion that 'belief systems are dynamic, permeable mental structures, susceptible to change in light of experience'.

The next element of this model is the teachers' assessment value. This relates to the first element in that it considers teachers' feelings of what a valuable assessment should be. The affective component of attitude centres on one's feelings and emotions (Johnson and Boynton, 2010; Olson and Maio, 2003; Bordens and Horowitz, 2002), and as such underpins this element.

The third element of the model is teachers' assessment behaviour. This element explores teachers' assessment actions, and in essence, reflects the observable aspect of the model. As the behavourial component reflects one's actions towards the attitude object (Johnson and Boynton, 2010; Olson and Maio, 2003; Bordens and Horowitz, 2002)', it forms the basis for the assessment behaviour element of the model. Considering that one's knowledge informs their practice (Golombek, 1998), then an understanding of their practices which include their choice of practices and reasons for their choice will give an insight into their knowledge. Therefore, the knowledge of teachers' assessment practices will give an insight into their assessment behaviours and how they value different assessment practices. In the context of this study, the Assessment Practices Inventory (API) tool (Zhang and Burry-stock 1994) which contains a variety of assessment practices will be considered when exploring the assessment value and assessment behaviour elements of the model. This will be explored with reference to the assessment standards set by the Assessment Reform group (Gardner *et al,* 2008). Such consideration was made with the view to curb the limitations of the API tool and cater for the assessment standards applicable in England.

The final element of the model is teachers' conceptions of teaching and learning. Underpinning the inclusion of this element is a number of principles. First, assessment is considered as an integral part to teaching and learning (Bell and Cowie, 2001; Absolum, 2011). Second, it has been argued that attitude formation is not limited to the link between the components of attitude but links between other attitude objects (Eagly and Chaiken, 1998). Both lines of reasoning highlight the importance of exploring teaching and learning as an allied attitude object. This element of the model will be explored using the teachers' conception of teaching and learning tool (Chan, 2001). A tool that explores the meaning teachers attribute to teaching and learning, their different teaching and learning strategies, and the role of teachers and students in teaching and learning process (Chan 2004; Aypay, 2011).

Having described the preferred model, the exploration of attitude is considered as a suitable option on account of the following principle. Attitude, as described earlier in this chapter, is a form of knowledge structure stored in the memory and inferred from or is constructed on the spot (Fabrigar *et al*, 2005; Oskamp and Schultz, 2005). If attitude depends on one's thoughts at any given time and it is subject to change over time (Erber and Hodges, 1995; Eagly and Chaiken, 1998), it is reasonable to assume that its understanding will give an insight into one's knowledge at any given time.

However, the exploration of attitude should not be limited to quantitative study using this model. To begin with, attitude accessibility can be increased by the amount and complexity of the working knowledge available as the individual encounters the attitude (Olson and Maio, 2003; Fabrigar *et al*, 2005). It is reasonable to infer that this may be referring to one's experience of the attitude object or other related objects. That is, the experience one is exposed to. This argument suggests the limitation to measuring teachers' attitude using a tool with fixed contents such as questionnaires. This perhaps justifies Deluca *et al*'s (2015) recommendation of the need to establish assessment literacy measures capable of accommodating the contemporary assessment standards. Furthermore, attitude can develop from either direct or indirect experience with the altitudinal object; with the stronger attitudes emerging from direct experience (Olson and Maio, 2003; Hassanein, 2015). Pajares (1992) argues that early exposure to an experience greatly influence one's final judgement. Richardson (1996) however, argues that one's beliefs can be altered by their experiences. I would agree

that early experience informs attitude but can be changed by subsequent experience depending on the length and complexity of the exposure. This could further indicate the limitations of measuring teachers'attitude using a fixed content tool. This line of reasoning can be further extended by the argument that attitude relies on a process which occurs within the subject and as such this poses difficulty with the direct observation of attitudes (Moliner and Tafani, 1997). Such an argument justifies why attitudes are inferred from observable responses (Oskamp and Schultz, 2005), and further explains why attitude will be explored qualitatively in this study.

To conclude, assessment is the process that aids the effective monitoring and enhancement of students' learning. Teachers play a key role in assessment and so an understanding of their attitude towards assessment is important. Teachers' attitude towards assessment will include their conceptions of assessment, their assessment values, and their assessment behaviours. These views will be influenced by the values accorded to the different assessment practices, since values are at the centre of that which we consider as the key principles to guide our lives or goals to aim for (Fien, 2007). Therefore, this study will centre on discussing science teachers' conception of assessment, and their views and rates of use of different assessment practices, with a view to understanding their attitudes towards assessment and the factors that affect them.

Chapter 3 – Methodology

3.1 Introduction

The purpose of this study is to understand science teachers' assessment conceptions and their views of different assessment practices, with the view to understand their attitudes towards assessment and the factors that affect these attitudes. As mentioned earlier, this was carried out through mixed methods and by using a pragmatic approach to finding answers to the research questions. The method includes the survey of science teachers in a Continuing Professional Development (CPD) related forum through questionnaires and interviews to gain insight into science teachers' attitude towards assessment. This was followed by an in-depth interview of a sample of science teachers working in secondary schools in London, in order to gain a deeper understanding of science teachers' attitude towards assessment. This chapter will discuss the key variables associated with the research questions and the methodological approach I took in more detail.

3.2 Key variables

The sample group used in this research comprises secondary school science teachers working in England. This sample is made up of two cohorts of science teachers, from which findings will be triangulated to answer the research questions. Besides the common characteristics of the group some variations exist between them. The first group comprises science teachers who often take part in an online science teachers' discussion forum. This sample was chosen because it involves a group of teachers who share and discuss topical educational issues, of which assessment is one. In addition, the group comprises science teachers from different parts of England and is a convenient avenue to access science teachers with regional variations. The forum can be considered as a platform for CPD programmes for teachers, due to the nature of the discussion and collaborative work that often take place therein. High-quality CPD programmes have been shown to be of benefit to teachers and schools in a number of ways, more so when teachers take ownership of their respective programmes (House of Commons: Children, Schools and Families Committee, 2010).

This group of teachers take their professional development into their own hands by engaging in online education-related discussion forums. For this reason, this study aimed to determine the extent to which this factor will have an effect by sampling teachers who often share a similar experience of personal CPD. The group is also characterised by a multitude of variations, which can be considered as variables in this research. Such factors include: the length of teaching experience, the teacher-training route, the highest educational level achieved by the participants, the type of school they work in and their current role. In addition, due to the geographical dispersion of the participants, regional differences were also explored.

The second group comprises science teachers working in secondary schools in East London. This sample was chosen to understand science teachers' attitude towards assessment without the interferences of regional variations. The school community make-up in England varies from region to region, hence, restricting the sample to this region reduces this variation. In addition, East London not only has a diversity of students but also teachers who may have had an overseas education, thereby adding another variable to the study. A further rationale for the choice of the sample was the desire to have a more suitable representation of typical secondary school science teachers, who are usually not actively engaged in voluntary online networking with science teachers around the country. Furthermore, the choice of this cohort allowed the selection of teachers from schools with the different Ofsted ratings.

3.3 Research methodology

3.3.1 Mixed Method Approach

As mentioned earlier, this study aimed to describe science teachers' attitudes towards assessment and understand how different factors can affect them. It is centred on the basic research focus 'to describe, explain and understand' (Blaikie, 2009: 69), for which describing the key variables can be done both quantitatively and qualitatively (Johnson and Christensen, 2014). In this study, mixed methods involving the use of both quantitative and qualitative data were used.

The use of the mixed methods approach was necessary, as it aims to draw from the strengths of both quantitative and qualitative method whilst minimizing their limitations (Johnson and Onwuegbuzie, 2004). Both methods are used to offset each other, given that the limitations of one type of research (qualitative or quantitative methods) are compensated by the strength of the other (Bryman, 2006; Creswell and Plano Clark 2011). For instance, the limitations of the survey of science teachers in a CPD related forum, resulting from the small sample size, could be compensated by the strength of the qualitative semi-structured interviews of the same group which generated richer views of the participants. In addition, the use of mixed methods helps to triangulate and explain findings as well as explain an unexpected result (Bryman, 2006). It is as Greene *et al* (1989) described – the method that creates the avenue for elaboration, clarification and development of ideas. There is also the belief that a combination of quantitative and qualitative methods presents a more comprehensive knowledge than either of the two can do on their own (Creswell, 2013; Ary *et al*, 2013). Moreover, to understand the complexity of educational phenomena requires a multiplicity of inquiry methods in order to meet society's diverse needs (Hartas, 2010). For instance, the effect of multiple factors on teachers' attitude to assessment is best considered using mixed methods, as this allows the study of different factors operating together (Johnson and Christensen, 2014). Furthermore, Johnson and Onwuegbuzie (2004: 15) discuss the need for 'epistemological and methodological pluralism in educational research' in a bid to carry out more effective research. This, in other words, highlights the limitations of a non-mixed methods approach.

Conversely, mixed methods research is faced with certain limitations. There is the possibility of non-corresponding findings from both the qualitative and quantitative segment of the research (Creswell and Plano Clark 2011; Johnson and Christensen, 2014). Although this has been viewed as a downside, the alternative way of viewing the findings or the new insight presented by the contradictions can be an added advantage to the study (Johnson and Christensen, 2014; Creswell and Plano Clark 2011). In comparison to the single method research, a mixed method research is also likely to require more resources and can be a more time-consuming approach (Creswell and Plano Clark 2011; Johnson and Christensen, 2014; Hall, 2008). This, however, was mitigated by the use of internet as data collection tool. A tool that helped to alleviate the cost and time spent on the study – as participants were able to

complete the paper-free questionnaire at their convenience and some interviews were completed online.

In the context of this study, the complexity of attitude as a concept (Yencken *et al*, 2000), and personal experience of periodic changes in educational policies indicating a dynamic educational system are the driving forces for the choice of methodological approach. Mixed methods as Creswell and Plano Clark 2011:17) argue, 'is both practical and intuitive' – given that it presents a similar scenario of looking at a problem using multiple avenues – as one often experience in life. It also presents an alternative means of research when the complexity of the research focus cannot be fully understood by a single approach (Ponce and Pagan-Maldonado, 2015). Above all, the combination of the qualitative and quantitative data generates a more comprehensive data (Bryman, 2006). Hence as a pragmatist, mixed methods provide the suitable platform for understanding the research theme in its complexity and dynamic nature, and was therefore chosen for this study.

3.3.2 Quantitative research method

In this study, quantitative data was collected using a questionnaire by surveying a convenience sample of science teachers. This tool was used because it often provides an avenue for the collection of large data over a short period of time (Gillham, 2008 Thomas, 2003). By so doing, this will enable a larger collection of teachers' views on the subject matter within a given time. It is also a cost-effective way of collecting data from a large and geographically dispersed sample of individuals with varied characteristics (Anderson and Arsenault, 1998; Thomas, 2003), as was the case in this research. Although the survey sample size was small, the participants in this study reside in different parts of England making a questionnaire the most convenient and cost-effective way of gathering data from them. The use of a questionnaire will not only allow more collections of answers to focused questions, but the analysis of such data can be easily carried out using statistical methods (Gillham, 2008). There is often no personal interaction with the person who completes the questionnaire (Anderson and Arsenault, 1998), which eliminates interviewer's bias (Gillham, 2008; Phellas *et al,* 2011). On the downside, this can cloud the circumstance surrounding its completion and the conviction that the respondents understood the question (Gillham,

2008). There are also possibilities of unanswered questions by the respondents, which cannot be tracked due to the anonymity often associated with this method (Gillham, 2008). These make the validity and reliability of the data questionable. Consequently, the opportunities for personal interactions with the respondents were provided through the use of interviews thereby justifying the use of mixed methods.

Quantitative research, in general, examines objective theories by looking at the association between variables (Creswell, 2013). As part of this study, science teachers' attitudes towards assessment were explored by looking at their conceptions of assessment, their views and rates of use of different assessment practices and the relationships between them. This was done quantitatively in the first instance. The decision for this choice of research results from the belief of the inaccessibility of attitudes to direct observations which necessitate their inference from measurable responses (Ajzen, 1989). In addition, quantitative research aims 'to discover new knowledge by simplifying complexities in settings that tend to be more contrived' (O'Dwyer and Bernauer, 2013:5). Therefore, it is the suitable option for studying a concept with a group with diverse variations. More so when there is an existing measurement tool – as was the case in this study. The science teachers' conceptions of assessment and their views of different assessment practices were measured using a questionnaire. Research on teachers' conceptions of assessment has already been carried out by other researchers, and a possible tool and hypothesis generated (Brown, 2002; 2006; Calveric, 2010; Brown and Michaelides, 2011; Brown and Remesal, 2012).

In addition, gathering the information quantitatively allows comparison and generalisation to take place (Johnson and Christensen, 2014). Previous research has argued that teachers' conceptions of assessment are 'ecological rational' (Brown and Michaelides, 2011; Brown, 2011), and the quantitative analysis in this study provides the platform for this belief to be confirmed or refuted. Quantitative data also allows for the statistical comparison of different variables (Johnson and Christensen, 2014; Teddlie and Tashakkori, 2009), which in turn generates causal explanations for findings (Johnson and Christensen, 2014). For instance, to gain an insight on how science teachers' conception of teaching and learning affect their conception of assessment, the relationship between the two was determined quantitatively through

the use of a questionnaire. This also explains why the effects of the independent factors – such as region, teacher training route, the length of teaching experience, type of school, highest education achieved and current role on teachers' conceptions of assessment – were also determined quantitatively through the questionnaire.

Although the quantitative data collected could give an insight into the rationale behind science teachers' varied attitudes towards assessment, a deep understanding of the rationale could be limited. The school (more so the classroom) is a dynamic environment**,** and there is the need to determine how different factors may affect teachers' attitudes to assessment. As Berliner (2002:19) argues, the school consists of individuals engaged in 'complex and changing network of social interaction', and this results to the difficulty of generating and implementing scientific findings in education. The use of quantitative data will not reveal a deeper understanding of the research questions. In addition, the quantitative tool will limit the ideas of teachers' conceptions of assessment and their views of different assessment strategies to the ones given in the questionnaire. Quantitative research is also better when done with a large sample (Hatch, 2002). Contrary to this, the sampling frame used in this research is small compared to an average quantitative research sampling frame. The online science teachers' forum on average pulls a total of 20 – 30 teachers during their weekly chat. The use of quantitative data from this convenience sample will limit my findings. This necessitated the use of a qualitative method to gain a deeper understanding of the research questions.

3.3.3 Qualitative research method

The collection of qualitative data bridges the gap the quantitative data creates. Qualitative research examines and aims to understand the varied meaning given to human or social problems by individuals or groups (Creswell, 2013). It aims to do so by maintaining the complexities that exist in the natural settings (O'Dwyer and Bernauer, 2013). Qualitative researchers believe in the fluidity of human beings and are normally not keen on generalising their findings beyond their focus group (Schreier, 2012: Johnson and Christensen, 2014). This is particularly important in this study as the school environment and teachers' experiences tend to change. Qualitative data can provide a more in-depth understanding of the topic in question, as its focus is

on ‘meanings rather than on quantifiable phenomena’ (Schutt, 2011:324). It also has the tendency to provide such attribute beyond its focus group (Schreier, 2012: Johnson and Christensen, 2014). For these reasons, qualitative data were collected to provide richer data for the limited sample frame. Schreier (2012: 21) summarises the key features of qualitative research as ‘interpretive, naturalistic, situational, reflexive, has emergent flexibility and inductive’. Qualitative research also allows the use of open-ended questions, unlike the closed-ended questions which are peculiar to quantitative research (Creswell, 2013). Additionally, the data collected are often subjective (Rubin and Babbie, 2009). These characteristics present the difficulty for generalisation and comparison of variables in qualitative research. Despite this limitation of qualitative data, they were collected in this study to accommodate the varied views that teachers have regarding assessment, and in so doing aid the understanding of individual teachers’ attitude towards assessment.

The qualitative data in this research were collected through the use of interviews, which include in-depth semi-structured interviews of a sample of science teachers from the online science discussion forum and a sample of science teachers working in East London schools. These research methods generate richer data quickly by uncovering science teachers’ viewpoints on assessment. It can be argued that the primary way to study an educational system is through the experiences of the stakeholders (Seidman, 2013). Participants through the interview process shared their experiences. The interviews unravel the ‘meaning structures’ used by participants in the organisation of their experiences and in making sense of them (Hatch, 2002: 91). Open-ended questions were used in all interviews, thereby generating richer data than that created by the questionnaire. On the downside, the use of interviews can be limited by the workload it generates which is usually associated with the transcription of the tapes (Seidman, 2013). It also requires a lot of time and in some cases finances.

Other methods of collecting qualitative data – such as observation – were not employed. The use of observation will only focus on the assessment strategy that the teacher employed during the observation. This will not serve the purpose of this study, which is to understand science teachers’ views of assessment in general so as to understand their attitudes towards assessment. Moreover, Seidman (2013) points out that interviews provide suitable, and if not always, adequate means of enquiry for

researchers to gain an understanding of the meaning individuals make of their experiences. Observing a teacher with the intention to focus on the assessment process could possibly be clouded by other activities in the classroom, such as behaviour management. Besides students' characteristics can affect teaching behaviours in a classroom (Berliner, 2002). Observation allows the presumption that actions are carried out with a purpose and convey the deeper values and beliefs one possesses (Rossman and Rallis, 2011). However, the idea of an expression of deeper values and beliefs may be superseded by impromptu classroom management strategies. Teachers' classroom management strategies tend to change during the lesson to meet the evolving demands of students, and as such may not be based on their belief, rather as a way to solve the situation at hand. In addition, my experience as a teacher could possibly make it difficult to completely focus on the subject of the investigation without being drawn into the other aspects of the lesson. In spite of these reasons, an observation, which involved the recording of actions and interactions, (Marshall and Rossman, 2010; Rossman and Rallis, 2011) was still carried out during the in-depth interview, by taking note of the interviewees' body language and tone of voice.

Taking into account the characteristics of each type of research method discussed above, a mixed methods approach was used in this study to allow the limitations of one to be offset by the benefits of the other.

3.4 Research paradigm

3.4.1 Defining research paradigm

The use of both qualitative and quantitative data in this study helped to better understand the research questions. This was decided based on the need to choose methods that are best suited for the research questions at the current time. This reveals the ideology of pragmatism, which this study is centred on. Every research project is carried out on a platform which informs every other aspect of it, and this can be referred to as paradigm (Johnson and Christensen, 2014). Guba and Lincoln (1994:107) describe a research paradigm as a:

> Set of basic belief (or metaphysics) that deals with ultimates or first principles. It represents a worldview that defines for its holder, the nature of the 'world', the individual's place in it, and the range of possible relationships to that world and its parts.

Similarly, Creswell (2013:6) refers to a research paradigm as a 'worldview', which is a 'general philosophical orientation about the world and the nature of research that a researcher brings to a study'. He also points out that factors such as the orientation of the subject area, previous research experiences and the influences from instructors or advisors can have an effect on worldviews. In other words, paradigm informs us how one conducts research, analyses findings and presents inferences. Guba (1990), in his description of different paradigms, characterised them by the responses given to ontological, epistemological and methodological questions. He believes the answers to these questions set the belief systems that are the starting points which determine what inquiry is and how it can be carried out.

3.4.2 Selecting research paradigm

As earlier stated, the mixed methods approach underpinned by the pragmatic research paradigm has been adopted in this study. This research paradigm combines the desirable features of the other paradigms with the explicit intention to better understand and address problems (Philips *et al*, 2012). This paradigm is centred on the premise that 'research is value-laden' (Philips *et al*, 2012:78) and choices are made based on what works well (Creswell, 2013). The need to choose methods that are best suited for the research questions at the current time makes pragmatism the paradigm of choice. This takes into consideration the fact that this research aimed to understand science teachers' attitudes towards assessment using both qualitative and quantitative data, and the findings will reveal what the attitude is at the moment but not attempt to predict the future. In line with Guba (1990)'s idea, the decision to choose this research paradigm was based on the review of the ontological, epistemological and methodological assumptions associated with different research paradigms.

Firstly, an ontological question considers 'the nature of reality' and 'the nature of the knowable' (Guba, 1990; Hatch, 2002). It considers questions on what one believes exist and is the truth (Killam, 2013). 'Positivism' believes in the existence of an objectively verifiable reality, whilst 'interpretivism' argues that there are multiple realities (Guba, 1990; Cohen *et al*, 2011). Guba (1990: 24) notes that the critical theory paradigm believes that 'nature cannot be seen as it really is or really works except through a value window'. Pragmatism, on the other hand, does not take into account the existence of single or multiple realities, rather it focus on what works best in answering the research questions (Lodico *et al*, 2010).

It can be argued that although teachers' experiences may appear similar, the ways in which their human minds construct the meaning of experiences often differ. This idea can be supported by Bassey (1999: 43)'s description of reality as a 'construct of the human mind'. He believes that there can be different interpretations of what is real, as people comprehend the world in often a similar but not essentially the same way. This suggests that there may be a sense of reality in teacher's attitudes to assessment as the positivists may argue. On the other hand, the existence of multiple realities cannot be overlooked, as people's experiences can be influenced by factors surrounding them. Teachers' attitudes towards assessment may appear to be formed by the same factors, yet variation still exists in the way they are construed thereby suggesting an interpretivist's viewpoint. This study does not also sit well with the critical theory paradigm. The idea of inequality and power struggles cannot be considered in the science CPD focus group since the forum is voluntary, social and non-political. Besides, the questions were not targeted to unravel inequality and power struggles in schools. Nevertheless, issues of power struggle were to be discussed if they are unveiled by the research findings. Therefore, this study was better carried without adhering 'to any one system of philosophy and reality' as the pragmatists believe (Creswell, 2013: 11).

Secondly, the epistemological questions consider that which is to be known and the relationship between the knower and the known (Guba, 1990; Hatch, 2002). The interpretative paradigm centres on understanding the subjective nature of human experience, and unlike the positivist paradigm, there is a resistance to the imposition of external forms (Cohen *et al*, 2011). Positivism supports the idea of 'objectivism',

which is that truth and meaning can be discovered 'as they exist in the external world' (Gray, 2009). This underpins the idea that teachers' attitudes to assessment can be measured objectively. Yet a richer meaning to the findings can only be achieved when subjectivity is allowed.

In the case of this study, both objectivism and subjectivism were needed to understand and sum up teachers' attitude to assessment. Whilst objectivism encourages the generalisation of findings, subjectivism is viewed as the only way to unlock the constructions of a human being (Guba, 1990). Although critical theorists accept the idea of the subjectivity of knowledge, this is mediated by the political view of the researcher (Hatch, 2002). They believe that some groups are more privileged than others in society and so exercise their power on the less privileged group (Gray, 2009). Once more, considering this research in terms of power relations will cloud its aim, which does not entail the addressing of political issues such as social inequalities in assessment systems. This justifies the non-selection of critical theory as my paradigm of choice. On the other hand, pragmatism does not allow the world to be viewed as an absolute unity (Creswell, 2013) instead it promotes the belief that 'epistemological issues exist on a continuum, rather than on two opposing poles' (Teddlie and Tashakkori, 2009: 90). It allows the researcher to be 'variably objective and subjective' whilst carrying out a study which is informed by the research purposes (Phillips *et al*, 2012:78). It also allows belief in an external world as both dependent and independent of the human mind (Creswell, 2013). These characteristics present pragmatism as a better platform for this study, as it allows the use of mixed methods given that data was collected and viewed in two different ways. Besides, considering the frequent changes to educational policies, findings may evolve in response to such changes during the course of the study. Such changes can be with any aspect of the teachers' attitude towards assessment. For instance, teachers' conceptions of assessment have already been described as ecological rational (Brown, 2011) as mentioned earlier, suggesting the possibility of its transformation with a change in environment.

Finally, the methodological question is how the inquirer gains the knowledge (Guba, 1990 and Hatch, 2002). The positivists, as Hatch (2002:14) mentions, use methods that 'allows for careful measurement, manipulation and control'. Babbie (2011: 34)

describes positivism as ‘a philosophical system grounded on the rational proof/disproof of scientific assertions’. Crotty (1998: 41) also points out that positivism is not just determined by ‘the use of quantitative methods but the attribution of objectivity, validity and generalisability to quantitative findings.’ Contrastively, the interpretative paradigm believes in the non-existence of value-free data and an objective knowledge independent of thinking, reasoning human beings (Klenke, 2008). Cohen *et al* (2011) distinguishes between the two paradigms on the basis of theory, action and behaviour. They mention that whilst the positivist aims to devise and validate general human behaviour theories, the interpretivist aims to understand the interpretations of the world, which if they generate a theory will make sense to the setting concerned. Both are required in this study. Pragmatists, as described by Teddlie and Tashakkori (2009: 93), accept that ‘there may be causal relationships, but these relationships are transitory and hard to identify’.

Currently, there is no widely proposed theory encompassing all the key variables of the topic, which this research aims to validate. Consequently, this research will require an in-depth knowledge of the topic, and as such will require a method that generates qualitative data**.** On the other hand, it will also test the hypothesis already developed on teachers’ conceptions of assessment, thereby necessitating the use of quantitative data. This study was thus conducted based on the ideology of pragmatism, which permits the freedom to choose methods that suit the different aspects of a study and works on the premise that what works at the time denotes the truth (Creswell, 2013).

It is clear from the above that the pragmatic paradigm is the suitable paradigm for this study. This paradigm allows the use of mixed methods in this study, which provides the platform for research approaches to be mixed and matched in a way that presents the best avenue for the research questions to be answered (Johnson and Onwuegbuzie, 2004). Also, taking into consideration the frequent educational policies and the possibility of findings evolving in response to such changes, pragmatism seems to be the paradigm that can accommodate this. The research process will now be discussed, having established the rationale for the research method and paradigm.

3.5 Research tools

The data collection process was made up of two parts: survey using questionnaire and semi-structured interviews. Each part was aimed to collect data that would answer the research questions thereby allowing the triangulation of evidence.

3.5.1 Survey

In the first stage of the data collection process, teachers' attitudes towards assessment were determined using a survey with a questionnaire as the research tool. This was given to science teachers who often take part in the ASE online discussion forums. This questionnaire was distributed through the online survey site 'SurveyMonkey', for which a link was sent to the participants. This was done through the Internet because the participants are all users of Twitter for CPD, and are inevitably familiar with / have access to the Internet. An internet-based questionnaire was also used due to its likelihood of reaching out to more people (Cohen *et al*, 2007; Thomas, 2003). It is an obvious and convenient tool for gathering the views of participants who are dispersed across a region, as was the case in this part of the study that involved science teachers in England. They are cost effective, convenient for the participant and enhance the voluntary nature of their participation given that they are anonymous (Robert, 2007). The questionnaire used in this study is a self-administered one, which availed the participants the opportunity to think and complete the questions as they so choose. This, on the downside, may limit the full completion of the questions should the participants find the questions difficult. However, this was minimised by presenting the questionnaire to another researcher and to two science teachers for evaluation on the simplicity of the questions.

In comparison with the paper-based questionnaire, internet-based questionnaires tend to take a longer time to complete, potentially resulting to the issue of people dropping out (Cohen *et al*, 2007). This data collection tool also comes with the downside of low response rates (Robert, 2007), which could be due to the lack of awareness of the existence of the survey by the targeted population. Some groups may be under-represented, as it is easier for one to ignore the request, quit or cancel the

questionnaire once it is started (Cohen *et al*, 2007). As a result of this, the link for the survey was sent out during the weekly science teacher discussion forum for three consecutive weeks. In addition, personal emails or tweets were sent to science teachers in the sample group.

The questionnaire used in this study is a self-developed tool which is eclectically developed from different sources. It is made up of four sections (see Appendix). Section one was designed to gather personal details of the participants which include the type of school and region they work in, their role in the school, highest education level attained and their years of teaching experience. This information on the participants forms part of their experience in education. The ease of answering these basic demographic questions was the rationale for presenting them first. As advised by Cohen *at al* (2007), it is advisable to keep the introduction brief and the first questions interesting and straightforward rather than too complicated.

The second section of the questionnaire aimed to determine participants' conceptions of assessment. This section is an adapted copy of the abridged Teacher Conception of Assessment version III (TCoA-III) by Brown (2006). This tool was developed and validated based on the original tool created by Brown (2002) and contains the statements on the different purposes of assessment and the rationales for considering assessment as irrelevant (Brown 2006). As argued earlier, the purposes of assessment inform the structure (Taras, 2009) and these purposes can be influenced by the views of the stakeholders. In view of this argument, an understanding of their views will give an insight into their belief of what assessment is and its purposes. The TCoA-III provides the opportunity to understand teachers' conception of assessment by considering their level of agreement or disagreement in relation to the different purposes of assessment, and their beliefs on assessment as an irrelevant process (Brown, 2006). It has been used in different studies on secondary school teachers' assessment conceptions (Brown and Harris, 2009; Calveric, 2010; Brown and Michaelides, 2011; Brown and Remesal, 2012; Gannon-Slater, 2014; Solomonidou, 2014; Moiinvaziri, 2015). The TCoA-III contains a list of statements regarding assessment for which participants rate their agreement using a 5-point Likert scale. As these statements are the perceived purposes of assessment, the tool serves as a suitable

source for gaining an insight into the participants' views of what assessment is and should be used for.

Prior to the inclusion of the tool into the questionnaire, its 27 statements were reviewed using content analysis resulting in the removal of statements that appeared to have semantic connotations similar to other statements within the questionnaire. A typical example is: '*Teachers should take into account the error and imprecision in all assessment'* and '*Assessment results should be treated cautiously because of measurement error'*. The two statements highlight the errors that assessment can sometimes have, therefore explaining why only one was chosen. The reduction was necessary to produce a questionnaire that was not too long but adequate enough to give an insight into the research topic. Moreover, there was another opportunity to gather more data on teachers' conceptions of assessment through the interview process.

The third section of the questionnaire aimed to determine teachers' views on different assessment strategies. These views include how they value a set of listed assessment practices and how often they employ them. This section aimed to unravel whether or how participants' views of different assessment practices differ from the rate at which they use them. A 4-point scale for 'very valuable' to 'of no value' was used to determine participants' views of valuable assessment practices, whilst a 5-point scale for 'Always' to 'Never' was used to determine participants' rate of usage. As questions were asked on assessment for learning, of learning and as learning practices; any relationships between teachers' attitude towards these assessment practices and their conception of assessment or conception of teaching and learning can be identified and explained.

This section was developed from the Assessment Practice Inventory (API) by Zhang and Burry-Stock (1994) and the Educational Assessment Practices section of the 'Knowledge, Attitudes, Skills, and Practices of Teachers in Educational Assessment Questionnaire' by Alkharusi *et al* (2012). Both tools individually contain a sufficient number of assessment practices and have been used in the study of teachers' assessment practices (Alkharusi *et al*, 2012; Zhang and Burry-Stock, 1994; Zhang and Burry-Stock, 2003). The API contains a list of assessment practices compiled based

on the literature review of classroom assessment practices and the Standards for Teacher Competence in Educational Assessment of Students. It covers both the development of tests and the communication and utilisation of assessment results (Zhang and Burry-Stock, 2003; Randel and Clark, 2013). The contents of the inventory, however, are more inclined towards summative assessments thereby necessitating the need for the second tool. The 'Knowledge, Attitudes, Skills, and Practices of Teachers in Educational Assessment Questionnaire' (Alkharusi *et al*, 2012) was therefore considered. This tool covers six different sections and has been used to explore teachers' educational attitudes, competence, knowledge and practices (Alkharusi *et al*, 2012). Of the six sections in the questionnaire, the Educational Assessment Practices section was used. This section contains the list of traditional assessment practices, alternative assessment practices, methods of analysing and communicating assessment results, in addition to more student-centred assessment methods (Alkharusi *et al*, 2012).

In developing the third section of the questionnaire, the contents of both tools discussed were reviewed. Then in reference to literature review and personal experience as a teacher, a list of assessment practices which covers the different paradigm of assessment (AfL, AaL and AoL) was generated. This self-developed tool was necessary because of the characteristics of the two contributing tools. They are more focussed on summative assessments, although the 'Knowledge, Attitudes, Skills, and Practices of Teachers in Educational Assessment Questionnaire' contains more student-involved assessment practices. In addition, none of them were developed in relation to the English educational system. Consequently, the selection of assessment practices was done in relation to the standards for classroom assessment practice as given by the Assessment reform group (Gardner *et al*, 2008). More importantly, the self-developed tool creates the opportunity for the inventory to be specific to the focus of this study (Randel and Clark, 2013).

Finally, the fourth section of the questionnaire aimed to determine participants' conceptions of teaching and learning. Here, participants were asked to rate their belief in the different statements regarding teaching and learning using a 5-point Likert scale of 'strongly disagree to strongly agree'. This section is an adapted version of the conception of teaching and learning questionnaire by Chan (2001). This tool was

developed based on the review of literature on teaching and learning conceptions backed up by the findings of a group dialogue with pre-service teachers on their views in teaching and learning (Chan 2001). Different studies on teachers' conception of teaching and learning have been carried out using this tool (Chan 2004; Chan and Elliot, 2004; Aypay, 2011; Yilmaz and Sahin, 2011; George 2013; Msendekwa, 2015). Although these studies were mostly with pre-service teachers, the tool was chosen for use in this study because it contains a broad distribution of statements characterising different teaching and learning conceptions. It does not only centre on the meaning of teaching and learning – but also reviews the role of teachers and students in teaching and learning – in addition to classroom management and teaching and learning strategies (Chan 2004; Aypay, 2011). The tool has also been used for experienced teachers (George, 2013; Msendekwa, 2015). Besides, it is reasonable to argue that a tool constructed to suit trainee teachers will hypothetically be easily comprehensible by teachers in their early teaching careers who lack sufficient experience in teaching and learning. Also, considering the variation in routes to teaching training which include a school-based only training route – participants may not all have the same level of exposure to theoretical conceptions of teaching and learning. Consequently, the use of a tool adaptable to teachers with presumed less experience of learning theories.

The tool was originally a two-way factor structure of constructivist and traditional conceptions (Chan 2001; Chan and Elliott, 2004; Aypay, 2011) but was later found to be a five-way factor structure by Teo and Chai (2008). The traditional conception was subdivided into directive, teacher-centred, rote and transmissive conceptions (Teo and Chai, 2008). Presumably, this will give access to a more detailed comprehension of teachers' conceptions of teaching and learning. Prior to the inclusion of this tool in the questionnaire, it was reduced from its original number of 30 to 12 using content analysis. The statements were grouped into themes, and where statements were found to share similar theme one was selected from the group. A typical example is found in this case where one statement was selected from these presumed similar themes: '*The ideas of students are important and should be carefully considered'*, '*It is important that a teacher understands the feelings of the students'* and '*Good teachers always make their students feel important'*. The content of this tool was also reduced because this study is focused on teachers' attitudes towards assessment, and as a result, an

insight into their conceptions of teaching and learning was adequate enough for the study. Besides, if assessments are considered to be a part of the teaching and learning process, the participants' conceptions of assessment and the interview process will throw more light on the participants' conceptions of teaching and learning.

Finally, it is important to note that, although the use of this self-developed questionnaire made the tool specific to this study, it leaves room for a potential limitation to its content validity (Randel and Clark, 2013). This potential limitation is one of the reasons why the study embraced a mixed methods approach, as the collection of qualitative data is seen as having the potential to ameliorate the limitations of the quantitative data.

3.5.2 Interviews

The second part of the data collection process was the interview of science teachers from the two sampling frames: Science teachers from the online discussion forum and science teachers working in East London secondary schools. Interviews were used as a data collection tool, as they allow the collection of data on things that cannot be easily observed or incorporated in a questionnaire, and as such, can assess one's attitude (Byrne, 2012). Stake (1995) believes that interviews are the main path to understanding multiple realities in research, as the process aids the discovery and presentation of the multiple perspectives of a case. This data collection tool allowed key identified questions to be asked without restricting the scope of the discussion between the participants and myself. The use of open-ended questions further allowed better access to respondents' views (Bryne, 2012).

The interviews were conducted in two phases. The first phase was a series of semi-structured interviews of the science teachers from the online discussion forum. These took place during the autumn term (October to November) and each interview took about 20-30 minutes. The questions for the interview were based on both the content and outcome of the questionnaire, which includes: teachers' perceptions of assessment and its purposes, valuable assessment practices and factors that influenced their views. The indicative questions for which follow-up questions were asked based

on the responses given include: *How would you define assessment, From your point of view what are the main purposes of assessment?, Which assessment practice(s) do you consider valuable and why?, Which assessment practices do you often utilise and why?, How would you define teaching and learning?* Twenty letters were sent out to the science teachers in the sample group of which nine accepted to take part in the interview. The choice of participants was based on the outcome of the questionnaire. The sample included participants within the different categories which the data analysis of the questionnaire showed could have an impact. These categories include participants' years of teaching experience, their role and the type of school they work in. Participants were allowed to choose the interview format that is most convenient for them. Six interviews took place on the Internet – through the Twitter direct message tool – and three by telephone interview, and all were conducted at the participants' convenience. These mediums were chosen as the participants are located across England and the ease of a face-to-face interview would have been impossible.

An Internet interview has the advantage of a reduced cost of administering the interview and transcribing the interview data (Meho, 2006). In the case of this study, the participants are regular participants in online discussion forums and undoubtedly familiar with this tool. This made it an easier and more cost effective method of collecting data. It also created a more positive experience for the participants – as they usually engage in educational discourse using this tool. This medium also offered participants access to their responses as they were presenting them, thereby enabling them to read their comments and adapt them if need be. For this reason, the risks of misinterpretation and misquoting were low. This promotes the research's descriptive validity, which Cohen *et al* (2011: 135) describes as the 'factual accuracy of the account that is not made up, selective or distorted'. However, unlike the use of the telephone, which offers the benefit of elaboration, the Twitter direct message tool has a limit on the number of characters per message. This may have limited the quality of data as some responses were given in few words. To address this, opportunities were made available for participants to give their responses in more than one message feed.

Telephone interviews, on the other hand, allowed more elaboration of the answers by the respondents leading the collection of a richer data. Participants do not have to type their answers and so were more willing to say more. In addition, questions that

needed more clarification were easily handled. In spite of this, it is recognised that errors in transcription can limit the quality of data. To address this possible problem area, the researcher ensured that there were repeated listening to the recordings.

The second phase of the interview process was the in-depth interview of six science teachers in East London. This took place between the end of the spring term and the beginning of the summer term (April –May). A sample of science teachers with lesser involvement in educational discourse outside the school was selected. This forms a better representation of a typical secondary school science teacher. Teachers were selected based on the Ofsted rating of their school and whether they are on a temporary or permanent contract. Interview requests were sent to the science teachers in the schools selected and six teachers responded to the request. The interview questions were informed by the outcome of the survey and also aimed to further understand teachers' attitudes towards assessment.

In this process, respondents were asked to describe different scenarios of application of assessment. They were specifically asked to describe one assessment process they developed, carried out and found to be valuable and another one which they found not to be valuable. They were also asked to describe an example of an assessment process they were made to carry out and found to be useful, and one found not to be useful. Spin-off questions which include the reasons for their choices, their views of what assessment is and their perceptions of teaching and learning were also asked. These were then followed up with further questions to elucidate their response. This strategy was used in view of Gruenert and Whitaker (2015:16)'s argument that 'it is always easier to describe *what you do* (climate) rather than *why you do it* (culture)'. In addition, it is believed that narratives can present a more holistic representation of teachers' experiences and knowledge (Loughran *et al*, 2012).

Although the interview questions were influenced by the outcome of the survey, the teachers in this sample were not given the questionnaire to complete. The rationale was to shield them from any possible bias the contents of the questionnaires may have on their answers. Exposure to the questionnaire content may possibly influence the information retrieved from memory. Moreover, the sample (6 teachers) is too small to make a significant difference to the findings from the questionnaire.

Each interview process lasted between 30–40 minutes and took place either through the telephone or face-to-face. The choice of interview method – face to face or telephone – was made based on the participants' convenience and location. Although the telephone interview was a more convenient and cost effective way of collecting data, it hindered the observation of the participants. The face to face method, on the other hand, made the process less formal and perhaps less demanding for the participants. Besides, observations were made on the participants' manner of speaking. Thus, both methods allowed some sort of observation of the participants during the process and this further enriched the data.

3.6 Data analysis

Different analyses were carried out to unravel the answers to the research questions. Statistical analyses using the Statistical Package for the Social Science (SPSS) were carried on the questionnaire data, while interview data were analysed using the content analysis process. The two data analysis processes have been discussed below.

3.6.1 Quantitative data analysis

As stated above, the quantitative data generated were analysed using the SPSS. Both descriptive and inferential statistical analyses were carried out on the data with the intent to describe science teachers' attitudes towards assessment and the factors that could shape them. The key dependent variables in this study are the science teachers' conceptions of assessment and their views of and rate of use of different assessment practices, all of which constitute their attitude towards assessment.

3.6.1.1 Descriptive analysis

Descriptive statistical analyses were carried out to describe the key variables, and these generated answers to the first research question (*Describing teachers' attitudes towards assessment*). They were also carried out to describe the demography of the sampling frame which includes participants' years of teaching experience, the highest educational level they have attained, their role in a school, the type of school and region they work in and their conceptions of teaching and learning. This data analysis

process turns large and difficult to comprehend data into smaller and comprehensible data for easy interpretation (Goodwin, 2009).

The descriptive statistics used for the key variables include the measures of central tendency and the measures of variability. Whilst the mean and median of the data were used for the former, the standard deviation and range of the data were used for the latter. These statistical measures were used to cater for the characteristics of the data, which can be described as both ordinal and interval data. The quantitative data, which was collected through Likert-type questions, can be described as ordinal data due to its ranking and unequal intervals (Blaikie, 2003; Corder and Foreman, 2009). The data can also be viewed as a Likert scale data, given that the composite scores of different sets of Likert-type questions constitute a measurement (Boone and Boone, 2012). Such data is considered to be interval data (Boone and Boone, 2012; Rubin, 2012) due to its consistent or equal intervals (Norman and Streiner, 2008; Ary *et al*, 2013). The mean and standard deviation were used to describe the data as they are best suited for interval measurements whilst the median and range were used because they are best suited for ordinal measurement (Blaikie, 2003; Cohen *et al*, 2011). However, as all the individual questions in the questionnaire came together in small groups to measure a particular feature, the data was considered to be Likert scale data and all subsequent analyses were conducted based on this assumption.

3.6.1.2 Inferential analysis

The inferential statistical analyses carried out include the correlation tests, which aimed to determine the relationships between the key variables, and the analysis of variance tests, which unravelled the effects of the influencing factors on the key variables. These were carried using the Spearman correlation test and the Kruskal-Wallis test respectively. Both tests are considered to be non-parametric tests because, unlike the parametric tests, they do not require assumptions on the nature of the distribution of data and are used with nominal and ordinal data (Ember and Ember, 2009; Norman and Streiner, 2008; Rubin, 2012). Both tests were still used irrespective that the composite scores of the different sets of Likert questions, which were considered to be interval data, were used for the inferential analysis. This is as a result of the violation of the parametric assumptions, as some of the data contained

outliers, or were not normally distributed. Besides, it can be argued that the data is not really interval data as the mean of agree, strongly agree and mostly agree may be difficult to describe (Kuzon *et al*, 1996; Jamieson, 2004). In addition, the parametric tests yield a more powerful result than their non-parametric counterparts when all the parametric requirements are met, and the non-parametric tests tend to yield a more powerful result when these requirements are not met (Clark-Carter, 2009), as was the case in this study.

To determine the relationships between the different conceptions of assessment, the Spearman coefficient test was used. As earlier mentioned, this may be less powerful than the parametric Pearson coefficient (its parametric counterpart) but only in the case when the parametric assumptions are not violated (Vaughan, 2001). Besides, the parametric Pearson coefficient and the non-parametric Spearman coefficient test have been shown to yield similar results for Likert scale data (Murray, 2013b). To further confirm or refute this finding, the Pearson coefficient test was carried out alongside the Spearman coefficient test. The same test analyses were carried out to determine the relationship between science teachers' views towards different assessment practices and the rate at which they use them, as well as with their conceptions of assessment and their conceptions of teaching and learning. These test analyses unravelled whether there are relationships between the key variables, thereby contributing to the answers for the first research question. These also contributed to the second research question (*factors affecting teachers' attitudes towards assessment*) when the analyses involved teachers' conceptions of teaching and learning.

Further inferential analyses were carried out using the non-parametric Kruskal- Wallis test to determine the effect of different factors on the key variables, which is the focus of the second research question. The Kruskal-Wallis test was used because it is a suitable method for comparing two or more independent groups (Cordor and Foreman, 2009; Keller, 2014; Mackey and Gass, 2015). The Friedman test – which is another suitable way of comparing multiple groups – was not used, as it considers related groups (Cordor and Foreman, 2009; Mackey and Gass, 2015). Although one can be a classroom teacher and a subject leader, these two were considered to be unrelated during analysis, in order to clearly understand the effects of teachers' role

on their attitude. The questionnaire used only allowed the inclusion of one answer per question, and this excludes the possibility of participants belonging to more than one group in each category.

Furthermore, where significant differences were found with each dependent variable, the Mann-Whitney U-test was used to elaborate on the variation by comparing two independent groups at a time; for instance: comparing the differences between the academy and comprehensive school teachers. The Mann-Whitney U test was used because it is the non-parametric test used to compare two independent groups and can be used when the dependent variable is ordinal, interval or ratio (Rubin, 2012). Although the sign test and the Wilcoxon signed rank test are non-parametric methods for comparing the mean differences between two groups, they were not suitable options. Both methods are used to compare the differences between paired groups (Rubin, 2012; Keller, 2014).

3.6.2 Qualitative data analysis

The data collected through interviews was analysed using both directed content analysis and conventional content analysis, as described by Hsieh and Shannon (2005). In the directed content analysis, codes which were derived from prior research findings and existing theories relevant to the study were used, and these can be defined prior to, or during the analysis (Hsieh and Shannon, 2005). This method was used to support the findings revealed by the questionnaire. The different themes in the questionnaire, which are informed by research, served as the sources of the codes. However, as the quantitative test was carried out with a small convenience sample, and the content of the questionnaire may be considered to be limited, this possibly limited the richness of the codes it generated. Consequently, the directed content analysis was carried out together with the conventional content analysis to augment this limitation. The conventional content analysis method utilises codes derived from the data, and as such, these codes were characterised during the data analysis process (Hsieh and Shannon, 2005). This encouraged the emergence of new themes whilst validating the already defined themes. Content analysis, in general, is a data analysis technique aimed to ‘make valid inferences from text’ (Weber, 1990:9). Schreier

(2012) discusses qualitative content analysis as a systematic and flexible method which aims to reduce data. It is 'any qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings' (Patton, 2002: 453).

To analyse the interview data, the steps, as described by Creswell (2013), were taken accordingly. Where interviews were conducted through the phone, these were recorded and notes jotted down during the process. The recordings were then transcribed after the process. The recordings were listened to several times during the transcription process to ensure the accuracy of the data. On the other hand, where an interview was conducted through the online chat tool, the transcript was a copy of the chat conversation. In both cases, the transcripts were thoroughly read through. The data collected were then coded and grouped into concepts. Each concept was subsequently linked to a research question.

3.7 Ethics

In this study, ethical approval was sort and granted by the University Research Ethics Committee (UREC). Due considerations were given to the different aspects of the study to ensure the safeguarding of participants. The key areas were the informed consent, ensuring anonymity and confidentiality and the right to withdraw.

Informed consent was sought from all participants before their participation. A consent letter, which contains a brief description of the aim of the study, was used (see Appendix). In the case of interviews, further explanation was given to participants prior to the interview process, so as to allow them to make an informed decision.

During the course of the study, the data collection process and analysis were carried out to ensure the anonymity of participants and the confidentiality of their contributions. To achieve anonymity, the questionnaires were all anonymised. There were no avenues for participants to include their personal details. As the questionnaires were all completed online, it was impossible to match responses to respondents. In addition, only the link to the questionnaire was sent to participants,

thereby preventing the return of questionnaires through email. During the interview process, the notes generated were labelled with pseudonyms, likewise the audio recordings. However, the recordings were deleted immediately after they were transcribed, and this took place within three days of the completion of the interview process. In the case where quotations were to be taken from the transcript, these were presented in ways that anonymised the participants. In addition, participants were given the opportunity up to the point of publication to withdraw from the research or make changes to their comments should they wish to do so.

To ensure the confidentiality of participants' contributions, the transcripts of the interviews were stored with a pseudonym representing the participants, and these were separated from their personal details. As there was no avenue for participants to indicate whether they wished to take part in the interview process in their questionnaire, there was no link between the participants' questionnaire answers and their interview notes.

Furthermore, provisions were made in the questionnaire and interviews for participants to opt-out from questions that they chose not to answer. The questionnaire tool allowed participants to skip questions if they wish to do so. It was also easy for the participants to exit the questionnaire at any point should they not wish to continue. The right to withdraw from the study was made clear in the consent letter and further reinforced prior to the interviews. These provisions were important as the treatment of participants is one of the key ethical concerns for educational research (Johnson and Christensen, 2014).

3.8 Summary

This research aimed to answer research questions using a mixed method approach underpinned by pragmatism. In this study, qualitative and quantitative data was collected and triangulated. Questionnaires were used as a research tool to gather information on science teachers' conceptions of assessment and their viewpoints and rates of use of different assessment practices, all of which form their attitudes towards assessment. The same tool was also used to determine some factors that affect science teachers' attitudes towards assessment. The information gathered was subsequently

triangulated with information gathered through semi-structured interviews in order to increase the validity of the findings. As a research conducted based on pragmatism, both descriptive and inferential statistical analysis using the SPSS and qualitative content analysis were carried out to analyse the data. The whole process was conducted whilst ensuring that due ethical considerations took place, and the inferable data generated will be discussed in the following chapters.

Chapter 4 – Data analysis

Introduction

The purpose of this study is to understand and describe the nature of science teachers' attitude to assessment and to identify the factors that affect these attitudes. As stated previously, this is a mixed method study underpinned by pragmatism. Both qualitative and quantitative data have been collected from the two sampling frames. This chapter will describe the data sources and the data collected with the view to present answers to the research questions.

4.1 Data source

Two different forms of data were collected in relation to the sampling frame. These included data collected through the use of questionnaires and interviews with science teachers.

The first survey request was sent out to science teachers who are often involved in the Association of Science Education weekly online discussion forum (ASEchat). As stated earlier, this forum was chosen because it is a convenient avenue to collect data from a representative sample of science teachers in England. It is estimated that about twenty science teachers take part in the discussion forum on a busy day and the individuals vary on each day. Fifty-four science teachers responded to the survey. Out of the fifty-four, three were excluded, as those teachers work outside England. Another five were excluded due to incomplete completion of the survey. The exclusion was done because more than 10% of the questionnaires were not completed, and as suggested by Bennet (2001) an omission of more than 10% is likely to lead to a biased statistical analysis.

The demographics of the sampling frame were analysed using the Statistical Package for the Social Sciences (SPSS). Variables such as years of teaching experience, the role of the teacher in the school, type of school and region where it is situated, highest qualification attained by the teacher and the teacher training route were considered. Of the total science teachers involved in the study, 73.9% of them (34 teachers) have more than five years teaching experience whilst 26.1% of them (12 teachers) are still

in their early years of their teaching career (Fig 7.1 in the appendix). Most teachers in the sampling frame [82.6%] (38 teachers) completed a PGCE programme, while the rest took other routes such as GTP and Teach first (Fig 7.2 in the appendix). Also 52.2% of the participants (24 teachers) had only a bachelor's degree, while the rest had higher degrees (Fig 7.3 in the appendix).

The region and the type of school participants worked in also varied as 39.1% of them (18 teachers) work in an academy, 41.3% (19 teachers) work in a comprehensive school and 10.9% (5 teachers) work in an independent school (Fig 7.4 in appendix). The participants also worked in different parts of England although only 10.9% of the participants (5 teachers) work in the capital where there is more diversity in the population of teachers and students (Fig 7.5 in the appendix). Furthermore, the role of participants varied with 28.3% of the participants (13 teachers) working as only class teachers, whilst the rest had some sort of extra teaching and learning responsibilites (Fig 7.6 in the appendix).

The interview request was sent to the same science teachers who were invited to take part in the first survey. A total of nine teachers with varied years of experience and roles took part in the semi-structured interview. Three teachers had five or fewer years of teaching experience whilst the remaining had over five years of teaching experience. Seven of the teachers had extra teaching and learning responsibilities whilst the rest did not have one. The interview sample, which is made up of five males and four females, also covers a range of schools: academy, independent and comprehensive. There was no confirmation as to whether these participants completed the questionnaire, as this was anonymised.

The second interview request was sent to science teachers working in selected schools in East London. The selection was based on the Ofsted rating of the schools. A total of six teachers participated in the in-depth semi-structured interview, and these include one teacher from an outstanding school, two teachers from a good school, two teachers from a 'requires improvement' school and one supply teacher (a teacher employed to cover a teaching post on a temporary and short term basis).

The data from the different sources were collated and analysed. The findings were then grouped into different themes and described below. These include: the description of teachers' experiences of assessment, their conceptions of assessment, their characterisation of different assessment practices, their rate of use of different assessment practices and factors affecting these themes.

4.2 Teachers' experiences of assessment – Findings from semi-structured interviews

The analysis of the in-depth semi-structured interviews of a sample of science teachers working in East London schools reveals that science teachers have a varied yet similar discourse of assessment. Participants were asked to describe scenarios when they completed assessment tasks which they considered to be either valuable or not valuable. Spin-off questions based on the rationale of their choices in addition to the positives and negatives of the assessment process were also asked. They were further asked to describe what assessment and teaching and learning meant to them. The key player in the assessment process and the beneficiary of the assessment process emerged as common themes in science teachers' descriptions of their experiences of/and views on assessment. A review of the findings shows that participants discussed assessment as a multi-type and multi-purpose process. These have been categorised into assessment as a teacher-oriented process for teacher benefits, a teacher-oriented process for student benefits and a student-oriented process for student benefits. These views were in one way or the other shared by the participants. However, variation occurred as to which principle each participant's views were mostly skewed towards.

4.2.1 Assessment as a teacher-oriented process for teacher benefit

There were instances when the participants talked about assessment as a teacher process with the benefits solely for the teacher. This did not come across as the most popular attitude towards assessment except with one participant whose views were all teacher-centred. This participant discussed the use of tests as both a valuable activity and an activity of no significant value for one as a teacher. This discussion includes an

example of how testing has improved her subject knowledge and instances of where tests were a waste of her time as expressed in these words:

> *Marking the test, especially the topics I am not very good at, helps me with my subject knowledge, as I have to read the question well and try to understand it in order for me to be able to mark it. But when tests are set close to an exam – which will still test the same topic – I don't see the point in it, then.*

In general, all participants remarked on the impact of assessment on themselves as teachers. Some participants described how they use assessment to evaluate their teaching, as one participant expressed: '… *the good thing with this assessment is that you can evaluate your own teaching. You will also know what students are learning and whether what they have been taught has been taken on board.'* They believed that assessment helps them to understand whether the teaching strategies they have employed are fit for purpose by ascertaining how much learning has taken place. In addition, some of the participants were of the opinion that the development of assessment tasks helps them to enhance their subject knowledge, as one of them stated: '*you have to know the answer to a question before you present it to the class, so I have to read around a topic to create rich questions for my students*.'

It was also revealed in the findings that there were occasions where assessment was described as a data collection process to satisfy teachers' administrative roles. A typical example is the use of regular end of unit or topic tests to collect students' levels or grades which are subsequently used to report to the relevant stakeholder as and when required, as one participant described:

> *'We carry out an end of unit test every half term and the results are used for report writing and also for progress and intervention meetings with my line manager. I also use the information to check the progress of my students over time and also present it to the observer during a lesson observation as we are usually required to do in my school.*'

There were also instances when assessment was described as a progress or achievement indicator tool. This inference is as a result of participants' discussions on

how they carry out an assessment in order to know students' current attainment status and predict future attainment. A typical example was given by one participant: '*we brought a bank of questions from … and use them to create different levels of questions … This also gives us an idea of where or what students are likely to get in their GCSE.'*

The negative impact of assessment on teachers' workload was also raised by the participants. This was more prominent with the participants interviewed at the end of the spring term. The marking workload was popular as a topic of discussion among the participants and in some instances the pressure of the short turnaround time. To alleviate the marking burden, some participants described how they use peer assessment for teacher benefit. Another impact on raised workload was the nature of the assessment task, although this was not common with the participants. Some participants discussed assessments of insignificant value as the ones that are not clear to the students, thereby creating more burden for the teachers as they had to adjust the tasks to increase students' ease of access. An example was given when students were made to sit a test that had ambiguous questions with significant grammatical errors. The concerns of the students created difficulties for the teacher.

Teachers also viewed assessment of insignificant value as the ones that they are made to carry out. When asked to discuss an assessment found not to be valuable, all the participants discussed an assessment they were made to carry out. Although the rationale varies, they were mostly skewed towards teachers' belief that such assessments are a waste of their time. A typical instance was cited when teachers were made to give students a test that covered topics they had not done, and another when they were made to give students test at the wrong time or give them an assessment task that covered a topic that had already been assessed several times.

To sum up, the above evidence suggests that the participants' perceptions of assessment demonstrate that they consider assessment to be a process they carry out, or a tool they utilise to aid them in their work.

4.2.2 Assessment as a teacher-oriented process for student benefit

The description of assessment as a teacher-oriented process for student benefits was more pronounced in the views gathered unlike the previous descripton. The analysis of findings reveals that the science teachers involved in this study considered assessment as a process they carry out to ascertain what students know and can do for their benefit. Thus, for them, assessment in science is not limited to assessing knowledge but also skills. Some went further to explain that the information gathered is used to plan subsequent interventions. One participant extended the argument by adding that assessment also includes ascertaining how students learn. This participant pointed out that assessment in science is a compendium of the ways to ascertain knowledge of '*what students have learnt, what students have not learnt, how they learn and how to make it better*.'

Some participants discussed the roles of teachers in assessment as the authors and directors of the assessment process. They discussed valuable assessments as mostly the ones they created, as they believed that these were thought through properly. In one particular instance, a participant discussed how they used the bank of graded exam-style questions to create the end of unit tests for students that met the needs of a variety of students. In another instance, a participant branded an assessment as not fit for purpose because it was not differentiated by the teacher in these words: '… *this is not fit for purpose because not all the students' needs have been assessed according to their different learning styles*.' This theme also emerged when one participant expressed the implications of over-differentiating low-stakes tests. This participant revealed that some students find certain levels of questions difficult to handle and this can be a challenge in the creation of low-stake tests. However, the participant in these words pointed out that over simplifying the tests for the students would not be beneficial to them in the long run:

> *… The challenge with this assessment is that the questions are a bit too difficult for weaker students. But not giving it to them doesn't help to train them, as they would still sit the same GCSE exam with other students. Some teachers disagree and prefer that easier questions are set, but for me this is not a challenge as it would be better for them in the long run.*

Furthermore, one participant in the discussion of valuable assessment practices states that in-class assessment using exam-style questions gives an idea of what students are more likely to get from high-stake exams such as the GCSE. This can be both beneficial to the teacher, as earlier mentioned and to the students. If it is believed that exams are the vehicles for students to show the acquisition of new knowledge they have gained through learning, then the outcome of the findings will help them in subsequent preparations.

Another line of discussion unveiled in the findings is the effect of giving feedback. Some participants believed that one role of the teacher in the assessment process is to give feedback to students which can either be oral or written. They believed that this plays a key role in improving students' learning. One participant clearly differentiated feedback from grades in these words: '*students benefit from the feedback more than just giving them the grade… I just believe that this is what students will read and learn from their mistakes.'*

Furthermore, most participants discussed the use of questioning in lessons as a useful assessment process and the positive impact it has on students. Findings show that these questions are mostly teacher-led, with the outcomes used to further enhance students' learning. For instance, one participant discussed how several teaching and learning techniques are used to diagnose what students have learnt at the beginning of the lesson (starter activity), during the course of the lesson (main activity) and at the end of the lesson (plenary activity). In the words of the participant, emphasis was placed on the use of the findings as narrated below:

> *During the lesson I will carry out an assessment for learning and an assessment of learning. I will use different learning and teaching strategies to do so … These help me to understand whether what is taught in lesson has been understood. I will not move over to the next one unless about 95% of the students understand the concept.*

Also, some participants discussed the role of teachers in creating the right assessment atmosphere for students. One participant discussed how setting tests at the end of the topic helps students, whilst another participant talked about how giving students a

science test shortly after a mock exam and in the midst of other GSCE exams taking place can have a negative impact on students. This participant explained that such practices could knock students' confidence if they struggle with the test or do not perform well in it.

To conclude, there is evidence to suggest based on the above discussion that the participants in this study also discussed assessment as a process carried out, or a tool used by the teachers with the aim to meet students' needs.

4.2.3 Assessment as a student-oriented process for student benefit

The participants also discussed assessment as a process carried out, or a tool used by students for their own benefit. There were strong beliefs that some assessment practices that students take part in are also a learning process for them. A typical example was seen in the discussion of peer assessment. Although this was not popular among the participants, the effects of peer assessment were raised by some participants. The use of peer assessment was highly promoted by one participant. This participant believed that peer assessment helps students to understand the characteristics of good work, thereby enabling them to know what to do to improve their work. It gives students ownership of their learning and makes them more independent. The same participant also discussed valuable assessments as those that enable students to apply their knowledge. This participant criticised the GCSE controlled assessment as failing to do this, as it was more teacher-led. References to the GCSE coursework were all from the participants interviewed at the end of the spring term. Another participant characterised peer assessment as a valuable tool for students in this narration:

> *I used peer assessment for some tasks, especially tasks with clear marking criteria like tests and levelled tasks. I found that students that do this well benefit from it. They understand what good answers looks like and what the correct answers are. I do check them afterwards because some of them may not be done properly*.

This line of thought was further raised when some assessment practices were seen as preparatory tools for other assessment practices. There was a belief that in-class assessment prepares for high-stake assessment. This was noted in the discussion on how the use of graded tasks alone as the end of topic/unit assessment prior to an exam is not useful for students. The rationale given was that this assessment fails to prepare students for high-stake exams, as students can use relevant resources such as books and work through the assessment ladder. This assessment fails to provide students with the opportunities to familiarise themselves with the language and format of the exam. One participant expressed:

> *Graded tasks are not good, as students refer to books and work through a level ladder and these do not prepare them for the real exam. In KS3, where this is regularly done, students do not do well in their end of term exam as they are not used to answering such questions.*

Assessment was also discussed as a tool that enables students to understand the curriculum requirements as well as the connection between the different aspects of the subjects. In one instance, a valuable assessment was expressed as those that cater for the needs of all learners through the provision of a variety of strands in a particular assessment process. A typical example was when students are given an assessment that involves both practical and theoretical work, such as GCSE or A-level coursework, and they use this assessment to understand the connection between practical and theory which subsequently helps to motivate them, thereby improving their performance. One participant explained:

> *The coursework practical investigation provides the opportunity for students who are interested in practical work and those who are interested in theoretical work to see the connection between the two, thus catching a bigger audience of students who are intrinsically interested, which subsequently leads to better performance.*

Another line of discussion unveiled is assessment as a motivational tool for students. Apart from the impact of assessment on students' learning, the impact of assessment on students' motivation was also raised. An instance was given when an assessment –

according to one participant – was '*unprofessionally done'* as they were ill-worded with many spelling mistakes giving rise to a counter-productive effect on students.

As a final point, it is obvious from the above discussions that the science teachers in this study also viewed assessment as a student-led process aimed to gather information to help students improve their learning.

4.3 Description of science teachers' conceptions of assessment

4.3.1 Findings from the questionnaire

The statements in the questionnaire which are centred on the conception of assessment were grouped into assessment for improvement, school accountability and student accountability purposes, as well as assessment as an irrelevant process. This is in line with the themes used by Brown (2006) in the description of teachers' conceptions of assessment and has since been used to describe teachers' conception of assessment (Brown and Harris, 2009; Brown 2011; Calveric, 2010; Brown and Michaelides, 2011; Brown and Remesal, 2012; Moiinvaziri, 2015). Descriptive statistics such as the mean, median, range and standard deviation of teachers' responses to each assessment conception were computed using SPSS (Table 4.3.1).

	Improvement	School Accountability	Student Accountability	Irrelevance
Mean	3.44	2.71	2.70	2.53
Median	3.42	3.00	2.50	2.40
Std. Deviation	0.72	0.73	0.68	0.52
Range	2.83	2.50	3.00	2.10

Table 4.3 1: The summary of the descriptive analysis of teachers' conceptions of assessment

Findings show that the highest scores were on assessment for improvement [mean = 3.44, median = 3.42], followed by assessment for school accountability [mean = 2.71, median = 3.00]. The lowest score was for assessment as an irrelevant process [mean = 2.53, median = 2.40]. This conception also has the lowest standard deviation [SD = 0.52] and range [range = 2.10]. Assessment for school accountability showed the highest standard deviation [SD = 0.73] while the assessment for student accountability has the biggest range.

Looking at the distribution of the mean scores for each conception (Fig 7.7 in the appendix), six outliers exist in the assessment for student accountability purposes. These are mild outliers, or out-values, because they lie between 1.5 and three times the interquartile range either below the 1st quartile ($x < Q1 - 1.5*IOR$) or above the 3rd quartile ($x > Q3 + 1.5*IQR$) (Larson, 2006). A closer look at the data revealed that three of these respondents mostly agreed with assessment for student accountability purposes [minimum of 4.00 score] and the other three disagreed with it [minimum of 1.50]. There was a similarity in the role of these respondents; whilst the first group were all NQTs the second group were either middle leaders or SLTs.

A further look at the respondents' views on the different elements of each conception was carried out (Table 4.3.2). Findings show that there are disparities in their views on the different elements of each conception. The highest was found in assessment for student accountability and assessment as irrelevant, and the lowest in assessment for improvement.

Statement	**Mean score**	**Range**	**Conception**
Assessment provides feedback to students about their performance.	3.826	0.797	Assessment for improvement
Assessment is integrated with teaching practice.	3.935	1.063	
Assessment informs students of their learning needs.	3.522	0.960	
Assessment information modifies ongoing teaching of students.	3.609	1.043	

Assessment helps students improve their learning.	3.500	0.983	
Assessment provides information on how well schools are doing.	3.087	0.890	Assessment for school accountability
Assessment is an accurate indicator of a school's quality.	2.326	0.818	
Assessment results are consistent.	2.222	0.805	
Assessment places students into categories.	3.413	0.884	Assessment for student accountability
Assessment is assigning a grade or level to student work	1.978	0.856	
Teachers conduct assessments but make little use of the results.	2.533	1.142	Assessment as irrelevant
Assessment is unfair to students	1.870	0.687	
Teachers should take into account the error and imprecision in all assessment.	3.533	1.057	
Assessment interferes with teaching.	1.978	0.802	
Assessment is an imprecise process.	2.783	0.867	

Table 4.3.2: Mean and range scores for the individual statements on the conception of assessment

The relationships between the different conceptions of assessment were investigated using Spearman's rank correlation coefficient. The test revealed that there is a medium negative correlation between teachers' conception of assessment for improvement purposes and their conception of assessment as an irrelevant process [$r_s = -.492$, $p < 0.01$] (Table 4.3.3). A Pearson coefficient test was also carried out without the outliers in the conception of assessment for student accountability. The test yielded a similar result with its non-parametric counterpart (Table 4.3.4). A medium negative correlation exists between teachers' conception of assessment for improvement purposes and assessment as irrelevant[$r = -446$, $p < 0.01$].

	Improvement	School Accountability	Student Accountability	Irrelevance
Improvement	1.000	.244	-.215	-.492**
School Accountability	.244	1.000	.047	-.242
Student Accountability	-.215	.047	1.000	.185
Irrelevance	-.492**	-.242	.185	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.3.3: Spearman's rank correlation coefficient test output showing the relationship between the different assessment conceptions

	Improvement	School Accountability	Irrelevance
Improvement	1	.255	-.446**
School Accountability	.255	1	-.223
Irrelevance	-.446**	-.223	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.3.4: Pearson correlation test output showing the relationship between the different assessment conceptions

To summarise, the above findings show that the participants have varied and multiple conceptions of assessment, with the conception of assessment for improvement as the popular conception.

4.3.2 Findings from the interviews

Different definitions of assessment were given by the science teachers in the interview process. These were in response to the questions: *How would you define assessment? From your point of view what are the main purposes of assessment?* Their responses can be summarised as assessment as a 'progression measuring' process and a 'fact finding' tool to ascertain progress or measure attainment. For instance, assessment was described as '*using tools to allow you to judge progress'* and '*any method that*

checks prior learning and real learning'. One participant went further to describe it as a two-part process which includes the collection and utilisation of evidence of learning as expressed in these words: '*assessment are* [sic] *activities to show students' knowledge and ability to use that knowledge to solve problems.'*

Two main themes on science teachers' conception of assessment emerged from the interviews. Assessment was discussed as an accountability tool and as an improvement process. All participants except one discussed assessment under the two themes. They viewed assessment as a multi-purpose process. For instance, '*assessment is used to measure progress for both teacher planning and reporting to school leaders and parents'*. The only participant that viewed it as a single purpose process described its use as solely for the judgement of students' progress and understanding for accountability purposes. According to this participant, '*it is hard not to be infected with the progression agenda*'.

In addition, four sub-themes emerged in the discussion of assessment for accountability purposes. Participants discussed the purposes of assessment for school, parents, teachers and students accountability. School accountability was more popular among the participants than the other three sub-themes, as they all acknowledged that the outcomes of some assessment practices are used in one way or the other to meet the schools' demand. On the other hand, fewer participants talked about accountability to parents than the others. When discussed, this was often done in conjunction with other functions such as school accountability. As noted, in the words of one participant: '*assessment is used to measure progress for both my planning and reporting to school leaders/parents and to diagnose strength and weaknesses*.' Teacher accountability was also raised as teachers used the outcome of assessment to evaluate their teaching. This sub-theme was often discussed in tandem with either school or student accountability. For example, one participant described the purpose of assessment as: '*to know how much students have learned, how well you have taught and students know how much they have learned*.'

Although all participants pointed out the use of assessment for accountability purposes, most of them believed that assessment should be more for improvement purposes. This was noted in their delineation of assessment as a diagnostic tool that

creates the information required in the adaptation of the teaching and learning process. In some cases, assessment was discussed as a process for both teacher and student improvement purposes, as exemplified in these words of one participant: '*assessment provides information that helps me to improve my teaching and my students to improve their learning*.' In other cases, it was viewed as just one or the other. A typical example is the description of assessment as a learners' process, as one participant pointed out: '*assessment empowers learners to make progress through the feedback process and teachers and parents facilitate the process by working together*.' Also, another participant described it as a teacher's process in these words: '*assessment complements teaching and learning so you can check the impact of your teaching on the students' progress and make changes to give them further opportunities to progress'.* It was also described as a starter tool used to determine students' starting point in learning in order for appropriate instructions to take place.

Despite the varied views of the participants on assessment, all believed that assessment should be more student-centric, be it for improvement or accountability purposes, as one participant explained: '… *I consider it to be done mainly for school accountability, but it should be more for student accountability*'. It was also emphasised in the interview that assessment should be more for improvement purposes, as the outcome of assessing for such purposes can also be used to inform grades.

However, most of the participants with this view previously viewed assessment to be more teacher-centric, with a change in view resulting from their experiences in the teaching and learning process. These participants had previously viewed assessment as a process of measuring attainment through grading or levelling of students' work, as one participant expressed: '*definitely early on in my career I would use assessment mainly as a way of testing at the end of the topic or unit but would not do much with it. Experience and good practice at my current school have changed my thinking*.' They also mostly discussed their previous views of assessment as test-marking, book-marking or activities to measure students' level of understanding. For example, one participant narrated:

When I first started out teaching I thought that assessment was just marking the books and giving the students a grade on their tests. Now they [my views] have changed through my mentor as a trainee teacher and SLT as a qualified teacher giving me feedback on my lessons, and attending internal CPD courses run by the school as an NQT, NQT + 1 and normal professional development.

To sum up, the science teachers in varied ways described assessment as an improvement and accountability tool with the teachers and the students as the common players and beneficiaries of the process.

4.4. Characterisation of assessment practices: Science teachers' ratings of the different assessment practices

4.4.1 Findings from the questionnaire

The different assessment practices mentioned in the questionnaire were grouped into Assessment for Learning (AfL), Assessment as Learning (AaL) and Assessment of Learning (AoL) practices (Table 4.4.3 or Table 7.1 in appendix). This is based on the categorisation of assessments by Earl (2003) into these paradigms, based on the different uses of assessment in the classroom.

A descriptive statistical analysis was carried out to summarise teachers' views of the different assessment practices. The analysis shows that, on average, science teachers in this small-scale study valued AfL practices [Mean = 3.62, SD = .31] more than AaL practices [Mean =3.52, SD = .36] and AoL practices [Mean = 2.74, SD = .41] (Table 4.4.2). Looking at the data, there are three mild outliers in AfL, four mild outliers in AoL and one extreme value in AoL (Fig 7.8 in the appendix). A closer look at the data shows that the extreme value in AoL, which is a mean score of 1.67, belonged to an SLT with over 15 years of teaching experience, and this respondent believes that AoL practices are of little or no value. The mild outliers in AfL and AoL are all experienced teachers with an additional school responsibility.

	AfL rating	AaL rating	AoL rating
Mean	3.62	3.52	2.74
Std. Deviation	0.31	0.36	0.41
Range	1.00	1.00	2.00

Table 4.4.2: Summary of the descriptive analysis for the participants' ratings of the assessment practices

The review of the teachers' responses to individual statements shows very little disparity in their views on AfL and AaL practices (Table 4.4.3). However, a larger disparity between teachers' views within each paradigm is found with the AoL practices. Unlike the other AoL practices given in the questionnaire, 70% of the respondents believed that comparing students' performances to each other when assigning their overall grade was of little or no value, compared to 30% who believed that it was valuable or even very valuable (Table 4.4.3). This view affected the overall mean score for AoL practices. With this exception, all the respondents on average viewed all the assessment practices given as valuable.

Assessment as Learning practices	Mean score
Provide students with suggestions to enable them to monitor their progress in learning.	3.43
Provide opportunities for students to reflect on their work	3.65
Train students to assess tasks done by other students	3.39

Assessment for Learning practices	Mean score
Involve students in the discussion of the standards to be expected in their work.	3.63
Give oral and written feedback to students	3.64
Provide time for students to act on feedback	3.72
Use assessment outcome to adapt learning activities	3.48

Assessment of Learning practices	Mean score
Assess students' academic achievement through a written test	3.02
Compare students' performances to each other when assigning their overall grades	2.20
Use assessment results to make decisions about students (e.g putting into groups/sets)	3.00

Table 4.4.3: Mean score of teachers' responses on their values of each assessment practice.

The Spearman's rank coefficient test was carried out to determine the relationship between the values science teachers accorded to the different assessment practices. The test reveals that there is a strong positive correlation between how science teachers' value the AfL and AaL practices [rs = .607 , $p < 0.01$] (Table 4.4.4). The Pearson coefficient test, which was carried out without the outliers, reveals a similar result. There is a strong positive correlation between how science teachers' value the AfL and AaL practices [r =. 584, $p < 0.01$] (Table 4.4.5).

	AfL rating	AaL rating	AoL rating
AfL rating	1.000	.607**	.185
AaL rating	.607**	1.000	.199
AoL rating	.185	.199	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.4.4: Spearman's rank correlation coefficient test output showing the relationship between the ratings of the different assessment practices

	AfL rating	AaL rating	AoL rating
AfL rating	1	.584**	.308
AaL rating	.584**	1	.295
AoL rating	.308	.295	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.4.5: Pearson correlation coefficient test output showing the relationship between the ratings of the different assessment practices without the outliers

To summarise the above findings, it is not instantly recognisable that the science teachers have varied views of what constitute valuable assessment practice. However, formative assessment practices such as AfL and AaL practices were considered to be more valuable than the AoL practices.

4.4.2 Findings from the interview

Interview findings show that the participants viewed different assessment practices as valuable in response to the question: *Which assessment practice(s) do you consider valuable and why?* Their views of valuable assessment practices can be discussed under two broad categories: Assessment for Learning (AfL) practices and the Assessment of Learning (AoL) practices denoting assessment for formative purposes and assessment for summative purposes.

As revealed in the interview, in-class AfL strategies, which are centered on interactive questioning, were popular among the participants. Some of the strategies mentioned include short quizzes which could be the use of exam questions, hands up voting, the use of ABC cards for multiple choice questions and the use of the traffic light system. Most of the participants pointed out that, with the exception of the use of exam questions for short quizzes, they found these practices most valuable with their Key stage 3 (KS3) classes. AfL practices in general were described as valuable because of the formative role they play for both learners and teachers; as one participant explained:

> *Daily assessment for learning using specific success criteria is important because it gives more information about learners over time and Ofsted is all about progress over time. It has become more apparent in the last couple of years as more research findings show that it has the largest impact on outcomes.*

On the other hand, AoL practices such as tests were considered to be more valuable with the KS4 classes. However, most teachers discussed the formative use of test results which categorises it as an assessment for learning practice. This was more popular with the participants interviewed during the autumn term. As one participant

explained: '*whilst marking tests, students' performance can be analysed at a question level so that specific intervention can be targeted to individual students*.' There were two teachers who only viewed AoL practices such as test as the most valuable. These are male teachers with varied years of experience. Although these teachers championed the regular use of tests, they also discussed how they use the outcome for formative purposes. This can be evidenced in the words of one of them:

> *I believe regular low-stakes tests, both written and multiple choices* [sic] *are valuable. I am moving to a system of assessing students every week via multiple-choice tests and at the end of every topic via a written test. … About every 2 weeks I devote a class to plugging students' gaps including re-teaching some aspect of a topic and students doing individual work on their weaknesses.*

Furthermore, peer assessment as an assessment practice had low popularity among the participants, as most participants only mentioned it when they were prompted to do so. They discussed it as an assessment practice with limited value as expressed by one participant: '*I also use peer assessment but only for quick checking, e.g. a calculation worksheet. I do not believe it has the strongest impact*.' The participants are mostly of the view that findings from this assessment can be limited by students' knowledge of the subject content. Other reasons cited include students' lack of confidence in peers assessing each other's work and on some occasions, the legibility of their handwriting and clarity of their feedback could be limited. However, there were strong assertions by some participants that peer assessment will be of real value to students and teachers if students are well trained on how to carry it out, as revealed in the words of one participant: '*I train students on how to assess each other's work and this helps them in their learning*.'

Overall, there are indications that science teachers usually view AfL practices as more valuable than AoL practices. They believed that these assessment practices are usually of more benefit to the students. To exemplify, one participant responded in these words when asked about the most valuable assessment: '*Formative, rather than summative. Summative doesn't give you specifics about areas of weaknesses for each student*.'

Analysis of findings also reveals that the views of most participants have changed during the course of their career. Some of them previously viewed AoL practices as the only valuable practices, with one of them citing the lack of formative assessment training during the teacher-training programme as the rationale (‘*I don’t remember during my training being given many examples of formative assessment or how it can be used. Levels/grades were all that mattered’*). Two participants talked about the non-existence of previous beliefs of valuable assessment practices. They revealed that as new professionals they carried out assessment based on what they had been told to do or how easy it is to administer, as one of them explained:

> *I don’t think I knew what worked and what was valuable. Early in your career, you tend to do what others show you and what works for you. This doesn’t always mean that it’s valuable; it just means that students respond fairly well to it or that it is easy to do.*

One of them further pointed out that the interview process enabled the reflection of what counts as a valuable assessment practice to take place. Besides the change in view between the two categories of assessment practices, a shift was also found within each assessment type. For instance, one participant moved from viewing two AfL practices as the most valuable to viewing another as such. This was noted in these words: ‘*the ABC and mini whiteboards I still consider to be valuable but not as much now as I do the question level analysis on tests*.’

Different reasons were cited as the rationale for the change of views. These can be summarised as personal and school-driven. The personal drive raised by the participants included: the change from a student to teacher perspective, technology aid, and reflective practices such as research and reflection whilst the interview was taking place. The school drive, on the other hand, is centred on the school culture.

As a final point, the evidence presented has shown that the science teachers’ characterisation of assessment practices as valuable vary and such variation is subject to periodic changes. Assessment practices with formative roles – such as the formative uses of summative tests and other AfL practices – are considered to be valuable.

4.5 Science teachers' rate of use of the different assessment practices

4.5.1 Findings from the questionnaire

The rate at which science teachers use the different assessment practices varies. This variation shows a similar pattern with the way the participants rate these assessment practices. A descriptive statistical analysis reveals that on average the participants utilise Assessment for Learning (AfL) practices [Mean = 3.99] more often than Assessment as Learning (AaL) practices [Mean = 3.60] and Assessment of Learning (AoL) practices [Mean = 3.20] (Table 4.5.1).

	Rate of AfL use	Rate of AaL use	Rate of AoL use
Mean	3.99	3.60	3.20
Std. Deviation	0.64	0.78	0.62
Range	2.75	3.00	3.00

Table 4.5.1: Summary of the descriptive analysis on the rate at which the science teachers use the different assessment practices

Further analysis of these mean scores shows that there are three mild outliers in AfL (Fig 7.9 in the appendix). These are teachers with less than 15 years of teaching experience who do not employ AfL practices as often as the others [Mean score < 3]. Analysis of the individual statements reveals that the participants often use all the assessment practices given in the questionnaire with the exception of 'comparing students'' performances to each other when assigning their overall grades' (Table 4.5.2). It also shows that participants give oral and written feedback more often than any of the other assessment practice given in the questionnaire.

Assessment as Learning practices	Mean score
Provide students with suggestions to enable them to monitor their progress in learning	3.71
Provide opportunities for students to reflect on their work	3.87
Train students to assess tasks done by other students	3.47

Assessment for Learning practices	Mean score
Involve students in the discussion of the standards to be expected in their work	3.93
Give oral and written feedback to students	4.67
Provide time for students to act on feedback	3.87
Use assessment outcome to adapt learning activities	3.67

Assessment of Learning practices	Mean score
Assess students' academic achievement through a written test	3.93
Compare students' performances to each other when assigning their overall grades	2.73
Use assessment results to make decisions about students (e.g putting into groups/sets)	4.13

Table 4.5.2: Mean score of the teachers' responses on the rate at which they use the different assessment practices.

A correlation analysis was carried out to determine the relationship between the rate at which science teachers use the different assessment practices. The Spearman's rank correlation coefficient test shows a strong positive correlation between the rate at which the participants use AfL practices and AaL practices [rs = .608, $p < 0.01$] (Table 4.5.3). The Pearson correlation test, which was carried out alongside the Spearman's rank test, also shows a similar relationship without the outliers [r = .604, $p < 0.01$] (Table 4.5.4)].

	AfL use	AaL use	AoL use
AfL use	1.000	.608**	.228
AaL use	.607**	1.000	.199
AoL use	.185	.199	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.5.3: Spearman's rank correlation coefficient test output showing the relationship between the rate of use of the different assessment practices.

	AfL use	AaL use	AoL use
AfL use	1	.604**	.111
AaL use	.604**	1	.144
AoL use	.111	.144	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.5.4: Pearson correlation test output showing the relationship between the rate of use for the different assessment practices.

Further analysis to determine the relationships between the way in which science teachers rate different assessment practices and how often they utilise them was carried out using the Spearman's rank correlation coefficient test. The test showed that there is a strong positive correlation between how the participants rate the AfL practices and how often they use them [$rs = .527$, $p < 0.01$] (Table 4.5.5). The same applies to AaL practices [$rs =. 556$, $p < 0.01$] and AoL practices [$rs = .620$, $p < 0.01$](Table 4.5.5). There is also a medium positive correlation between how they rate AaL practices and how often they use AfL practices [$rs = .374$, $p < 0.05$], and how they rate AoL practices and how often they use AfL practices [$rs = .378$, $p < 0.05$] (Table 4.5.5). A weak positive correlation exists between how the participants rate AoL practices and how often they use AaL practices [$rs = .294$, $p < 0.05$] (Table 4.5.5).

	AfL use	AaL use	AoL use
AfL rating	.527**	.272	.118
AaL rating	.374*	.556**	.048
AoL rating	.378*	.294*	.620**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.5.5: Spearman's rank correlation coefficient test output showing the relationship between how the science teachers rate and use the different assessment practices.

To sum up, the science teachers often utilised the assessment practices given in the questionnaire with the exception of comparing students whilst allocating assessment

grades. It is evident that there is a positive relationship between their perception of the value of the different assessment practices and their rate of use of such practices.

4.5.2 Findings from the interview

The analysis of the interview data reveals that science teachers utilise a variety of assessment practices which correlate with the activities they discussed as valuable. This was shown in their responses to the question: *Which assessment practices do you often utilise and why?* These practices, as identified in the previous section, can be summed up as AfL and AoL practices denoting assessments for formative purposes and assessments for summative purposes respectively. Both practices were found to be often utilised interchangeably, or one was used as a precursor for the other. The nature of the subject was cited as one of the rationales for this, as shown in this response:

> *There are different ways of assessing students in science as the sciences have a broad element that can be assessed: keywords, texts, diagrams etc … there are lots of opportunities. Lots of opportunities to teach and assess at the same time.*

Findings show that the AoL practices common to most participants include tests, quizzes and exams. Some participants also commented on the use of levelled tasks. The participants that viewed AoL practices such as tests as the main valuable assessment practice indicated that they utilise the outcome of the tests for formative purposes. One of the participants described how the test results are shared with both parents and students, and further intervention was carried out to close the gap. Another participant reported that tests are carried out close to a major exam and the outcome used to plan further intervention.

In addition, it has been shown that the AfL practices common to the participants include book marking with feedback, in-class question and answer sections using strategies such as exit cards system and the traffic light system. They all acknowledged that they often give oral or written feedback to students. There were also comments on the benefits of assessment whilst the learning process is taking

place. Strong emphases were made on the necessity of giving feedback during book marking, and some participants presented them as one process (*book marking and feedback*). One participant went further to describe book marking in these words:

> *Assessment through marking is depressingly time-consuming. Teachers should only mark if students use the information in some way … Otherwise, it's essentially a waste of time, other than for checking that students are completing enough work.*

There is an indication that the use of AfL practices such as the traffic light system or exit cards were more common with the female participants, and the use of exam questions in class was more common with the male participants. As one male participant remarked, '*Are you thinking about traffic light, etc. They will never be found in my classroom! I teach a serious subject to bright boys and get cross at the thought of trivialising it*.' In addition to this variation, there is also a slight dissimilarity in how often individual teachers utilised each assessment practice. A distinction on how often each assessment practice was carried out at both KS3 and KS4 with more tests at KS4 was also shown.

It is obvious from the analysis of the interviews that science teachers' views of valuable assessment practices mirror the assessment practices they utilise. There was no sense of imposition of assessment practices on the teachers interviewed, as one participant declared: '*There are none that we have to use. We're required to use a range of strategies, but there is no prescription of what we have to use*.' Another participant stated how the desire to improve the learning of students led to reflective practices which subsequently led to the choice of assessment practices currently used. It was felt during the interviews that the assessment practices they discussed were the ones they were passionate about. This may perhaps have clouded the possibility of other assessment practices they may be employing involuntarily. However, other rationales such as research findings and ease of assessment practice were presented as the determining factor in the choice of assessment practices. For instance, the idea of marking books and giving feedback was discussed as a practice carried out not as a result of choice but based on the fact that research proves it to be useful, as exemplified in this response: '*all research shows that is where you can make a*

difference, so I don't enjoy it but I do try to give detailed help.' Similarly, views relating to the ease of assessment practices indicate the preference of assessments with little prep as one participant expressed: '*I often use mini whiteboards as it breaks up the lesson and requires no prep. I tend to fall back on those with no prep*.'

Lastly, the evidence presented has shown that there are variations on how the science teachers utilised different assessment practices. This disparity in some way has been influenced by the gender of the teacher, the key stage they teach, their reflective practices, their perception of what counts as a valuable assessment and undeniably the nature of the assessment practice.

4.5.3 Relationship between teachers' conceptions of assessment and their rate of use of the different assessment practices

The analysis to show the relationship between teachers' conceptions of assessment and their views of the different assessment practices shows that there are no significant relationships between the two. On the other hand, there are relationships between teachers' conceptions of assessment and their rate of use of the different assessment practices (Table 4.5.6).

	Rate of use of AfL practices	Rate of use of AaL practices	Rate of use of AoL practices
Improvement	.316*	.407**	-.026
School Accountability	.130	.034	.194
Student Accountability	.006	-.103	.000
Irrelevance	-.465**	-.525**	-.103

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.5.6: Spearman's rank correlation coefficient test output showing the relationship between teachers' conceptions of assessment and the rate of use of the different assessment practices

A medium positive relationship was found between the participants' conception of assessment for improvement and their rate of use of AfL practices ($r_s = .316$, $p < 0.05$), and with their rate of use of the AaL practices ($r_s =. 407$, $p < 0.01$). A strong negative relationship was also found between the participants' conception of assessment as irrelevant and their rate of use of AaL practices ($r_s = -.525$, $p < 0.01$) and a medium negative correlation with their rate of use of AfL practices ($r_s = -.465$, $p < 0.01$).

4.6 Effect of teachers' conceptions of teaching and learning on their attitudes toward assessment

4.6.1 Findings from questionnaire

The statements in the fourth section of the questionnaire (Table 7.2 in appendix) were grouped into five categories according to Teo and Chai (2008). These groups which include the constructivist, directive, transmissive, teacher-centred and rote viewpoints are centred on teachers' perceptions of their role in the teaching and learning process. Whilst the constructivist conception underpins the student-centred view, the rest were based on teacher-oriented views. The descriptive analysis carried out shows that science teachers tend to agree most with the constructivist conception [mean = 3.78, SD = .72] and disagree most with the teacher-centred conception [mean = 1.55, SD = .56] (Table 4.6.1). An analysis of these variables reveals the presence of an outlier on constructivist and teacher-centred conception (Fig 7.10 in the appendix). Both outliers were from the same participant who is a class teacher with 1–5 years teaching experience. This participant mostly agreed that the idea of teaching and learning is mainly teacher-centred and disagreed with the constructivist view.

	Constructivist	Directive	Teacher-Centred	Rote	Transmissive
Mean	3.78	2.55	1.55	2.36	2.05
Std. Deviation	.73	.88	.56	.77	.69

Table 4.6.1: Descriptives of the mean score for the different conceptions of teaching and learning

The Spearman's rank coefficient analysis carried out to show the relationship between the different conceptions shows that there is strong positive correlation between rote and transmissive conceptions of teaching and learning [rs = .511, p < .01] (Table 4.6.2). A medium positive correlation between teacher-centred and transmissive conceptions of teaching and learning [rs = .468, p < .01] and a weak positive correlation between directive and teacher-centred conceptions of teaching and learning [rs = .268, p < .05] were also shown (Table 4.6.2). The Pearson correlation test without the outliers was also carried out. This shows a strong positive correlation between rote and transmissive conceptions of teaching and learning [r = .513, p < 0.01], a medium positive correlation between teacher-centred and transmissive conceptions of teaching and learning [r = .439, p < 0.01] and directive and teacher-centred conceptions of teaching and learning [r = .346, p < 0.01] (Table 4.6.3).

	Constructivist	Directive	Teacher-Centred	Rote	Transmissive
Constructivist	1.000	.137	-.257	-.114	-.231
Directive	.137	1.000	.298*	.142	.017
Teacher-Centred	-.257	.298*	1.000	.138	.468**
Rote	-.114	.142	.138	1.000	.511**
Transmissive	-.231	.017	.468**	.511**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6.2: Spearman's rank correlation coefficient test output for the different conceptions of teaching and learning

In addition, a Spearman's rank correlation analysis was carried out to identify the relationship between the science teachers' conceptions of assessment and their conceptions of teaching and learning. The analysis reveals a medium negative correlation between the conception of assessment for improvement and the conception of teaching and learning as transmissive [rs = -.376, p < 0.01](Table 4.6.4).

	Constructivist	Directive	Teacher-Centred	Rote	Transmissive
Constructivist	1	.146	-.188	-.143	-.229
Directive	.146	1	.346*	.192	.068
Teacher-Centered	-.188	.346*	1	.137	.439**
Rote	-.143	.192	.137	1	.513**
Transmissive	-.229	.068	.439**	.513**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6.3: Pearson correlation test output for the different conceptions of teaching and learning.

	Improvement	School Accountability	Student Accountability	Irrelevance
Constructivist	.194	-.034	-.039	.047
Directive	.159	.127	.111	.060
Teacher-Centred	-.145	.034	-.069	.129
Rote	-.165	-.084	.035	.125
Transmissive	-.404**	-.052	.288	.136

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.6.4: Spearman's rank correlation coefficient analysis output between assessment conceptions and teaching and learning conceptions.

Further analysis was carried out to determine the relationship between science teachers' conceptions of teaching and learning and how they rate different assessment practices. The Spearman's rank coefficient test reveals a medium positive correlation between the participants' ratings of AfL practices and their constructivist views of teaching and learning [rs = . 360, $p < 0.05$]; their ratings of AaL practices and their constructivist views of teaching and learning [rs = . 336, $p < 0.05$]; their ratings of AoL practices and their teacher-centred views of teaching and learning conception [rs

= . 432, p < 0.01]; and their ratings of AoL practices and their transmissive views of teaching and learning [rs = . 334, p < 0.05] (Table 4.6.5).

	AfL ratings	AaL rating	AoL rating
Constructivist	.360*	.336*	-.029
Directive	-.109	.054	-.124
Teacher-Centred	-.213	-.162	.432**
Rote	-.010	-.231	-.048
Transmissive	-.216	-.275	.334*

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6.5: Spearman's rank correlation coefficient output for the relationship between the science teachers' conceptions of teaching and learning and their ratings of the different assessment practices.

	Rate of use : AfL	Rate of use: AaL	Rate of use: AoL
Constructivist	.260	.210	-.097
Directive	.072	-.023	.117
Teacher-Centred	-.091	.050	.551**
Rote	-.110	-.245	-.019
Transmissive	-.154	-.182	.299*

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6.6: Spearman's rank correlation coefficient analysis output for the relationship between the science teachers' conceptions of teaching and learning and the rate at which they use the different assessment practices.

The same inferential statistical analysis shows a relationship between science teachers' conceptions of teaching and learning and how often they use different assessment practices. A strong positive correlation exists between the rate at which the participants use the AoL practices and their teacher-centred conception of teaching and learning [rs =. 551, p < 0.01] and a weak positive correlation exists

between the rate at which they use the AoL practices and their transmissive conception of teaching and learning [rs = .299, $p < 0.05$] (Table 4.6.6).

It is clear from this convenient and small-scale study that correlations exist to an extent between the science teachers' conceptions of teaching and learning and their attitudes towards assessment in general.

4.6.2 Findings from interview

The participants described the idea of teaching and learning in two forms: one as two separate concepts and the other as one concept. This was shown in their responses to the question: *How would you define teaching and learning*? In the case of two separate concepts, some participants described teaching separately from learning. Teaching was described as the process of transmitting information to students, or, as one participant described it, a process of '*students acquiring information from other sources*.' Learning was described as the process of students absorbing the information presented to them and utilising these sources. Most of the participants argued that learning will only have taken place when students are able to utilise the information transmitted to them. On the other hand, teaching and learning were described as one concept. To exemplify, one participant described it as 'an *expert imparting skills on learners so they are able to learn for themselves and create solutions to solve their own problems.'*

The analysis of the interview findings suggests that the science teachers have broad, varied and similar views of teaching and learning. These can be thematised into a teacher-centred process and a student-centred process. On the whole, the majority of the teachers interviewed believed in a student-centred teaching and learning process where students are encouraged to construct ideas by finding information or solutions for themselves. For instance, one participant stated: '*I prefer pupils to find out for themselves… So, I plan an activity or practical they then come up with the conclusions/learning.'* However, they all agreed that this should be done with limitations. They were of the view that the nature of the subject suggests that there are concepts or topics that should have more teacher's input. Some comments to illustrate this include:

A healthy mix is required. Teacher direction is vital for some key and/or complex ideas. Students' construction instils some independence.
– Participant A

I think constructivism has some nice ideals but I think has to [be] applied carefully. For instance, in science, I can't expect students to take the mental leap that Newton or Darwin did. It took them many years to construct their ideas. – Participant B.

Although most of the participants subscribed to the idea of a constructivist classroom, the male participants were less inclined to it. One male participant described teaching and learning as solely a teacher-led process and disapproved of the idea of students constructing the ideas themselves. As cited by this participant, '*there is a reason why we remember those who constructed the ideas of science as geniuses*.'

Furthermore, the analyses of the interviews reveal a link between science teachers' attitudes to assessment and their conceptions of teaching and learning. It was obvious that the discussions of teachers with a more teacher-centred view of teaching and learning were more inclined to regard assessment as a school accountability tool, and their assessment practices were more inclined to be AoL practices. Conversely, advocates of the constructivist classroom projected assessment as an improvement and student accountability tool. Their discussions of assessment practices promoted the AfL practices.

Notwithstanding, the outcomes of the interview showed that irrespective of teachers' views on teaching and learning, both AfL practices such as marking and feedback in books and AoL practices such as tests were employed. Variation, however, occurs to the extent to which teachers utilise these practices and other practices within these paradigms. The advocates of a constructivist learning environment employed more AfL practices such as the use of traffic light and exit cards, whilst the advocates of the teacher-centred learning environment employed more AoL practices such as short quizzes.

Therefore, the evidence presented in this section suggests that the science teachers' conception of teaching and learning influence their attitude towards assessment. They have two common conceptions of teaching and learning with the student-centred conception more prevalent than the teacher-centred conceptions.

4.7 Effects of Science teachers' experiences on their attitude towards assessment

4.7.1 Findings from the questionnaire

The effects of teachers' roles in the school, type of school and the region they work in, years of teaching experience and the highest education attained were considered as factors that could have an impact on teachers' general attitudes towards assessment. The first series of the Kruskal-Wallis H tests were conducted to determine the effects of these factors on science teachers' conceptions of assessment. The test shows that there are no statistically significant differences in mean scores between the different years of teaching experience group (NQT, 0-5 years, 6-15 years and over 15 years) for each conception of assessment. Similarly, there are no statistically significant differences in mean scores between the different types of schools (Academy, Independent, Comprehensive and others such as special schools) and between the different regions (London, South-east, South-west, Midlands, North and Eastern) for each conception of assessment. However, the Kruskal-Wallis test reveals a significant difference in mean scores between the different educational status groups (Bachelor's, Master's, Doctorate) for the conception of assessment as irrelevant [$\chi 2$ (2) = 6.51, p = 0.04]. There are no statistically significant differences in mean scores between the different educational level groups for the other conceptions of assessment (Table 4.7.1).

Further tests were carried out to determine the differences among the groups. The Mann-Whitney U tests show that the Master's degree holders have a statistically significant higher mean rank for assessment as irrelevant than the Bachelor's degree holders [U = 105.5, p = .030] and, Doctorate degree holders [U = 20, p =.021] (Table 4.7.2).

	Improvement	School Accountability	Student Accountability	Irrelevance
Chi-Square	3.39	2.57	0.85	6.51
df	2	2	2	2
Asymp. Sig.	0.18	0.28	0.65	0.04

Table 4.7.1: Kruskal-Wallis Test output showing the differences in mean scores between the different educational level groups for each conception of assessment

	Role	N	Mean Rank	Sum of Ranks
Bachelor's vs. Master's	Bachelor's degree	24	16.90	405.50
	Master's degree	15	24.97	374.50
Master's vs. Doctorate	Master's degree	15	13.67	205.00
	Doctorate	7	6.86	48.00

Table 4.7.2: Mann-Whitney test output showing the statistical differences in mean ranks for assessment as irrelevant between the Master's degree group and the Bachelor's and Doctorate degrees groups.

Further Kruskal-Wallis test reveals that there is a statistically significant difference in mean scores between the different roles for the conception of assessment as improvement [$\chi 2$ (2) = 14.985, p = 0.002] (Table 4.7.3). However, no statistically significant differences in mean scores were seen between the different roles for the other conceptions of assessment (Table 4.7.3). The Mann-Whitney U tests carried out to determine the differences in mean scores between the different groups for assessment as improvement show that the SLTs have a statistically significant higher mean rank than class teachers [U = 5.5, p = .001], deputy subject leaders/key stage coordinators [U = 6.0, p = .019], and subject leaders [U = 18.5, p = .004] (Table 4.7.4). In addition, the subject leaders have a statistically significant higher mean rank than class teachers [U = 54, p = .017] (Table 4.7.4).

	Improvement	School Accountability	Student Accountability	Irrelevance
Chi-Square	14.985	0.703	2.805	2.491
df	3	3	3	3
Asymp. Sig.	0.002	0.873	0.423	0.477

Table 4.7.3: Kruskal-Wallis Test output showing the differences in mean scores between the different roles for each conception of assessment.

	Role	N	Mean Rank	Sum of Ranks
Class teacher vs SLT	Class teacher	13	7.73	100.50
	SLT	8	16.31	130.50
Deputy subject leaders or Key stage Coordinators vs SLT	Deputy subject leaders or Key stage Coordinators	6	5.17	31.00
	SLT	8	9.25	74.00
Subject leaders vs SLT	Subject leaders	17	10.26	174.50
	SLT	8	18.81	150.50
Class teacher vs Subject leaders	Class teacher	13	10.96	142.50
	Subject leader	17	18.97	322.50

Table 4.7.4: Mann-Whitney test output showing the statistical differences in mean ranks for assessment as improvement between the different roles

The second series of Kruskal-Wallis tests were carried out to determine the differences between the different groups on their ratings of the different assessment practices as well as their rate of use of these practices. The tests reveal that there are

no statistically significant differences in mean scores between the different roles, the different regions and the different educational level groups on their ratings of the three assessment practices. The tests also show that although there are no statistically significant differences in mean scores between the different years of teaching experience groups on the participants' views of AfL and AaL practices, there is a statistically significant difference in the mean scores for AoL practices [$\chi 2$ (2) = 8.970, p = 0.030] (Table 4.7.5).

	AfL ratings	AaL ratings	AoL ratings
Chi-Square	5.09	2.85	8.97
df	3	3	3
Asymp. Sig.	0.17	0.42	0.03

Table 4.7.5: Kruskal-Wallis Test output showing the differences in mean scores of teachers' ratings of the different assessment practices between the different years of teaching experience groups.

Further tests were carried out to determine the differences in mean scores between the groups. The Mann-Whitney U tests reveal that NQTs have a statistically significant lower mean rank for AoL ratings than teachers with 1–5 years teaching experience [*U* = .000, p = .023] and teachers with 6–15 years teaching experience [*U* = 1.5, p = .028], whilst teachers with over 15 years experience have a statistically significant lower mean ranks for AoL ratings than teachers with 1–5 years teaching experience [*U* = 39.5, p = .038] (Table 4.7.6).

	Teaching experience	N	Mean Rank	Sum of Ranks
NQT vs 1 - 5 years	NQT	2	1.50	3.00
	1 - 5 Years	10	7.50	75.00
NQT vs 6 - 15 years	NQT	2	2.25	4.50
	6 - 15 Years	19	11.92	226.50

1-5 years vs over 15 years	1 - 5 Years	10	16.55	165.50
	Over 15 Years	15	10.63	159.50

Table 4.7.6: Mann-Whitney test output showing the statistical differences in mean ranks between the different years of teaching experience for AoL ratings.

Further Kruskal-Wallis test reveals that there is no statistically significant difference in mean scores between the different type of schools for: AfL ratings [$\chi 2$ (2) = 5.566, p = 0.135] and AoL ratings [$\chi 2$ (2) = 5.312, p = 0.150] (Table 4.7.7). However, there is a statistically significant difference in mean score between the different types of schools for AaL ratings [$\chi 2$ (2) = 9.889, p = 0.020] (Table 4.7.7). The Mann-Whitney U tests carried out subsequently show that teachers working in independent schools have a statistically significant lower mean rank for their AaL ratings than teachers working in academies [*U* = 11.500, p = .010], teachers in comprehensive schools [U = 10.00, p = .006], and teachers working in other schools such special schools [U = 1.00, p = .034] (Table 4.7.8).

	AfL ratings	AaL ratings	AoL ratings
Chi-Square	5.566	9.889	5.312
df	3	3	3
Asymp. Sig.	.135	.020	.150

Table 4.7.7: Kruskal-Wallis Test output showing the differences in mean scores of teachers' ratings of the different assessment practices between the different school groups.

	Teaching experience	N	Mean Rank	Sum of Ranks
Academy vs Independent	Academy	18	13.86	249.50
	Independent	5	5.30	26.50

Independent vs Comprehensive	Independent	5	5.00	25.00
	Comprehensive	19	14.47	275.00
Independent vs Others	Independent	5	3.20	16.00
	Others	3	6.67	20.00

Table 4.7.8: Mann-Whitney test output showing the statistical differences in mean ranks for AaL view between teachers working in the different school groups.

Finally, the Kruskal-Wallis tests carried out to determine the differences in the rate of use of the different assessment practices show that there is a statistical significant difference in the mean scores of participants in the different types of schools on the rate at which they carry out AaL practices [$\chi 2$ (2) = 9.992, p = 0.019] (Table 4.7.9). No statistically differences were found for AfL practices [$\chi 2$ (2) = 7.089, p = 0.069] and AoL practices [$\chi 2$ (2) = 6.364, p = 0.095] (Table 4.7.8). Similarly, no statistical differences were found for the others factors considered.

	AfL use	AaL use	AoL use
Chi-Square	7.089	9.992	6.364
df	3	3	3
Asymp. Sig.	0.069	0.019	0.095

Table 4.7.9: Kruskal-Wallis Test output showing the differences in mean scores for the rate at which teachers utilise the different assessment practices in the different school groups.

Further tests were carried out to determine the differences in mean scores between the different school groups. The Mann-Whitney U tests reveal that participants working in independent schools have a statistically significant lower mean rank on the rate at which they employ AaL practices than those working in Academies [U = 18.5, p =

.044], in comprehensive schools [U = 12.0, p = .010], and in other schools [U = 8.00, p = .046] (Table 4.7.10).

	Teaching experience	N	Mean Rank	Sum of Ranks
Academy vs Independent	Academy	18	13.47	242.50
	Independent	5	6.70	33.50
Independent vs Comprehensive	Independent	5	5.40	27.00
	Comprehensive	19	14.37	273.00

Table 4.7.10: Mann-Whitney test output showing the statistical differences in mean ranks on the rate at which teachers carry out AaL practices in the different school groups.

As has been shown above, teachers' experiences in some way affect their attitudes towards assessment. The uncertainty in these findings is possibly fuelled by the limitation of the sample size.

4.7.2 Findings from the semi-structured interview

The analysis of interviews of the science teachers from the online discussion forum presents the factors that affect science teachers' attitudes towards assessment under two themes: personal and external factors.

The personal factors are the ones that characterise the individual and include factors such as the role of the teacher, their years of teaching experience and their previous/current experience. Firstly, findings show that all the participants with a leadership role such as heads of departments emphasised the importance of assessment for accountability purposes. Most of them maintained that it is difficult to escape from the accountability bubble. However, when asked to discuss the factors that influenced their views on assessment and its practices, none of them cited their

role. The influences cited include research, teaching experience, self-reflection, school CPD and CPD through the social media. The assessment practices they carry out more often varies and it was not obvious that these were linked to their role. However, one participant with the responsibilities that exclude departmental leadership talked about the impact of role on assessment views and understanding in these words: '*As a ... mentor, yes I have to keep up to date with the latest practices in order to advise and assess them properly against the new teaching standards'*.

Secondly, the lengths of teaching experience for the participants were linked to the possibility of having a leadership role. The higher the years of teaching experience, the more likely it was that they had a teaching and learning responsibility. It was not evident from the interviews whether the length of teaching experience had an impact on teachers' views of assessment. The participants that presented experience as a factor discussed it in terms of their exposure to certain events or ideas. A typical example can be found in this response to what influences assessment views: '*it's really just through becoming more experienced – knowing what motivates students. Any teacher ought to be able to recognise these*.' One participant cited the experience of the post-lesson observation discussions had during the teacher-training period and as a qualified teacher. Two other participants commented on the impact of the CPD done through social media on their attitude towards different practices. Besides these findings, one participant discussed the relationship between the years of teaching experience and teachers' views of assessment. The participant is of the view that older teachers are more into assessment for summative purposes in these words: '*the older teachers view assessment as more of a number crunch whilst the younger teachers are more into how to use the feedback to improve learning.'*

The external factors, on the other hand, include the nature of the assessment practice, research findings, and influences from the school community such as other teachers, parents, students, school authorities and school ethos. Some participants discussed how research findings influenced their attitude towards assessment. Whilst describing marking and feedback as mentioned earlier, one participant stated: '*All the research shows that this is where you can make a difference, so I don't enjoy it but I do try to give detailed help*.' Another participant said this in response to a question on the

reasons why views on assessment have changed*: 'I think it was my depth of knowledge of evidence-based research on assessments and feedback'.*

The ease of the assessment practice was also raised as a factor that influences teachers' attitudes towards assessment. As one participant pointed out in the description of valuable assessment practices, *'during lessons I like anything quick and easy*.' When asked the reason for the choice of an assessment practice another participant remarked: '*it is aided by technology, e.g. Quick Key app for multiple choice testing as well as Google forms*.'

Findings also suggest that the type of school can influence their attitude towards assessment. Although all participants discussed the use of assessment for school accountability purposes, interview findings showed that participants from independent schools discussed assessment as more for school accountability purposes than the other groups (academy and comprehensive schools). This view could be limited, bearing in mind that only two teachers from such schools were interviewed. However, what was clearly evident was that the school ethos affected teachers' views on assessment and the assessment practices they employed. This was shown in one participant's response when asked whether their current view of assessment practices had always been the same: '[*my*] *view only changed recently when our science department started doing this*.' Another participant emphasised the role of the school in these words: '*As head of department I am held accountable, but it is more that the whole school is being moved that way.'* There were instances where participants cited their personal views and the views imposed by the school policies. In such instances, the assessment practices they employ are linked to the imposed views as exemplified in this response:

> *The school wants us to level some of the students' extended writing and give them written feedback. I don't see how this really helps students because they focus more on the levels and not on the feedback. But I don't have a choice. I have to do it because that is what the school wants. Would prefer not to level the written task and just give feedback that students will act on.*

The above findings support the findings from the questionnaire that teachers' experiences can affect their attitudes towards assessment.

4.8 Conclusion

From the above discussions, it is clear that the science teachers that took part in this study have varied attitudes towards assessment and varied factors affect these attitudes. It is also evident that these teachers exhibit multiple attitudes towards assessment, which is influenced by different factors. Although these findings have been deduced from both the quantitative and qualitative studies, it still cannot be generalised for all science teachers. The quantitative data is limited by size and the qualitative data is limited by the subjective nature of the data.

Chapter 5: Discussion of findings

Introduction

Different themes emerged from the findings of this study of science teachers' attitudes towards assessment. This chapter will discuss these themes, their place in the existing knowledge, their contribution to knowledge, the gaps they could not fill and the new ones they created. The themes are centred on conceptions of assessment, the valuing and rate of use of different assessment practices and the conceptions of teaching and learning, all of which constitute the attitude towards assessment as shown in fig 2.4.

5.1 Science teachers' conceptions of assessment

Teachers' conceptions of assessment centre around their beliefs regarding what assessment is and for which purposes it should be used (Brown and Gao, 2015). Findings show that respondents have multiple and diverse conceptions of assessment. They discussed assessment as a teacher-oriented process for teacher benefit, a teacher-oriented process for student benefit and a student-oriented process for student benefit. Their perceptions of the motives behind assessment vary and overlap. These have been summarised as assessment as an improvement tool, a learning tool, an accountability tool and an unnecessary tool. This is similar to Brown (2002)'s description of assessment conceptions: *assessment for improvement, for school accountability, for student accountability and as irrelevant*. However, the 'student accountability' and 'school accountability' conceptions were merged in this study and the 'learning' conception was separated from the 'improvement' conception. This is also in line with Remesal's (2011: 479) discussion of assessment conception based on the four dimensions of teachers' beliefs about assessment, which include: *the learning process, the teaching process, accreditation of learning and accountability of the professional teaching activity*.

5.1.1 Assessment as an improvement tool

The participants described assessment as a teacher and student improvement tool that enables teachers to modify the teaching and learning process for better advantage.

This also includes an improvement in both teachers' and students' subject knowledge and teachers' knowledge of students' learning needs. These are equally beneficial to both stakeholders, thereby further explaining why teachers discussed assessment as a student and teacher improvement tool. Yet, little variation occurred, as teachers who were strong advocates of peer assessment seem to discuss assessment as more of a student improvement tool. This is as a result of the role of peer assessment in the development of evaluative skills of learners (Booth *et al*, 2014), which enhances their self-monitoring skills (Dixon *et al*, 2011; Black *et al*, 2003). This possibly results in the shift of some assessment responsibilities from the teacher to the student.

It was evident in the findings that participants agreed with all the statements that describe assessment as an improvement tool in the questionnaire. The strength of the agreement was at its greatest with the belief that assessment is integrated into the teaching practice. Although limited by the sample size, this is further reinforced by the findings from the interviews where teachers presented assessment as a diagnostic tool that provides information for the adaptation of the teaching and learning process. Their characterisation of assessment extended to its description as a progression-aiding process, or tool centred on the collection and utilisation of information to boost progress.

In addition, the belief in assessment as an evaluative tool as portrayed by some of the participants contributes to this assessment conception. It is without a doubt a well-known fact that teachers often measure the effectiveness of their teaching by how their students are able to apply or describe the new knowledge gained. This leads to an evaluation of their teaching as well as an adjustment if needs be. Such an outcome aims to improve students' learning, thereby re-emphasising the role of assessment as an improvement tool for students. This, in the long run, could lead to effective curriculum development, which will then be beneficial to both the teacher and future students. Assessments in such instances, as Black *et al* (2003) maintains may well serve a formative role for the teachers without a direct impact on their current students; thus re-accentuating the role of assessment as an improvement tool for teachers.

All of these beliefs and ideas possibly stem from the fact that assessment is usually not seen as a separate entity in education but as part of the learning process (Absolum, 2011; Allanson *et al* 1990). It should not and does not stand on its own, as it is in tandem with curriculum and instruction as the central components of educational practices (Pellegrino, 2012). This further explains the argument made by a participant that assessment is incomplete without the ability to utilise the outcome. This outcome, as it unfolded in this study, can be both for student and teacher improvement thereby confirming the idea that assessment can be student or teacher-oriented (Harlen, 2007). Although, all assessment strategies share a common principle (Pellegrino *et al*, 2001); their functions will influence their structure (Taras, 2009). Assessment can thus be viewed as a means for investigating what students have or have not learnt, how they learn and how to further improve their learning at any given instance.

The participants tend to agree that assessment is for improvement purposes more than for any other purpose. This is in line with previous research which showed that teachers often exhibit higher scores in assessment for improvement and lower scores in assessment as irrelevant (Brown 2002, Calveric, 2010, Moiinvaziri, 2015). This inference also supports Drummond's (2003) assertion that assessment forms part of our daily routine as we strive to extend learners' knowledge through better teaching and learning processes. The campaign for Assessment for Learning (AfL) may have possibly driven more teachers into accepting the assessment for improvement purposes. As Marzano (2006) points out, formative assessments have been the popular research focus on classroom assessments. Although the participants are dispersed across England, there were still similarities in their views. This supports Brown and Gao's (2015) argument that more people even in diverse locations or cultural settings will have similar conceptions of a phenomenon, as it becomes more stable in both structure and function over a period of time. The participants from the online discussion forum have similarities resulting from their interest in professional discussion outside the classroom, though the same cannot be said for the sample of science teachers from East London schools. Thus, it will be logical to suggest that the popularity of an assessment conception is influenced by the campaign around it. To this end, it is rational for school leaders and policy makers to carefully consider the campaign and training they offer prior to the introduction of new assessment policies.

In spite of the fact that this drive for formative assessment has proven to have an impact on teachers' beliefs about assessment, there are still teachers who have a different view. Assessment for improvement has a standard deviation of 0.72 in the findings from the quantitative study in this research. This indicates that although most teachers on average believe that assessment is for improvement, the extent of their agreement varies. This suggests that there are other factors that possibly drive conceptions of assessments. However, it is obvious from the above discussion that the science teachers' conception of assessment as an improvement tool or process was a popular but not imposed opinion.

5.1.2 Assessment as an accountability tool

Assessment was viewed as an accountability tool for the different stakeholders in the school system; these stakeholders include the students, parents, teachers and the school authorities. Assessment in this study was in some instances described in terms of test-taking and results fed back by teachers to students and the school, which subsequently uses the information to report to parents. This demonstrates the interconnected nature of accountability purposes, although less emphasis was placed on accountability purposes for parents and teachers.

The participants viewed assessment as an evaluation tool for themselves, which enables them to ascertain how well their teaching has been received and how well their students are doing. They also view assessment as an information generating tool for parents. The lesser reference made to these stakeholders further supports teachers' belief that assessment should be more student-oriented. If assessment in the UK is commonly viewed as the 'judgement of students' work' (Taras, 2005:467), then the fact that school reports are written by teachers and made available to parents makes it logical to suggest that both stakeholders, including the school authorities, can be grouped as one. This can be justified by cases found in the interview where participants discussed assessment as providing information for schools, which is used for different purposes. The similarity in participants' views, especially as found in the interview processes, perhaps indicates that the conceptions of assessment for accountability purposes were not differentiated by the teachers but held as one view. This is similar to Remesal (2011), who did not differentiate between the

accountability purposes, but explored them as one entity which he further merged with the conception of assessment as a certification tool to form the societal conception of assessment. Brown (2002; 2004; 2011), on the other hand, discussed both the school and student accountabilities. Categorising them as one will possibly encourage the discussion of the role of the other stakeholders such as the parents and the government whose actions are often the initiator of the pressure associated with school accountability.

In other instances, the accountability rationales of assessment were viewed differently by the participants. Some participants promoted assessment as more of a student accountability mechanism, whilst others were more in favour of school accountability. Individual differences which include external influences may have played a part here. Instances were given in the interview of where assessments were solely carried out to gather information for the school, and in other instances, this was done solely for the students' benefits. In spite of these, most participants' belief in assessment for school accountability and student accountability were generally found to be just about the same, although assessment for school accountability was found to be slightly greater than student accountability from the analysis of the questionnaire data. This, besides the limitations of the small convenience sample, possibly results from the unavoidable wave of the Global Educational Reform Movement (GERM) as discussed by Sahlberg (2011). The test-based accountability associated with the GERM promotes teaching to the test (Sahlberg, 2011) and assessment in this case may determine readiness for, or predict grades in the high-stake tests. In addition, the reform that encourages teaching for preset outcomes limits risk-taking in the teaching and learning process (Sahlberg, 2011), of which assessment is an essential part of. Ofsted, school league tables and performance related pay could also play a significant part in this finding. These inevitably set performance targets and indicators and, as Ball (2003) argues, lead to the generation of practitioners who model themselves as responses to performance demands. These override their personal beliefs and make them prone to becoming more calculating individuals with the quest for excellence (Ball 2003). It is now common knowledge that schools are judged based on how well their students are performing in high-stake exams. Similarly, teachers are judged by how well their students do.

Furthermore, there is a great disparity amongst teachers' views on assessment for student accountability, as the questionnaire analysis revealed contrasting views on the components of this conception. Whilst they disagreed that assessment is about assigning grades or levels to students' work, they agreed that assessment places students into categories. This disparity can be considered to be contradictory. Most schools use the setting or banding system either for class setting and/or setting the examination tier for students. Assessment is the only avenue to create the information needed for these purposes, hence the view that assessment places students into categories. However, assessment can only achieve this purpose by making judgements on the quality of work done by the students. Such judgments, one can argue, can involve the assignment of some sort of level or grade to students' work. This presents an uncertainty regarding the view of teachers on this belief. This contradiction, however, can be justified by the meanings given to the statements. The syntax of the statements may have possibly influenced the participants' responses, taking into account the likelihood that these statements could have been interpreted differently. Whilst they disagreed that 'assessment is assigning a grade or level to students work', perhaps they may reconsider their views if the statement reads 'assessment *includes* assigning a grade or level to students' work'. This was an inference that was evident in the interviews, as some participants discussed assessment as involving the assignment of grades or levels to work. Assessment was also described as a test/exam in which the end point will be the generation of levels or grades, but which also included other processes such as marking with formative annotations.

Slight disparities also occurred with the conception of assessment for school accountability, as the questionnaire analysis reveals. The participants agreed that assessment provides information on how well a school is doing, but slightly disagreed that it is an accurate indicator of school quality. This can be linked to the idea that assessment is part of the central core of educational practices (Pellegrino, 2012) and as such can only contribute to the overall quality of the system. This is further reinforced by teachers' acknowledgement that assessment is carried out to meet schools' accountability purposes and in some instances can be done unwillingly, which affects the quality of the outcome. The unwillingness to carry out the assessment practice may perhaps be a form of quiet resistance to assessment. Resistance to change usually results from the effort to retain current situations which

could be perceived as more appropriate or conducive than the uncertainty of the future (Smit 2003). In the case of this study, the type, timing and frequency of the assessment generated this resistance.

Based on the above discussions, it can be argued that assessment was considered as an accountability tool or process with influence mostly from the stakeholders in the educational system.

5.1.3 Assessment as a learning process

The science teachers in this study discussed assessment as a learning process for students and teachers. Unlike the assessment conception for improvement, this conception centres on the belief that assessment helps teachers to learn more about themselves and their students in addition to helping students to learn. As Brown (2004b) suggests, teachers associate improvement to the accountable actions of the school and the teachers. Learning, on the other hand, is what should take place when the gaps between what one knows and can do, and what one should know and do are made evident (Absolum, 2011).

The notion of assessment as a subject knowledge development tool as portrayed by some of the participants could be a contributor to this conception of assessment. The assessment process helps in this regard, as the act of trying to comprehend the information presented by students generates the thinking process that aids learning. As Pritchard (2014) points out, learning as a process leads to the acquisition of new knowledge or skill which can be acquired through experiences. Such experiences are not limited to classroom teaching experience but extend to experiences outside the formal learning environment (Pritchard 2014). The creation of the assessment tasks and the aim to understand the assessment criteria exposes teachers to an experience that contributes to their enhanced knowledge, which may also add to their professional development. This is possibly so because the principles of AfL, as explained by Swaffield (2009), extend from students' learning to include professional and organisational learning that encourages teachers to take on the learning role, develop robust questions, and review and share outcomes. Similarly, teachers' involvement in multiple types of assessment with the view to produce a complete

summary of students' learning exposes them to a variety of knowledge and thinking skills (Abell and Siegel, 2011), which creates the experience that leads to the acquisition of new knowledge.

Students, on the other hand, use assessment as a learning process in more directly individual ways. Peer assessment was portrayed as an assessment that aids the development of students' knowledge and skills. It encourages active participation of students in the assessment process in view of the fact that it promotes the discussion of assessment criteria. Although emphases were made on the need to train students for effective implementation, the benefits of such assessment for both students and teachers outweighs the time taken in the training process (Isaacs *et al*, 2013). In spite of this, the lack of strong popularity associated with such an assessment possibly suggests that time and the ease of the assessment influence its usage. The limited curriculum time often experienced in KS4 science, and the pressure of completing the curriculum content before the high-stake test, influence the demand for peer assessment. This may, therefore, explain why there are instances according to this study's findings, where the motive of peer assessment is to reduce teacher workload. This finding is not unusual, as one of the benefits of peer assessment – as discussed by Isaac *et al* (2013) is the provision of time for teachers to lean back from the delivery role and take on the role of observing students. In essence, engage in assessment through observation. Regardless of this, the use of assessment as a learning process may still be achieved if students are engaged in the process and prior training is given to students.

Furthermore, the idea that some assessment tasks can provide the opportunity for students to be familiar with the nature of high-stake exams identifies it as a learning tool. Hui (2012:381) presents the conception of assessment as a tool 'to prepare students for future challenges' as the missing conception linked to assessment for improvement. I will, however, argue that if learning leads to the acquisition of new knowledge (Pritchard (2014), then teachers' belief that classroom assessment aids students' understanding of the demands of high-stake exams and how to handle them identifies assessment as a learning tool.

Assessment was also viewed as a learning process that aims to bridge the gap between students' comprehension of the different strands of the science subject. The coursework practical investigations, which are assessment tasks carried out as part of some science GSCE qualifications, were described as activities that help students to appreciate the importance of practical work and to make links between the practical and theoretical elements of science learning. On the other hand, such tasks were criticised by some respondents, as they were viewed as activities that fail to allow students to apply their knowledge. This shows two contrasting experiences of using the same assessment process. In line with this finding, and the idea that previous experiences with a concept or object affect subsequent attitudes towards them (Richardson. 1996), it can be argued that the usefulness of an assessment task depends on the experience of the assessor with such tasks. Therefore, a positive attitude towards an assessment practice is influenced by a positive experience, which like every other experience creates a learning opportunity.

5.1.4 Assessment as an unnecessary and/or imprecise tool

The perception of assessment as irrelevant yielded the lowest mean score, indicating that teachers are less likely to believe that assessment is irrelevant. Yet, most participants believed that they should take into consideration the imprecision involved in all assessment. This implies that the participants agree that different assessments have limitations and as such should not be viewed as a perfect account of students' learning. It supports the idea that assessment helps teachers to recognize what the students know and can do but does not present a straight pathway into students' minds (Pellegrino *et al*, 2001).

Some of the participants agreed that assessment is an imprecise process, although, there were some who disagreed with the view. Possibly the advocates of assessment as an imprecise process agreed that the information generated from the process, as Pellegrino *et al* (2001: 40) describes it, is 'typically incomplete, inconclusive and amenable to more than one explanation'. This is a view that is supported by Drummond's (2003:14) assertion that 'assessment is essentially provisional, partial, tentative, exploratory and, inevitably, incomplete'. This further explains why Pellegrino (2012) believes that assessment processes cannot be described as

straightforward as measuring distance, since they assess mental representations and processes which are not seemingly visible. Accordingly, it is fair to argue that teachers' understanding of what constitute an assessment or a valuable one differs.

However, there seems to be a more unified view of the participants' perception of assessment as irrelevant, as showed by a lower standard deviation of 0.52. This could possibly be explained by the view depicted in the interview by teachers that there are assessments that are beneficial to learners and some of which are not beneficial. This is also supported by teachers' disapproval, as seen in the questionnaire, that assessment is '*unfair to students*' and '*interferes with the teaching*'. This was not unforeseen, as the respondents' agreement that 'assessment is integrated into teaching practice' was the strongest. In addition, as earlier discussed, assessment was described as a teacher and student improvement tool that provides information for subsequent teaching and learning. It is, therefore, an indisputable fact that teachers essentially consider assessment to be useful.

Assessments in some occasions were also deemed unnecessary, as the interview findings reveal. Teachers can carry out some assessment practices unwillingly and this often led to the generation of unfavourable outcomes. Most of these assessment practices are school cultural practices, indicating that teachers may not necessarily be in support of them. Such assessments are carried out to satisfy the purpose of 'ticking boxes', as instructed by the school. In other instances, they are teachers' own initiatives that were not properly implemented. These, therefore, suggest that the attitudes of teachers towards assessment are not always positive and the negativity involved can be influenced by the nature of the assessment or the ways in which teachers implemented it.

5.1.5 Science Teachers' interrelated conception of assessment

It has been established that the science teachers in this study not only have varied conceptions of assessment but also possess multiple conceptions of assessment. This is in line with other findings where teachers have shown a multiplicity of conceptions of assessment (Brown 2011; Resemal, 2011; Leong, 2014). Teachers engage or create discourses of assessment at different levels (Rea-Dickens, 2004) and this possibly

encourages a multiplicity of conceptions of assessment. The 'Spearman's rank correlation coefficient' finding shows that there is a medium negative relationship between assessment for improvement and assessment as irrelevant. Similar results were revealed by the Pearson correlation test. This finding is in line with Murray's (2013b) conclusion that there is a significant similarity in the correlation coefficients given by the Spearman Rho and Pearson coefficient tests involving Likert values. Therefore, I can conclude that the use of the non-parametric statistical analysis did not necessarily limit my inferences.

The negative relationship between assessment for improvement and assessment as irrelevant shows that teachers who view assessment for improvement tend to disagree with the idea that assessment is irrelevant. This is in line with the findings of Brown (2011) and Calveric (2010). The view of assessment as an improvement tool signals positive views of assessment. It is, therefore, unlikely that teachers in this school of thought will have a contradictory view on what they believe. As earlier raised, understanding how assessment can be used to improve the learning of students may more likely cloud the view that assessment is irrelevant. However, the association is not strong, implying that this may not be true in all cases. This suggests that there are possibly other underlying factors involved in shaping science teachers' conceptions of assessment. As was evident in the interview findings, teachers discussed assessment as a useful tool, with the criticisms centred on the motives that lay behind the use of different assessment practices and how they are carried out and not on assessment as a process itself. Their descriptions of assessments of insignificant value were centred on the nature of these assessment practices and the rationale for carrying them out. In view of this, I can argue that one of the underlining factors affecting teachers' conceptions of assessment, which in turn affect their attitudes towards assessment, is the nature of the assessment task and the motives for engaging in the process or using the tool.

The science teachers' descriptions of an assessment rationale were often multiple rather than singular. They discussed different assessment tasks as providers of the opportunities for varied assessment purposes to be achieved. This further reinforces the idea that they have multiple conceptions of assessment. Although one cannot ignore the limitation of the sample size in the quantitative data, the lack of a strong

correlation between the different conceptions of assessment and the interview findings further confirm that teachers in this sample had multiple conceptions of assessment, which informed their attitude towards assessment. As Lambert and Lines (2000) points out, both summative and formative assessment are necessary, as these different assessment paradigms serve completely different purposes, are not accorded equal value by the 'system' and so coexist in a state of tension. On the other hand, Remesal (2011) presents the idea that the different dimensions of teachers' beliefs in assessment – that intertwine to form their conceptions – cannot be considered as an individual entity when assessment and the school's role are taken into consideration. Given this, I can argue that the conflict between the different assessment conceptions that the science teachers have may possibly affect their attitudes towards assessment. The variations in their attitudes towards assessment would, therefore, be influenced by the strength of their agreement to a particular conception.

5.2 Science teachers' attitude towards assessment practices

The discussions on assessment practices were centred on the use of assessment for learning, for improvement and for accountability purposes. In that regard, the variety of assessment practices the science teachers employed will be discussed using Earl's (2003) categorisation of classroom assessments which include: Assessment for Learning (AfL), Assessment of Learning (AoL) and Assessment as Learning (AaL).

5.2.1 AfL as a common practice for science teachers

AfL practices were rated the most valuable and the most used assessment practices by the participants in this study. Some of these practices are often quick ways of assessing students' understanding during the lesson or at the end of the lesson. This was presented as more of a two-way process between student and teachers with both as active participants. Their belief supports Swaffield's (2009) assertion that AfL practices are more inclined to the phrase 'to sit down beside', which is the phrase the concept of assessment is derived from. Such assessment practices have the potential to boost students' learning by turning the daily assessment practices into teaching and learning processes (Stiggins, 2007). AfL allows teachers to unravel the extent of students' learning and also provides students with the tools that would aid the

improvement of their learning (Gadsby, 2012). The instant feedback often provided means that teachers can work on closing the gap in knowledge. These arguments explain why AfL practices have become popular in schools in England as was reflected in my findings.

It is also revealed in the findings that although science teachers in general view all AfL practices to be valuable and often use them, slight variations exist between their views and their rate of use. This further reinforces the inference that there are factors that influence their attitudes. Despite the fact that the crusade for AfL has been on for decades, there may still be teachers who have chosen not to exclusively agree to this idea of assessment (Popham, 2008). There are also slight variations in the assessment practices discussed in the interviews and the findings in the questionnaires. This can be explained by the limitation of the questionnaire, which contains a handful of assessment practices, and this further justifies the rationale for the semi-structured interviews.

The review of the different assessment practices in the survey showed the popularity of 'giving oral and written feedback'. This is not only evident in the questionnaire responses but also in the interviews. Teachers find giving oral and written feedback effective. This was not surprising, as giving feedback is a key part of the AfL model that provides the platform for students to know where they are and what next they need to do (Hodgson and Pyle, 2010). It also presents opportunities for a teacher-student dialogue. It creates opportunities for improvement and learning to occur, as Pickford and Brown (2006:13) points out, if 'assessment is the engine that drives learning then feedback is the oil that lubricates the cogs of understanding'. This finding, however, can be limited depending on teachers' perceptions of feedback, as my findings revealed. If they view feedback based on Hattie and Timperley's (2007) description, which is the information relating to what one can do or understand, then the use of feedback could be for either summative or formative purposes. On the other hand, the view of feedback as a practice that must be used to change the gap (Ramaprasad, 1983 in Sadler, 1989) identifies it as an AfL practice.

Findings show that the teachers discussed feedback as both. Instances were given where test results were shared with parents and students, denoting a summative

perspective, and where oral or written feedbacks were given to students to act upon, denoting a formative perspective. In another instance, both were distinctively separated in terms of definition and use. Feedback was used for formative remarks, and grading was used for summative remarks. This raises the issue of confusion in the use of assessment terminologies, which could have led to the misinterpretation of the questionnaire statements and to limitations in the findings. This in real terms could also limit teachers' understanding of assessment terms, which may possibly affect their attitudes towards them. However, the emphases given in the interview on how tests results are shared with students and the outcomes used to inform subsequent learning processes suggest that they discussed feedback as more of a formative term than summative, though it is unclear as to what level of interaction took place whilst the test results were being shared. As Shermis and Di Vesta (2011) argue that the usefulness of feedback reaches its optimum at the point where teachers and students engage in an interaction where their understandings of the assessment measures are shared. It is therefore reasonable to argue that teachers' assessment knowledge will affect the way they view and use different assessment practices. In other words, teachers' assessment knowledge affects their attitude towards different assessment practices.

Although giving feedback was popular among the participants, giving students time to act on their feedback was considered the most valuable practice, according to the questionnaire analysis. This could be a typical example of where the participants' 'espoused theory' contradicts their 'theory in use'. They considered giving students time to act on feedback as very valuable but do not always carry it out. The espoused theory, as described by Argyris and Schön (1974), is the theory that one claims to conform to when asked; whilst the 'theory in use' is the theory that one actually implements in real terms. Feedback becomes meaningful when it is acted upon. This accounts for possible reasons why ensuring there was adequate provision of time for students to act on feedback was considered the most valuable in the questionnaires. The direct involvement of students in this practice may also be a possible reason. This further supports the assertion that the science teachers denoted feedback more in terms of formative use. There are possibly factors that influenced the slight variation between their most popular assessment practice (giving feedback to students) and their most valuable assessment practice (giving students time to act on feedback). The

absence of strong emphasis placed on giving students time to act on feedback, as revealed by the interviews, reinforces this. Both practices can be part of a school assessment policy; however, 'giving feedback' can be easily monitored through book checks, unlike 'giving time to act'. This raises the issue of how actions may be influenced by school culture. In addition, the clash between the heavy content curriculum and the limited curriculum time for science, especially in KS4, may have contributed to this slight disparity in attitude. Therefore, I can argue that the teachers' attitudes to assessment practices were influenced by the priority given to the assessment task, necessitated by the external force which can be one of higher authority or influence.

Furthermore, it was found that the discussions of AfL practices were focussed more on Key stage 3 (KS3) than with the Key stage 4 (KS4) setting. As the AfL practices discussed were more of the deliberate and planned ones, this finding can be considered inconclusive due to the lack of clarity of teachers' attitudes towards unplanned AfL practices. However, the findings possibly imply a higher popularity of AfL practices with KS3 classes. The pressure of the GSCE exams may be a contributing factor. Students in English schools on average gain two GCSEs in science, which in most cases is completed in 2–3 years. Teachers tend to focus on getting the students ready for the exams and this often clouds their views on the importance of some AfL practices. This explains why the use of exam questions as quizzes is considered more valuable for KS4. Irrespective of this, strong advocates of AoL practices such as regular testing discussed the formative use of test results. This supports the existence of 'informal summative assessments', which are assessments which are mostly summative with some formative use (Harlen, 2012). This is also not unexpected, as the existence and demands of high-stake summative assessment in English schools have led to a surge in the formative use of summative assessment (Swaffield, 2009). This bridges the gap between AoL and AfL and explains why the former can be discussed as the prerequisite of the latter. Moreover, it supports the belief that AfL encourages the personalisation of learning whilst posing a challenge to the dominancy of summative assessment (Isaacs *et al*, 2013).

From the above, it is obvious that the participants viewed and discussed AfL as their common assessment practice. Thus, I would argue that AfL practices could be

considered to be the common practices for science teachers – which they used to support and underpin the key practices of teaching and learning. Just as Swaffield (2009:2) states: 'the *sitting besides* form of assessment is a natural part of many teachers' practice'.

5.2.2 AoL practice as a key practice for science teachers

AoL practices were viewed as the least valuable assessment practice in the questionnaire but still a valuable assessment practice. Despite the lower mean score for AoL practices, there are teachers that strongly viewed AoL practices as the most valuable. Such teachers argued that the need to show comparable and documentable progression in learning puts this assessment strategy at the forefront. AoL practices provide reports that can be presented to all stakeholders, and can be used for monitoring and evaluation purposes. Considering that the purpose of education for young people is to prepare them to become valuable contributors to society, assessment will determine the extent to which this aim has been achieved, and both teachers and institutions will utilise the findings in the grading, ranking and selection of students (McKellar, 2002).

The idea of 'comparing students' performance with each other whilst assigning their overall grade' was not popular among the science teachers. This may be due to the unfairness of the process and the notion that all students are unique. Also, tests scores often generate inconsistent results of educational achievements (Koretz, 2008). It was the only practice in the questionnaire which most teachers regarded as not valuable and was not raised by teachers in the interview.

In spite of this, the use of tests was discussed by all the participants in both interviews in response to specific questions and the survey results also demonstrated that it is an assessment practice that all teachers often use. This is not surprising, as the ultimate goal of every secondary education ends in a high-stake summative assessment. Hence it is fair to say that the need for accountability cannot be easily satisfied without this form of assessment. Scores generated from such assessments determine the achievement of students, which in turn determine the achievement of the school. As Shermis and Di Vesta (2011:87) state: 'a salient characteristic of such scores is the

finality of the judgements, interpretations, implications or decisions about schools or students'. This explains the need to prepare students for this important exam and emphasises the role of such preparatory practices in a school assessment regime. Besides, tests when carefully developed accord educators some level of assurance that good instructions will lead to positive outcomes (Stiggins 2004), just as some participants acknowledged the use of test outcomes for formative purposes. Based on these reasons, I can argue that the science teachers viewed this AoL practice as the unavoidable assessment practice in the sense that it is an obligatory assessment for them to carry out. In spite of this, the incomplete nature of tests as achievement measures (Koretz, 2008) may explain the variation in science teachers' responses to this form of assessment. Tests only measure a sub-set of students' required skills and knowledge, and only a small sample of behaviour is used in this measurement (Koretz, 2008).

The review of the different assessment practices in the survey also showed that on average participants indicated that they often use assessment results to make decisions about students. This has been categorised as AoL practices, However, findings from the interviews show that the assessment result used and the decision made can be coming from either or both AoL and AfL practices. Decisions about students can include putting them in groups, putting them in examination tiers, setting targets for them and differentiating the work to suit their needs. The latter (differentiating the work to suit their needs) can be viewed as an AfL practice, as the findings are used to adjust materials for students' learning. This possibly explains the higher rate of use accorded to this practice by science teachers. If the participants viewed the practice of making decisions about students as more of a summing up of their achievements and labelling them, there is a sense that the rate of use would be lower. Nevertheless, the practice of class settings according to ability and the existence of different examination tiers may contradict this assertion and be the rationale for higher rate of use of this practice. Based on these arguments, it is therefore acceptable to state that the categorisation of this practice will vary depending on the perception of the teacher. In other words, teachers' perception of an assessment practice affects their attitude towards it.

Furthermore, the analysis of findings reveals that all the AoL practices discussed by participants are centred on measuring students. The outcomes of the measurement processes were used for different purposes. In some instances, these served as an accountability report to the different stakeholders, and in other instances these were used to inform teachers' future plans. Other uses of such practices include the recording of achievements and the prediction of future ones (Isaacs *et al*, 2013; Swain, 2010). This indicates that AoL practices are precursors to other assessment practices, as without ascertaining the level at which students are currently working, further improvement cannot be made. As Shermis and Di Vesta (2011) point out, every assessment practice generates key information pertaining to learners' progress, which the learners and the other stakeholders have an interest in. Similarly, as Harlen (2007) suggests, there is no conclusive distinctiveness between formative and summative assessment due to the other possible uses of AoL practices. Thus, it can be argued that the science teachers presented AoL practices as the key assessment practices on the grounds that they underpin other assessment practices. However, the higher range and standard deviation, as well as the presence of an extreme outlier in the data collected on AoL practices through the questionnaire, suggests a wider view on the value of these practices.

5.2.3 AaL as the hidden assessment practice

The findings from this study, as earlier mentioned, show that the science teachers believed that peer assessment is useful only when students are well trained to carry it out. They cited the limitation of students' knowledge of the subject as a hindrance; thereby implying that effective self-reflection will require a good understanding of the subject content. Some of them believe that science is not a very simple subject to grasp and so students should be well guided and not allowed to construct ideas without guidance. Science, as described by (Farmery 2005: 4–5), is a subject that does not only relate to the 'body of knowledge' and skills utilised in knowledge development, rather it includes the thinking that leads to the interpretation of the evidence, the comprehension of the application of the knowledge discovered and the attitude resulting from the learning. It is therefore expected that secondary school students' abilities to comprehend complex concepts, especially the abilities of the less able students, could be limited. Science teachers come across many misconceptions

daily and these trigger their concerns about the use of peer assessment. One can, therefore, conclude that teachers accept this aspect of AaL as valuable, as long as students are properly trained to carry out peer assessments.

This observation was evident from the questionnaire as respondents considered 'training students to assess the work done by others' as valuable. Yet science teachers did not discuss this as an assessment practice they regularly carry out. The issue of time comes into question and possibly a clear understanding of the impact this will have on students in the long run. This is because the only participant who emphasised the importance of this practice discussed how it has helped to improve students' learning and reduce teacher workload. The variation found can also be explained by the idea of assessment priorities. Teachers view AaL practices as valuable but when it comes to implementation, the push for AfL in class limits the extent to which they carry out the former. The fact that teachers acknowledged the use of some AaL practices in the questionnaire confirms this. The perception of peer assessment as a low-status assessment and the supposed biased feedback from students possibly contributes to the limited use. The assumption that the ability to evaluate students' work is a non-transferable skill held by teachers (Sadler, 1989), combined with the complexity of peer assessment, may also be contributing factors. Isaacs *et al* (2013:99) acknowledge that peer assessment is a '*sophisticated skill*' that may possibly take time to develop, thus explaining the positive views but limited use. The same applies for self-assessment, though as Ercikan (2006) suggests, students ideally should be equipped with the knowledge and skills of the ways in which they can effectively assess themselves. These provide concrete reasons to argue that when time became a limiting factor, assessment priorities affected the science teachers' attitudes towards the assessment practices. This then means that the availability of time and probably sound knowledge of the impact of different assessment practices can affect science teachers' attitudes towards them.

The AaL practices were also found to be popular in the questionnaire, as on average the participants replied that they use them often. However, this was not reinforced in the interviews, as most participants discussed other forms of assessment. Yet, in the discussion of some assessment practices, it became evident that science teachers use some assessment practices as a learning process for both themselves and the students.

While this appears to reflect the term AaL, the term 'AaL' was not used in a specific sense as the other two assessment practices (AfL and AoL). Assessment practices in this category were mostly referred to as AfL practices. This is not surprising, as they are both bounded by the same ideology which is the active involvement of students in the process, which makes them partners in the learning process (Swaffield, 2009). Moreover, self and peer assessment have been considered as 'the cornerstone of good AfL practice', with significant advantages in the teaching and learning of science (Hodgson and Pyle, 2010:7). This, therefore, suggests that the AaL practices comprise the hidden assessment practices of science teachers.

5.2.4 Teachers interconnected attitudes to assessment practices

The evidence presented in this study has shown that each assessment paradigm has a unique role in the teaching and learning cycle. There are arguments that these assessment paradigms are interwoven, with one serving as a prerequisite of the other (Harlen, 2005; Swain 2010). This can be evidenced from the interview findings, where AaL practices were discussed as AfL practices and AoL practices were used for formative purposes as previously mentioned. All assessment practices – regardless of the purposes and context – share a common principle, which is to reason from evidence (Pellegrino *et al*, 2001). Teachers can use an assessment practice for different purposes. This is apparently possible, given that the functions of an assessment practice will influence the structure but not the process (Taras, 2009). Pellegrino *et al* (2001) believes that an assessment purpose drives its priorities and the context in which is employed drives its design. If attitude is 'a summary evaluation of an object of thought' (Bohner and Wänke, 2002:5), then there is a strong suggestion that the purpose of the assessment influences science teachers' attitudes towards assessment. The relationships between the different assessment practices will be further discussed below.

5.2.4.1 Valuing of assessment practices vs. the rate of use of assessment practice

This research reveals that science teachers in this study generally view all categories of assessment practices as valuable and at least occasionally use them. Teachers view assessment as a pedagogy with a wide range of functions (Harris and Brown, 2008).

They agreed with Pellegrino *et al* (2001:40) that 'one type of assessment does not fit all', and with Harlen (2012:137) that there is 'no single approach to teacher assessment'. Their beliefs are in line with the idea that assessment involves the use of varied avenues to gather information on students' performance and the interpretation of this (Brown, 2004b). This is not an unanticipated outcome, as one of the principles of assessment as outlined by the Gardner *et al* (2008) specifies that judgements on students' progress in their learning should not be limited to one source but made from varied sources. Similarly, the current assessment guidelines for schools allow each school to create their assessment structure (DfE 2013b).

This research suggests that the knowledge of science teachers' views of different assessment practices can inform the knowledge of the assessment practices they utilise. This is evident in the strong positive correlation between teachers' valuing of the different assessment practices and their rate of use of them. Similarly, the knowledge of assessment practices described as valuable can be informed by the notion that the participants in the interview process discussed the use of assessment practices they were passionate about or may have reflected on. This inference can be explained by the idea of accessible attitude. Attitudes that are easily accessible from the memory are more likely to manifest (Fazio *et al*, 1989). However, this does not prove that the science teachers only employ assessment practices that they found valuable. It could be argued that being passionate about something could be for a positive or negative reason and could be surrounded by tension, pressure and emotions, considering that the science teachers also talked about the assessments they found not to be useful. This implies that the science teachers may have possibly been passionate about some of these assessment practices due to the influence of other external factors and not their positive belief in them. This takes into account Pajares' (1992:316) definition of belief as 'an individual's judgement of the truth or falsity of a proposition'. This assertion can be supported by the correlation level between the value accorded to the different assessments and the rate of use, which is not considered to be very strong (the highest is the AoL view vs AoL use: $r_s = .620$, $p < 0.01$ (See Table 4.3.10). The idea that affective material may possibly be assessed more quickly than cognitive material – especially when the evaluation is more affective than cognitive (Giner-Sorolla, 2014: 761) – could provide a justification for this. Therefore, it is reasonable to argue that science teachers' attitudes towards

different assessment practices can be influenced by the extent of the harmony that exist between their view of the assessment practices and the need for them to utilise these practices

Although the science teachers value and utilise assessments in the different categories, the extent of their positive affiliation with the different assessment paradigms varies. Similarly, their views of individual assessment practices are not always strongly linked to their rate of use of these practices. This supports James and Pedder's (2006) argument that teachers' values can be contravened by their assessment practices. The lack of coherence between the variables investigated shows that there are possibly tensions within teachers' minds as to which attitude to exhibit at any given time, which could possibly be influenced by the different values accorded to them. This is suggested because the science teachers accorded different values to the different assessment practices in each assessment category. More so, as Fien (2007) points out, the possible occurrence of tension between the values that one holds is one of the challenges individuals encounter as they decide on the attitude towards the object or subject in question. This is as a result of the varied degree of commitments one holds for different values (Fien 2007). This shows another example of where their espoused theory differs from their theory in use. It also raises the issue of conflict between what teachers believe and the influences of externals such as school culture and their impact on teachers' attitudes towards assessment. On this account, I can with a greater assertion argue that the degree of harmony between the science teachers' perception of different assessment practices and the need to utilise them affects their attitudes towards the assessment practices.

Regardless of this, the science teachers' discussions of different assessment practices are centred on the key players in the assessment process and the beneficiaries of the assessment process. Although references were made to the role of the school authorities and parents in the assessment process, strong emphasis was placed on the role of the teacher and student. Again, this is not unexpected as the key players in the learning process are teachers and students, with the school authorities and parents on the periphery. In a situation where a teacher assesses the same class but with different assessment practices, the influences by the key players and beneficiaries, that is, the teacher and the students, may no longer be significant. Other underlining factors could

come into play in this case. Taking into consideration the discussion above, it is reasonable to conclude that this could be the conflict between their beliefs and the need for the practice.

5.2.4.2 Formative assessment vs. Summative assessment

The analysis of findings reveals that although there is no relationship between science teachers' rate of use of AfL and AoL practices, there is a positive correlation between their values they accorded to the AoL practices, and their rate of use of AfL practices. This can be explained by the shift in the assessment regime, which is not fully from summative to formative but to a balance of both, with the view to support learning (Segers and Tillema, 2011). Findings further support James and Pedder's (2006:128) assertion that teachers are willing to acknowledge the legitimacy of the 'performance orientation' aspect of assessment and its inescapable nature in the current education system in England.

The relationship between summative and formative assessment regimes was also evident in the interview. As earlier mentioned, teachers discussed the use of tests for formative purposes. This was more pronounced in the discussion of assessment at KS4. This research reveals that teachers who are strong advocates of AfL practices tend to use more AoL practices at KS4. The need to be exam ready and reinforce the importance of the GCSE exams could possibly have necessitated this move. It could also be a clear indication that the AoL practices are precursors of other assessment practices. Similarly, the need to gather evidence that will help to improve learning may possibly be the drive. There is a belief that the way a teacher approaches assessment has an effect on the learners' perception of the class environment, which includes what is being taught and the learners' work (Brookhart, 1999). As Boud (1988) argues, assessment is believed to have a greater influence on student's learning than any other lone factor. Consequently, the choice of the assessment focus could provide students with the notion of the relative values of each aspect of the curriculum (Brown *et al*, 1997; Edwards, 2013). In view of assessment in KS4, schools' goals for a high performance in GCSE would trigger assessment practices that mirror or expose the structure of the GCSE exams. As noted in the interviews, a series of AoL practices

were employed and the outcomes were subsequently used to plan revision sessions and lessons.

If assessment can be regarded as a single process aimed to bring about a judgement and cannot be completed in a vacuum, then standards or criteria must be present for it to occur (Taras, 2005). Perhaps science teachers who view AoL as valuable discuss the assessment criteria with their students and/or use the outcome of the assessment for formative purposes. This confirms the arguments on the link between the formative and summative assessments. As Taras (2005) argues, assessment cannot be distinctively formative without a preceding summative judgment. Equally, Sadler (1998) considers AoL practices to be a fundamental part of AfL practices. Popham (2008:7), on the other hand, rejects the use of 'formative tests' by arguing that tests in the formative assessment process are simply a part of the process. In addition, the gathering of evidence to support inferences of the level of students' knowledge characterises all assessments (Pellegrino, 2014).

Findings from the interviews show that science teachers view AoL practices as totally separate practices from AfL. Some of the participants discussed them as the 'not so relevant' type of assessment. Yet in their description of AfL practices they carry out there were descriptions of AoL practices, although they did not acknowledge them as such. This raises the issue of the impact of the folk theory, which is the 'everyday taken for granted way of describing reality' (Babione, 2015:95) on my findings. This also supports the idea that the formative nature of assessment arises from how the teachers and students use the results (Benjamin 2008). Taras (2005) believes that the demonisation of AoL practices is a result of the lack of recognition of AoL as vital to all assessment. She also believes that AoL can be seen as 'a stepping stone to learning' (p.476). I can therefore further argue that science teachers tacitly present AoL practices as the key assessment practices in their role.

The same explanation can be given to the weak positive correlation between science teachers' views of AoL practices and their rate of use of AaL practices. Besides the limitations of the sample size, there is the possibility that the science teachers concerned shared the outcomes of the summative assessments with their students who were then encouraged to reflect on the outcome. This may have come in the form of

tests and levelled task results as the interview finding reveals. The summative assessment activities can also be self-assessed and students use the feedback to adapt their learning. These inferences further support my argument that the AoL practices were considered as the key assessment practices.

Yet, taking into account that AfL was acknowledged and discussed by all participants in one way or the other, even in the discussions of the other types of assessment practices, I would suggest that this assessment practice was common with the participants. This, therefore, further supports my argument that the AfL practices were the common assessment practice for the science teachers.

5.2.4.3 Assessment for learning vs. Assessment as learning

The disparity between the science teachers' views of AaL and AfL practices are small when compared to AoL practices. This gives an insight into the fact that there is a more unified view towards AfL and AaL practices, possibly resulting from the positive emphasis placed on them. This inference may be limited due to the restriction in the choices of assessment practices in the questionnaire and the small number of participants. However, the similarities in evidence from the interviews increase the validity of the inference.

The extent of the relationship between AfL and AaL practices was not only revealed through science teachers' views about them but also the rate at which they employ them. A positive correlation was observed in the questionnaire data between both the view and the rate at which science teachers utilise AaL and AfL practices. As pointed out above, findings from the interviews also showed that teachers discussed AaL practices as AfL practices. This supports the strong positive relationship between the two and can be justified by the link between both practices. AaL practices can be seen as extensions of AfL that place learners at the heart of the process (Berry, 2013). Learners take up the role of a critical connector between assessment and learning (Earl, 2013; Berry, 2013). They are able to utilise the outcome of an assessment to monitor and improve their learning. AfL can be described as the assessment that empowers students to take hold of their learning (Gadsby, 2012), thereby suggesting the lack of variation often observed between the two assessment practices. Both

practices involve the monitoring of learning and the use of feedback to improve; however, the student is the key assessor in AaL, unlike the teacher in AfL (Earl, 2013; Berry, 2013). Volante and Fazio (2007) describe AaL as a sub-set of Afl, which takes place when students engage in self-monitoring of their learning and use the feedback generated to adapt their learning. The utilisation of feedback in both assessments serves a formative purpose and thus this strengthens the link between the two assessment strategies.

The idea of a third category of assessment (in addition to the summative AoL and formative AfL) was not popular with the teachers. This results from the finding that the term 'AaL' was only cited by one participant during the interview; though, they all discussed practices that are deemed to be AaL practices. This is not an unexpected finding, as Black and Gao (2015) point out that the debates on assessment mostly sit between the formative and summative use of assessment, with AfL and AaL considered as the two 'closely related' assessment objectives for formative assessment (Clark 2011). This can be shown in the five formative assessment strategies as described by Wiliam (2011b). Whilst the first three were centred on AfL the last two were centred on AaL. In addition, Earl (2013:31) is of the view that 'systematic assessment as learning is almost nonexistent'. Thus, I can further argue that the AaL practices are the hidden assessment practices of science teachers.

5.2.5 Effect of science teachers' conceptions of assessment on their assessment choice

It can be inferred from the findings of this study that the science teachers' conceptions of assessment can be considered as a determinant in the formation of their attitudes towards assessment. A medium negative correlation was found to exist between teachers' conceptions of assessment as irrelevant and their use of AfL practices. As previously discussed, the use of AfL practices requires the collection of evidence and the utilisation of evidence to improve students' learning. For this reason, teachers' active involvement in such assessment practices will more likely cloud their negative disposition towards assessment in general. This can also explain the strong negative correlation between teachers' conception of assessment as irrelevant and their use of AaL practices. Taking into account the fact that these practices are more student-

centred as previously raised, the idea that assessment can be irrelevant to students is unlikely to be considered by their advocates. If Taras (2005: 469) describes formative assessment as 'the antiseptic version of assessment', and AaL and AfL practices are both formative assessment, then teachers who employ these assessment practices more often are unlikely to regard assessment as irrelevant. This indicates that science teachers' conceptions of assessment play a part in forming their attitudes towards different assessment practices.

There is also evidence to suggest that there is a medium positive relationship between the conception of assessment for improvement and the rate at which AfL and AaL practices are employed. It is not unpredicted that the perception of assessment as an improvement tool could initiate the usage of formative assessment tasks. As have already being made clear in this study, AfL and AaL practices centre on the use of feedback to improve learning. Similarly, assessment for improvement centres on the improvement of learning. AfL and AaL practices are therefore the fundamental tools for practitioners with such views. This further suggests that teachers' conceptions of assessment influence the assessment practices they employ, and thereby supports Griffiths *et al*'s (2006) argument that a positive correlation exists between teachers' beliefs and their practices. Although the correlations between formative assessments and conceptions about assessment for improvement have medium effects, there is a stronger relationship with AaL practices ($r_s = -.465$ for AaL and $r_s = .316$ for AfL). Such student-centred practices contribute to personalised learning which positively affects learning. This can be reinforced by the fact that students' learning can be promoted by providing opportunities for self-reflection (Marzano, 2006).

Irrespective of the relationship between science teachers' conceptions of assessment and the rate of use of different assessment practices, there is no significant relationship in the questionnaire responses between teachers' valuing of these practices and their conceptions of assessment. This was an unpredicted outcome as the interview findings brought to light a link between the two. Teachers' discussion of valuable and unnecessary assessment practices in the interviews gave an insight on their conceptions of assessment, as the rationale given for each category were all centred on their beliefs. However, it was evident in the interview process that teachers' views were evolutionary and as such more subject to change. The

opportunity to reflect on the essence of the practice could play a part in this finding. Unlike the questionnaire, the interviews provided more opportunities for reflection, as the participants in the interviews were more likely to have thought through their answers. This supports Thompson's (1992:140) belief that 'the relationship between beliefs and practice is a dialectic, not a simple cause-and-effect relationship'. In addition, the limitation of the questions in the survey could be a contributing factor. The possibility of other factors influencing teachers' views on and use of different assessment practices may come into play and influence the findings. This takes into consideration the idea that teachers' pedagogical acts are all influenced by their conceptions of various educational '*artefacts*' (Brown, 2004b). Time, school policy and the level of demand in different assessment practices can play a part in this. This raises the question of what 'valuable assessment' means to science teachers. Is it based on what teachers believe is valuable or what they are made to believe is valuable? Regardless of this, I can still argue that science teachers' conceptions of assessment play a part in shaping their attitudes to different assessment practices.

5.3 The Assessment and teaching and learning link

This study suggests that the science teachers' conceptions of teaching and learning influence their attitudes towards assessment. This can be seen in the relationship between their conceptions of teaching and learning and their conceptions of assessment, and how they value and use the different assessment practices as discussed below.

5.3.1 Science teachers' conception of teaching and learning

Findings from the questionnaire revealed that science teachers were mostly in favour of the constructivist conception of teaching and learning. The traditional way of teaching as instruction is becoming overshadowed by the contemporary way of teaching as a collaborative social process of constructing meaning. Results from Teaching and Learning International Survey (TALIS) shows that teachers are more oriented towards the idea of students as 'active participants' in the learning process rather than the more traditional teachers' role of transmission of new knowledge (OECD, 2009). The same observation was made in the interviews, where participants

described teaching and learning as more of a student-centred process than a teacher-centred process. Although all teachers interviewed, with the exception of one, were in some way in favour of the constructivist philosophy of learning, most of them believe this needs to be carefully implemented. This could, as Kahn (2000) suggested, be due to teachers' perception of the level of difficulties associated with maintaining student concentration and cooperation as well as better classroom management in the constructivist learning environment when compared with traditional approaches.

The idea of constructivism in science implies the formation of new knowledge by learners based on the existing knowledge (Keogh and Naylor, 1996). A good understanding of their existing knowledge, which will vary among students, will be key for the constructivist teacher, thereby suggesting the need to carefully implement this philosophy. Science as a subject is also not free from misconceptions which students bring to the classroom. A constructivist classroom can provide opportunities for misconceptions to be identified and handled. The discovery of misconceptions, as Hodgson and Pyle (2010) explain, relies on a classroom climate built upon trust where students' understandings are explored through questioning. Such an environment can be achieved in a constructivist classroom.

Nevertheless, there are still limitations within a constructivist classroom. If constructivism is centred on the belief that students are able to construct their knowledge from their experiences (Bell, 2005; Berry 2008; Keogh and Naylor, 1996), then the existence of misconceptions, which students normally favour because they are more relevant to their daily life, (Magnusson *et al*, 1999) becomes an issue. The difficulty in identifying the misconception for every child in a class suggests some limitations in the positive use of this paradigm. Besides, science as a subject contains abstract concepts which lack connections to students' common experiences and instructions. As a result, students often find these concepts difficult to comprehend (Magnusson *et al*, 1999). This justifies participants' belief that science as a subject contains complex concepts that students should not be left to construe on their own. The male participants were more inclined to this view. Their discussions on teaching and learning were more in line with teachers as transmitters of knowledge, although confidence in this finding is limited due to the small sample size. Nevertheless, this is in line with the findings from TALIS which found that female teachers are more

likely to implement structured and student-centred practices, whilst their male counterparts are more likely to regard teaching as 'the direct transmission of knowledge' (OECD, 2009:88). It is therefore fair to suggest that, although most of the science teachers promoted the constructivist learning environment, there is an uncertainty on whether or how they implement it

5.3.2 The effect of teachers' conceptions of teaching and learning on their conceptions of assessment.

Unlike the constructivist conception, the teacher-led conceptions of teaching and learning are like a one-way traffic system. The teachers' role in this is to give out information whilst the students receive this. The result indicates a negative correlation with the conception of assessment as an improvement tool. This is not surprising, as earlier discussed, the idea of assessment as improvement places students at the centre of the assessment process and involves dialogue with them to improve their learning. Science teachers with this conception are therefore more likely to have a teaching and learning conception that centres on the students.

Although statistical analysis showed no strong relationship between the constructivist idea and the conception of improvement, the interview process showed a link. However, this view could be limited by the sample size. Teachers who discussed teaching and learning as more student-centred discussed the purposes of assessment as being more for improvement or student accountability or both. As mentioned earlier, Boud (1988) points out that it seems that the greater influence on the method and content of students' learning comes from the assessment practices and requirements than any other lone factor. Similarly, Remesal (2011) is of the view that varied and sometimes contrasting beliefs about the role assessment plays in teaching and in learning might form their conceptions for assessment functions. If teaching and learning are the product of 'curriculum, pedagogy and assessment' (Osborne 2007: 180), then the assessment implemented in the constructivist classroom will be more student-centred. The absence of a significant positive relationship between assessment for improvement and the constructivist view of teaching and learning could possibly be affected by the pressure from external factors such as the school's philosophy. The limitation of the content of the questionnaire

could also possibly play a part in shielding this relationship. The original questions in the questionnaire tool, involving conceptions of assessment and conceptions of teaching and learning, were adapted to streamline and refine the questionnaire design. The reduction of content during the adaptation could possibly have eliminated the statements that may have shown the supposed correlation. Despite this, it is reasonable to argue that the science teachers' conceptions of teaching and learning should inform what their conceptions of assessment are.

5.3.3 The effect of teachers' conceptions of teaching and learning on their attitudes towards different assessment practices.

Although there were not strong links between teachers' conceptions of assessment and their conceptions of teaching and learning, there is a strong link between teachers' conceptions of teaching and learning and the way they value and use different assessment practices. The findings show that teachers with a constructivist view of learning are more likely to consider the AaL and AfL practices valuable, which in essence constitute a positive view of them. This can be explained by the idea that learning theories which enhance teachers' and learners' capacities to foster both the quality of their relationship and the learning that occurs create a solid foundation on which formative assessment practices can be built (Absolum, 2011). This implies that teachers' views of learning influence their teaching and assessment strategies (Bell, 2005; Berry, 2010). If good assessments, as Gareis and Grant (2015) argue, require the alignment of the three elements of teaching and learning, which include curriculum, instruction and assessment, then it is expected that one will possibly influence the other. In addition, as Shavelson *et al* (2008) believes, assessment as an integral part of teaching is becoming the prevalent notion especially with the formative assessments.

The constructivists believe that students learn not by receiving information only but by constructing new ideas through their experience (Bell, 2005; Berry, 2008); thus AaL and AfL will fit into this paradigm of thought, as constructivist teachers place students at the centre of assessment. As Shermis and Di Vesta (2011:106) point out, teachers who view student learning as 'an incremental process' are more likely to be users of formative assessment than teachers with the mindset that 'learning ability is a

fixed, inherent, entity'. Such teachers encourage the effective use of feedback, which, one can argue provides the information that students build on to construct new knowledge.

By contrast, non-constructivist views link with AoL practices. There is a positive relationship between the teachers' positive views on AoL practices and the rate at which they employ AoL practices with more traditional teaching conceptions. The belief that teaching and learning is transmissive and teacher-centred does not place students at the centre of their learning. The teaching practices that result from this involves the dissemination of information by the teacher and the receipt of information by the students. Teachers' beliefs in such practices perhaps beget assessment strategies of the same philosophy, which aims to measure how much information students have acquired. It is therefore reasonable to argue, based on the above discussions, that the science teachers' conceptions of teaching and learning affect how they value and use different assessment practices, both of which constitute their attitudes towards these assessment practices.

5.4 The evolutionary nature of science teachers' attitudes towards assessment

Teachers' views of assessment were found to be dynamic, due to periodic changes in their views. Earlier conceptions were more of assessment as a measuring tool using grades and levels but now assessment includes a diagnostic role for improvement purposes. The differences in educational era play a significant role in these changes. This is not unanticipated, as traditionally in most countries, assessment in schools is associated in the minds of the stakeholders as a summative process for measurement purposes (Isaacs *et al*, 2013:12). The pre-campaign for the AfL era generated teachers who mostly considered assessment as a process for summative purposes. Even the younger participants who may have been students during this era still viewed assessment as such. Perhaps the role of the student and the teacher in the learning environment plays a part.

Similarly, the way assessment is presented to students informs their conception of it. This is evident in the findings, as all the previous conceptions were centred on assessment as a measuring tool, be it test marking, book marking or other AoL

practices. If the end point of every educational system is to gain a qualification, then teachers are probably going to focus on helping their students achieve this goal and this may possibly promote such assessment conceptions in students. In spite of this, one can argue that this conception should have been modified during teacher training programmes. Interview findings show that this did not alter teachers' conceptions rather, their experience as qualified teachers did. This brings into question the way assessment topics are addressed in teacher training programmes. However, this assertion may be limited as there may be changes in the current training process that may not have been experienced by the participants.

The findings also showed the evolutionary nature of teachers' views of different assessment practices. AoL practices were mostly considered as the initial valuable assessment practices prior to the changes in the AfL era. The history of assessment shows that AoL was originally promoted and assessment is still in some cases promoted as an AoL process. Some of the definitions given by the participants support this. Similarly, tests/exams seem to be the only AoL practice that were used earlier on, but now other AoL practices such as levelled tasks are used. This is not unexpected, because tests were the main tool for summative assessment in the early educational era, unlike now, where 'essays, teacher ratings and other indexes of performance' may be used (Shermis and Di Vesta (2013:87).

The lack of formative assessment training during teacher training programmes was cited as the rationale for initial conceptions of assessment and views about assessment practices. On that account, there is a strong indication that experience plays a part in the formation of teachers' attitudes towards assessment. This inference is also reinforced by the lack of previous views on valuable assessment provided by some participants. The findings suggest that science teachers can carry out assessment practices because they have been told to do so or they found it easy without ascertaining their value. This creates a vacuum that relevant experience can fill. The realisation of the value of an assessment practice through reflection, as discussed by one of the participants, also supports this argument. This adds to the question of what valuable assessment means to science teachers. Does the ease to carry out the task or the mandatory nature of the task make it valuable? However, it can be argued that experience will influence the answer, and as people's experiences change the belief

system may change. This argument agrees with Richardson's (1996) view that although belief is the driving force for one's actions, factors such as experience may bring about changes in one's beliefs. Thus, there are reasons to argue that science teachers' attitudes towards assessment were evolutionary in their structure. Taking into account the periodical changes in the schools' assessment policies, it is logical to argue that teachers' attitude towards assessment will change as policies and other external interventions change in structure.

5.5 Variation in Science teachers' attitudes towards assessment: The influencing factors

From the above discussion, it is clear that the science teachers in this study exhibited different attitudes towards assessment. This results from the variation between the participants or alternatively results to variations between them. Science teachers have been portrayed as the authors, directors and benefactors of their assessment processes. Consequently, their perceptions of the impact of an assessment practice influence their attitudes towards assessment. The findings show the various contributing factors to the varied attitudes. These factors can be summarised as assessment-induced factors, society-induced factors and experience-induced factors.

5.5.1 Assessment-induced factors

The nature of the assessment tool was raised as a factor that influences science teachers' choice of assessment practices and valuing of assessment practices. The nature of assessment was considered based on the time taken and ease of carrying out the assessment, both of which impact teachers' workloads. Findings show that science teachers often prefer to carry out assessment that requires limited planning and administrative time. This in essence reduces their workload. This is expected, as teachers' workload was found to be one of the reasons why teachers leave the profession (Smithers and Robinson, 2003) and continues to be a big issue for teachers (NUT, 2014). Teacher workload was raised as a factor that discourages certain assessment practices. This supports Alkharusi *et al* (2012) and Lyon's (2011) findings that teaching loads can affect teachers' assessment beliefs and practices, thereby emphasising the role of workload in shaping the nature of teachers' attitudes towards

assessment. It was found in this study that science teachers on some occasions implement peer assessment to ease workload.

Similarly, there is an indication that science teachers consider the ease of carrying out an assessment process in their choice of assessment practice. The belief in the existence of opportunities and means to perform behaviour influences one's intention to perform one (Ajzen 2005). Thus the idea of convenience in the selection of assessment practices comes into play. Convenience in this sense is not restricted to the teachers but also to students, as inaccessible assessments for students will impact teachers' workloads as they try to make them accessible to students. The use of technology to aid the assessment process was acknowledged and in some instances was the key influencing factor in the choice of assessment practices.

The role of the teacher in choosing the assessment practice also influenced their attitude towards assessment. There was a clear indication that the assessment practices participants projected as valuable are mostly the ones they devised or have thought through as such. When an assessment process or tool is deemed not to be valuable to the teacher or when its limitations impact the teacher, it generates a wave of negativity towards the whole process. This was also recognised in the survey, as science teachers agreed that consideration should be given to the errors and imperfection of all assessment processes. In view of these findings, I would argue in support of Cizek *et al* (1995) that teachers have individualised assessment policies, which are based on their personal beliefs and values in relation to teaching.

It is therefore reasonable to state, based on the above discussions, that nature of different assessment practices influenced the science teachers' attitudes towards them, which in turn inform their attitudes towards assessment.

5.5.2 Experience-induced factors

Personal experiences influence one's knowledge and beliefs about teaching (Richardson, 1996), of which assessment would form a part. Teachers discussed experience as the factor that influenced their views of assessment. Such experiences may possibly be part of one's previous attitude, which Fazio *et al* (1989) believe, due

to its ease of accessibility from memory, appears to greatly influence one's behaviour. These experiences go through the journey of a teacher, which includes their experience as a student (studying experience), their experience as a trainee teacher and NQT (training experience) and their experience as a teacher (teaching experience) and these have been discussed below.

5.5.2.1 Training experience

Teacher training experience was raised as one of the factors that influenced science teachers' initial attitudes. Although questions were raised earlier on the impact of teacher-training programmes on science teachers' attitudes towards assessment, there is evidence to suggest the impact of this process on teachers. The findings show that the NQTs have the highest mean score for assessment as improvement, whilst teachers with 1–5 years experience have the lowest score. This could be explained by the possibility that teacher-training programmes promote assessment for learning as an effective pedagogy. The inability to fully understand the rationale and how to effectively apply it could possibly turn around the views of new professionals, as teachers with 1–5 years teaching experience have the lowest score. This could also be explained by the idea of 'culture shock' which one experiences as they move into familiar environment yet faced with the inability to fully embrace the culture (Ryan *et al*, 2012). A significant difference was also found in teachers' views of AoL practices; the NQTs have the lowest positive score for AoL practices. This further reinforces the role of teacher training programmes on teachers' initial attitudes towards assessment. Despite this, it can be argued that this finding is greatly limited, due to the sample size of the survey group coupled with the fact that this finding was not replicated in the interviews.

Furthermore, in-service experience gained through feedback from other teachers was highlighted as another contributing factor to the teachers' attitudes. Regular school CPD sessions and feedback from lesson observations were often targeted to guide the teachers in their development process. These set in a reflection process in their minds. Considering that the positive evaluation of behaviour can lead to the intention to perform it (Ajzen 2005), this will result in changes in attitude towards assessment. These changes may not be applicable in all instances, taking into account that the

intent to perform a behaviour can also arise when there is social pressure or the opportunities to perform it (Ajzen 2005).

The findings of this study also revealed that teachers' access to research evidence played a part in forming their attitudes towards assessment. As Howley *et al* (2013) argue, teachers are not and have not considered themselves as mere executors of an unchanging assessment system developed by others, instead they believe that they are contributors to a dynamic assessment system. Research acts as vehicle for this. If teachers' roles are considered to be a 'combination of art and science' (Minstrell *et al*, 2008:46), then reflection on practices with the view to create a blend of acceptable ones will possibly provide the avenues for teachers to reflect and plan a wide range of classroom practices (James and Pedder, 2006). The references to research were only made by participants who involved themselves in personal CPD sessions; thus suggesting the role of CPD in forming teachers' attitudes.

5.5.2.2 The teaching experience

Teaching experiences do not only centre on the length of experience but also on the nature of experience. This is because the attitudes resulting from direct experience tend to be better predictors of subsequent behaviours than attitudes from indirect experience (Fazio and Roskos-Ewoldsen, 2005). The nature of experience in this context refers to the describable form of teachers' experience ranging from their daily teaching activities to their other responsibilities in the school. It includes their experience of planning learning activities, teaching and assessing students, and for the teachers with an extra teaching and learning responsibility - their leadership role. Both the length of teaching experience and the nature of the experience contributed to shaping the teachers' attitudes towards assessment as revealed in this study.

The roles of the teachers in the school were found to contribute significantly in shaping their conceptions of assessment. This is expected, as teachers' roles have been described as 'an indispensable part of their professional identities' (Gu, 2007:9). The survey findings show that the school leaders tended to agree more with the conception of assessment as improvement than the other groups, followed by the subject leaders. Perhaps the added responsibilities these leadership roles bring expose

teachers to more reflection on their teaching pedagogy. It can be argued that school leaders should tend to agree more with assessment for school accountability amidst league table pressure. Yet it appears based on the questionnaire findings that school leaders have a different view from this. This is a limited inference since it was not confirmed or contradicted in the interview process, as no school leader was interviewed. The subject leaders, on the other hand, discussed assessment as more employed for school accountability. Their position in the league table performance ladder subjects them to a greater pressure, as they are accountable for progress in their area, about which they give feedback to the school authorities. This, however, was not reflected in their assessment choices. This explains the effects of the factors they identified as their influencing factors, which include research, school experience, reflection and CPD.

It was also found in this study that teachers with training and pedagogic developmental roles tend to be more reflective about assessment practices. They pointed out the effect of their role on their assessment views and choices. This indicates further evidence of the impact of teachers' roles on their assessment attitudes. Teachers with such responsibilities are more likely to have their reflection centred on improving pedagogy rather than improving exam results, although one can argue that the former will lead to the latter. The finding that the NQTs who are supposedly on the lowest spine of the league table pressure ladder have the least score for assessment for school and student accountability reinforces this inference. Although there are strong limitations based on the sample size, fewer discussions on assessment for school accountability by the non-subject leaders support this.

Furthermore, there was no apparent evidence that teachers' length of teaching experience affected their conception of assessment. There is, however, an indication that this may have affected their views on the different assessment practices. The NQTs, as stated earlier, considered AoL to be less valuable than the other groups, although this inference is limited due to the non-replication of the evidence in the interview findings and the limited questionnaire data. Interview findings show that teachers did not refer to their years of experience as a factor that affected their views and choice of assessment practice; rather they talked about the nature of experience. This supports Ary *et al*'s (2013) belief that personal experience can enable us to

locate answers to the questions we have. They describe experience as 'a familiar and well-used source of knowledge' (p.2). This further supports the findings, as it was obvious that the longer the years of teaching experience, the more likely the teacher is to have some sort of leadership role and other exposure such as CPD which played a part in forming their attitudes. There is a belief amongst some participants that the older teachers are more inclined to support summative assessment, whilst the younger ones are more inclined to favour formative assessment. This can be explained by the possibility that experienced teachers still nurse the belief that assessment is linked to tension and challenge; 'where the way to maximise learning is to maximise anxiety' (Chappuis *et al*, 2004:32). Such a supposition is made with the view that these teachers were trained during the pre-AfL campaign era. Despite this, there is an indication that the nature of the teaching experiences of the participants, which include their role in the school, influenced their attitudes towards the different assessment practices.

5.5.2.3 The role of teachers' education

It is believed that teachers' experiences as students influence their assessment belief (Pajares, 1992). However, the influence of one's secondary education was not identified as a factor in this study. The participants in this study were secondary school science teachers with qualified teacher status, and as such, their experience as secondary school students may have been overshadowed by their university education and teacher training process.

There is limited evidence that the teachers' educational status affected their conceptions of assessment. This limitation was caused by the sample size and the absence of this evidence in the interviews. Teachers with a Master's degree tended to agree more that assessment can be an irrelevant process. This is because although on average each group slightly disagreed that assessment is an irrelevant process, the views of the Master's degree holders were weaker and tended to lean towards agreeing rather than slightly disagreeing. The level of education could possibly play a part here. Teachers with Master's in education may have been exposed to more reflective practices and the critical review of educational literature. The idea that practical knowledge, which is a forerunner of one's actions, can be changed by

reflection in action practices (Woolfolk-Hoy and Murphy, 2001) may perhaps have played a part here. Regardless of this, the inference is limited, as there is no clear indication that their Master's degrees were all in education. These were science teachers and they may have had a Master's degree in their area of specialism. Moreover, such arguments can be made for Doctorate degree holders who may possibly have such degree in education. Hence, it can be argued that there is an over-riding factor that influences the decision of the Master's degree holders. A review of the finding showed that the Master's degree group has the lowest percentage of SLTs (6.7%) compared to the Bachelor's degree group (25%) and the Doctorate group (14.3%). This could possibly have an effect on their views on assessment as an irrelevant process, bearing in mind that the SLTs have the most positive view on assessment for improvement. Again, considering the size of the sampling frame, there could be a limitation to this finding. However, I can still argue that, although teachers' beliefs about teaching are understood to be developed through classroom experiences as students and teachers (Lumpe *et al*, 2000), the impact of the teaching experiences tend to surpass the schooling experience.

This supports Richardson's (1996) argument that one's beliefs can be altered by their experiences. The experience gained through direct action with the attitude object creates a more accessible attitude than the one gained through indirect action (Fazio and Zanna 1981). In this case, teachers' experience of assessing students, designing assessment activities and utilising assessment outcomes may have informed their attitudes more than their experience as students responding to assessment practices or observing the assessment process. Besides, it can be argued that there is a decline in attitude accessibility over time when such an attitude is not reinforced (Arpan *et al*, 2007). This might be the case because attitude rehearsals strengthen attitude accessibility (Oskamp and Schultz, 2005; Descheemaeker *et al*, 2016). Simply put, the accessibility of the experiences gained as a student may decline if they are no longer replicated in the life of a teacher. Hence, the argument raised by Gotch (2012) on the lack of clear consensus between teachers' level of assessment literacy and their teaching experience can be supported by the finding that the nature of the experience rather than the length of the experience is crucial. Although the generalisation of this assertion is limited by the methodological approach and the

sample size in this study, there nevertheless is an indication that this might be at least generalisable in part.

From the above discussions, it is clear that experience plays a part in forming teachers' attitudes towards assessment. These experiences together with their impact vary, and there seem not to be an overriding experience for all. I will therefore argue that although teachers' experiences affect their attitudes towards assessment, the underlying factors of the experiences play a greater role.

5.5.3 School initiated factors

There is evidence to argue that the type of school and region the science teachers in this study worked in did not influence their conception of assessment. It seems that either they form their views of assessment irrespective of these factors, or there are other factors that supersede these factors in influencing their conceptions of assessment. This is in line with Griffiths *et al* (2006) who found no significant link between teachers' performance and the demography of their school and their years of experience. The respondents in the survey were all science teachers who often take part in the discussions of topical educational issues in an online forum, of which issues on assessment is one. As Bennett *et al* (2010:26) argue, CPD activities are more likely to influence classroom or any other school practices if they tackle 'pre-existing conflict' in the context applicable to the participants. It is therefore reasonable to assume that teachers who are involved in voluntary CPDs are reflective practitioners who are enthusiastic about their roles. In this regard, the impact of the CPD is more likely to overshadow other factors, as Bennett *et al* (2010:26) point out that the impact of CPD on the classroom is increased more by 'enthusiastic translators of change' rather than by 'successful agents of change'. That is to say, teachers who regularly reflect and discuss the impact of their pedagogies, such as the teachers in the online discussion forum, are more likely to be enthusiastic and knowledgeable about their ideas. Hence there is a possibility that the effect of factors such as teaching experience, region, type of school, highest education and role may often be sidelined by teachers' involvement in these online CPDs, as some teachers refer to them.

Conversely, teachers' place of work influenced their views and choices of assessment practices. Interview findings showed the link between teachers' attitudes towards assessment and the school policy. This is supported by the evidence that teachers in independent schools view AaL practices as less valuable and use them less than teachers in other schools. This was evident from the surveys (using questionnaire and interview) of the science teachers involved in the online CPD-related forum. Possibly, the limitations of experience as a source of knowledge and the role of authority in its place (Ary *et al*, 2013) come into play. People refer to authority when it becomes difficult or impossible to acquire knowledge through personal experience (Ary *et al*, 2013), or, better still, when there is a consequence for non-compliance. Also, if teachers' beliefs are considered to be the reflection of 'societal priorities' and 'jurisdictional practices' (Brown and Remesal, 2012), the school culture which is informed by the school ethos could possibly play a part here. Brown and Michaelides (2011:320) believe that providing teachers adhere to the school assessment guidelines, their assessment belief system will matter to the reason and method of the assessment. The classroom activities are a reflection of the school activities surrounding their assessment policy and a discourse on how assessment can be effectively used to measure attainment and promote learning (Harlen, 2010). In addition, teachers do not operate in isolation; rather, their actions are influenced by local and national policies (Maughan *et al*, 2012). These therefore support the finding on the role of the school in shaping teachers' assessment attitudes.

Equally, as Webb (2002) points out, what teachers are required to know about assessment is dependent on factors, which include the assessment system used in the region and the requirements set locally or by the state. This was evident in the interview process, as the participants discussed assessment based on what is done in their current school. They did not always agree with the schools' assessment ethos, though, they had to adhere to them. If the information gathered in assessment is dependent on the curriculum delivered and the method of instruction (Pellegrino *et al*, 2001) and every school possibly has their own teaching and learning policy, then there are reasons to argue that teachers' attitudes towards assessment can be influenced by their school system.

Furthermore, whole department widely acclaimed practices in some instances influenced teachers' views on the value of different practices. This still forms part of the school culture and may even have more impact, given that it is centred round the subject. Culture, as expressed by Gruenert and Whitaker (2015), informs its members of that which needs to be recognised, ignored or expected. This can swerve from positive to negative views amidst other factors that arise, such as convenience and workload. As a result of this, it would be rational to argue that science teachers' general attitudes to assessment are influenced by their school's ethos and this could be either a positive or negative attitude.

Based on this finding, I agree with Brown (2011) that teachers' conceptions of assessment are ecologically rational. Having said this, there is some evidence that there is no link between the teachers' conceptions of assessment and their places of work. However, there is evidence of a link between their attitudes towards assessment practices and their places of work. This, arguably, limits Brown's (2011) argument on the ecologically rational nature of teachers' assessment conceptions. In addition, given that the relationship between the two variables was only established in the context of one type of school (independent), it is conceivable that there may be other underlying factors responsible for this link. Nonetheless, it is the researcher's view that the weakness of the questionnaire data and the presence of the supporting evidence in the interviews minimise this limitation.

5.5.4 The role of the evolutionary nature of science teachers' attitudes to assessment

Participants' views of assessment and their choices of assessment practices were found to evolve. The evolution stages discussed started from teachers as trainee teachers or teachers as NQTs. This, therefore, to an extent, supports Richardson's (1996) idea that one's experience of schooling can play a part in shaping their knowledge and beliefs about teaching. However, this idea is challenged by the revelation of the respondents in the interview that their views on assessment had changed. Findings show that these beliefs can be altered during one's teaching career. Teachers are challenged in a bid to achieve a preferred blend of practices (James and Pedder, 2006). I can argue that the evolving nature of teachers' views on assessment

results from the fact that teachers are considered to be reflective practitioners. The reflective practice will allow the critical review of practices and control changes aimed for improvement within the classroom (Jameson and Hillier, 2003). As Miller (2011:79) states, 'identity is multifaceted and multilayered, and can change between contexts and situations'. In light of this, there is the possibility of another change occurring in the teachers' views. To this end, I can agree with Brown and Remesal's (2012) assumption that teachers' conception of assessment can change during their teaching experiences. I also agree with Thompson (1992) that belief systems are dynamic structures which are susceptible to change due to experience. However, the limitation of this study to a sample of teachers who engage with online CPDs and a small sample of teachers working in East London may limit the generalisability of this assertion.

Despite the limited sample, some of the factors initiating the change are linked to collaborative work and research. As more of this continues to take place, there is the possibility that the evolution of teachers' conceptions and choice of assessment practices will continue. Moreover, the Assessment reform group (Gardner *et al* 2008:13) disagrees with the notion that the process of sustaining new assessment practices is fixed and static. They argued that new assessment practices will quickly turn into 'drab routines' unless they are developed alongside the ever-changing needs of the students and teachers. In the same way, the change in curriculum will impact the assessment system, which may subsequently impact the teachers' attitudes to assessment, since a change in one part of the curriculum-instruction-assessment triangle requires a change in the other two (Williams, 2007).

Teachers' views on assessment practices were also found to evolve with time. The assessment practices that are popular at any given time are more likely to be discussed by teachers, for instance, some quick AfL activities such as the traffic light system. The popularity of these practices was also influenced by the period in the school year. Whilst the formative use of test results was popular with the teachers interviewed in the middle of the autumn term, discussions on controlled assessment and teacher workload were more popular with the teachers interviewed at the end of spring term. This suggests that teachers' attitudes to assessment may not only be evolutional but

also seasonal. Taking into account that the same teachers were not interviewed during different periods, this needs further research for confirmation.

5.6 Conclusion

Clearly, this study has shown the nature of the science teachers' conceptions of assessment, their valuing and rate of use of different assessment practices, and their conceptions of teaching and learning – all of which constitute their attitudes towards assessment. Several conclusions emerged from this analysis. Teachers' conceptions of assessment have been summarised as assessment for improvement, for accountability, for learning and as an unnecessary and imprecise tool. The science teachers' attitudes towards the different assessment practices also differed and were discussed as – AfL as the common assessment practice, AaL as the hidden assessment practice and AoL as the key assessment practice. The effects of different factors on teachers' attitudes towards assessment were also discussed in this section. It emerged from the above analyses that the science teachers' attitudes towards assessment tend to be evolutional.

Chapter 6: Conclusion and Recommendations

6.1: Summary

This study aimed to understand science teachers' attitudes towards assessment and the factors that affect them. This was carried out by looking at the science teachers' conceptions of assessment, their attitudes towards different assessment practices and their conceptions of teaching and learning. In addition, factors that affect these elements of science teachers' attitudes towards assessment were identified and described. It is revealed in this study that science teachers possess multiple attitudes towards assessment and that these have the tendency to evolve in line with variations in their experiences. Several conclusions emerged from this study and are summarised below

6.1.1: Science teachers' attitude towards assessment

Firstly, this study reveals that the science teachers presented a multiplicity of assessment definitions and uses, indicating the existence of multiple conceptions of assessment. This supports Brown's (2011) finding that teachers can have multiple and conflicting assessment conceptions. They view assessment as a process or tool to measure progress, improve learning, and as a learning tool for themselves and/or their students. These conceptions of assessment were summarised into assessment as improvement, accountability, learning and as an unnecessary and imprecise tool. This is unlike Brown's (2002; 2004b; 2006) classification of assessment conception, which includes assessment as improvement, school accountability, student accountability and as an irrelevant process. The two accountabilities conceptions were merged as one in this study to accommodate other accountabilities such as parent and teacher accountability.

It was found that the popularity of an assessment conception was influenced by the awareness created in relation to the issues that were found to be assumed within the conception. This was evident in the case of assessment for improvement, which was promoted by the drive for AfL. The assessment for improvement conception was not only found to be popular, as was also revealed by Brown (2002; 2011), Calveric

(2010) and Moiinvaziri (2015), but it was found to be an 'unimposed' conception of assessment. It was the conception that all participants acknowledged in one way or another without demonstrating any sense of pressure from externals.

The discussion of assessment as a learning tool was found to be popular and often emphasised in respondents' commments about assessment. Assessment was not only discussed as a learning tool for the assessed but also for the assessor. This resulted in its characterisation as a conception. This study revealed that the science teachers discussed assessment as a learning tool for themselves and for the students. Their general belief about assessment was that it is the method of investigating how students learn, what they have learnt or not learnt and how to improve their learning. Thus, assessments were not discussed as irrelevant processes, rather, as inferred from the data, selected kinds of assessment were classified as unnecessary and imprecise tools. This emerged as a result of the findings that the limitations of the assessment process could be the type, time and the frequency of the assessment for a specific purpose. Therefore, the classification of assessment as an unnecessary and imprecise tool stems from the finding that the nature and purpose of *some* assessment practices are more likely to negatively affect teachers' attitude towards assessment then their general belief about assessment.

The different meaning given to assessment, the rationale for its use and the varied ways of implementing it reveal that assessment can be presented as a 'teacher-oriented process for teacher benefit' which is a process centred on the teacher, with the main purpose being to meet teachers' needs; a 'teacher-oriented process for student benefit' which is a process centred on the teacher but aiming to meet students' needs; and as a 'student-oriented process for student benefit', which is a student-centred process with the sole responsibility of meeting students' needs. It was found in this study that these multiplicities of science teachers' conceptions about assessment lead to conflicts, which may possibly affect their assessment attitude at any given time. This suggests that their attitudes are dynamic and may possibly evolve, leading to the acceptance of one conception more than the other. Therefore I can argue that the strength of the acceptance of a conception determines the overall impact of the conception itself.

Secondly, the science teachers' attitudes towards assessment practices were determined by looking at the way in which they valued and rated the use of different assessment practices. Although this was limited to certain assessment practices, they still catered for assessment practices in the three assessment categories as described by Earl (2003), which include: Assessment for Learning (AfL), Assessment as Learning (AfL) and Assessment of Learning (AoL). Their descriptions of these different assessment practices show that these practices are similar and only differentiated by the purpose and outcome. They discussed them as interlinked practices, with one leading to another. AfL was found to be the assessment category that every participant described as valuable and seemed to willingly carry out. Though there were variations in the relationship between the rate of use and the valuing of different practices, it was still evident that there was a correlation. The popularity of this assessment category and its 'unimposed' nature, as revealed by the research analysis, justifies why this assessment was described as the 'common' assessment practice. 'Common' in this sense implies that they are the assessment practices that the participants carried out regularly with an understanding of the need to implement them. This is unlike AoL practices that were not consistently considered as valuable in this study. However, what is clear from this study and is also backed up by previous research (Taras, 2005; Swain, 2010), is that AoL practices were described as the prerequisite for the other categories. Simply put, the AoL practices are the first part of the AaL and AfL practices. This implies that although AoL may not be the most popular category, it was still both directly or indirectly employed by all participants. For this reason, AoL practices were described as the 'key' assessment practices which generated information that can be further used for pragmatic purposes. One of these uses was to provide learning content or atmosphere for both teachers and students, thereby serving as the prerequisite to AaL. AaL practices, on the other hand, were discussed as a valuable assessment practice, although there were reservations about the impact of peer assessment. It was found that this assessment category was mostly carried out by the participants but often characterised as assessment for learning. Therefore AaL was described as the 'hidden' assessment practice.

From the above, it is clear that there are different types of attitude towards assessment marked by the different conceptions of assessment and attitudes towards assessment

practices. These attitudes, which were mostly shared among the participants, can indicate that an inessential assessment was carried out either willingly or unwillingly, or a necessary assessment was carried out, again either willingly and unwillingly. In other words, respondents' attitudes could be characterised as being towards 'assessment with informed purposes' and 'assessment without informed purposes'. The idea of 'informed purposes' in this case means that the purpose(s) of the assessment process has (have) been understood and accepted. There was also a clear indication in the study that these attitudes were evolutionary, as the teachers discussed changes in their views. The idea of these attitudes being seasonal was also raised, although there is a significant limitation on this finding, resulting from the limited nature of the data unveiling this inference.

6.1.2: Factors affecting science teachers' attitudes towards assessment

Various factors affected the science teachers' attitudes towards assessment. The knowledge of the teachers' conception of teaching and learning provided an insight into their conception of assessment. This, therefore, confirms the link between assessment and learning and the idea that assessment is an 'integral part of teaching and learning'. It further justifies the inclusion of the conception of teaching and learning in the teachers' assessment attitude model. The confirmation was also found in the correlation between the valuing and rate of use of different assessment practices and the conceptions of teaching and learning held by respondents. It was evident that constructivist learning environments were promoters of formative assessments, whilst the more traditional learning environments were more often provided by summative assessments advocates.

Further factors underpinned by experience affected teachers' attitudes towards assessment and to varied degrees. This includes the nature of assessment, which often was informed by the pressure imposed by the assessment process. It was found that some of the teachers discussed the impact of the ease of assessment practices and the time involved as being the determining factors in their choice of different practices. Personal experiences – gained as a trainee teacher and teacher – were also found to play a role in forming teachers' attitudes towards assessment. The most significant factor between them was their experience as a teacher. The effect of this was more

from the teaching experience itself rather than the length of teaching although there is a link between the two. However, it was clear that the nature of their experience was the decisive factor. Therefore it is reasonable to conclude that the roots of experiences can be the key determining factor in attitude formation. To this end, this study confirms the notion that experience may inform one's attitude (Olson and Maio 2003; Hassanein 2015; Holmes and Singh 2012). As more experiences are gained and sometimes resulting from the evolution of previous classroom histories, the resultant attitude also evolves. This reinforces the idea that the science teachers have dynamic attitudes towards assessment. Also, there was evidence which can be used to argue that teachers' attitudes were influenced by evolutionary factors, be they personal or society-induced factors.

In addition, it was obvious from this study that different factors may affect the attitudes of different practitioners. In essence, teachers' attitudes towards assessment are multi-influenced. The influencing factors were not limited to those within the teachers' domain but extended to those outside their domain. Such factors, which include the type of school in which teachers found themselves and the school culture, can be subjected to the demands of Oftsed and to league table pressure, thereby generating an obligatory vibe. This could result in productive effects, which lead to positive attitudes, or unconstructive effects, which lead to negative attitudes. Such factors were also found to create seasonal effects such as respondents' discussions on the impact of workload as schools approached the high-stake examination period, although I would strongly emphasise the limitation of this finding and recommend further research to authenticate this. The factors that affect teachers' attitudes towards assessment also complemented and in some cases contradicted each other. The resultant attitudes were either positive or negative, depending on the overriding factor.

From the above, it is clear that the science teachers' attitudes to assessment were influenced by personal or public, voluntary or imposed, current or past experiences, and fixed or evolutionary factors. This research also revealed that science teachers exhibit different attitudes towards assessment at different periods in their teaching career. I can therefore conclude that the science teachers showed multiple but similar attitudes to assessment, which I have described as '*experience–induced and evolutionary'* with worthwhile or futile outcomes. The idea of the evolutionary nature

of science teachers' assessment attitudes and the factors that affect them is the key hypothesis unravelled in this study but can only be generalised to the sampling frame. Further studies are therefore required to test this hypothesis with a larger sample and possibly with teachers from other subject areas to ascertain its applicability to teachers in general.

6.2 Limitations

The generalisation of findings is restricted to the sampling frame. Science teachers who took part in the questionnaire were limited to those who often took part in the Association of Science Education (ASE) weekly online discussion forum. This limitation on its own can skew the views of the participants, as they often engage in personal voluntary Continual Professional Development (CPD). The interview process contributed to the findings but also presented its own limitation. The number and demography of the participants limited the findings, as they were unevenly distributed in the sampling frame. In addition, the data collection process involving the Twitter messaging tool limited the depth of the interview dialogue, although it enhanced the content validity of the data. The in-depth interviews with the science teachers from the East London schools aimed to mitigate this limitation by generating richer data, though it was still limited by demographic factors such as role of participants.

The finding that science teachers' attitudes towards assessment is evolutionary, and may be seasonal, suggests that the current findings were likely to change whilst the writing-up process was taking place. As Berliner (2002:20) argues, educational findings have a 'short half-life' resulting from the changes occurring in the social and educational environment. In spite of this, this research has presented an insight into science teachers' attitudes towards assessment and the different factors that can influence these. Further research thus needs to be carried out to understand science teachers' behaviour towards assessment. This will possibly require participant observation and interview. Alternatively, a larger survey of science teachers can be carried out to further confirm or refute these findings. Further research also needs to be carried out to ascertain the evolutionary and seasonal nature of teachers' attitudes

towards assessment. Perhaps interviewing the same participants over different periods during the school year may help to review this finding.

6.3 Recommendations

Teachers' attitudes towards assessment tend to evolve with the changes around them. Clearly, there are underlying factors driving these changes. Experience is the driving force for the evolutionary nature of science teachers' attitudes towards assessment. Teachers' experience is also the main factor that affects their attitude towards assessment. These experiences, which can be current or past, can alter their conceptions of assessment and teaching and learning, and influence their general attitudes towards assessment. Considering these findings, it is imperative that the right experience is created to ensure positive attitudes. Teachers should be exposed to constructive experiences that showcase the positives of assessment; those in which teachers will understand and feel the advantageous nature of assessment.

For policy makers, this experience can be achieved by getting more classroom teachers to be at the forefront of the development of assessment, both at national and school levels, so as to allow the development of practices through experiential learning in an authentic environment. A possible strategy for achieving this goal might be the development and management of a central on-line assessment database furnished by assessment practices developed and reviewed by teachers. The proposed database will allow teachers to share new practices developed, trial existing ones and give feedback on them. To make this more constructive, every government-funded school should be encouraged to contribute to it and use it. This database will not only showcase teachers' experiences and views of different assessment systems, but also provide rich contemporary findings into assessments in schools. This ultimately will aid policy makers in the development of policies to suit new educational needs. Through this system also, teachers will be exposed to constructive assessment experiences at an earlier stage as well as the evolving nature of assessments.

For school leaders, opportunities should be provided for teachers to reflect on the assessment practices they use and its effects. Perhaps, periodical assessment-related CPD programmes should be carried out in schools – where assessment practices are

reviewed and discussed. Although one can argue that the preferred attitudes should ideally be developed at an earlier stage, with the right experience, the preferred attitudes can still be developed at a later stage.

School teachers, on the other hand, should avail themselves of opportunities for constructive experiences - those which can be achieved through reflective practices and engagement in self-CPD activities. This can be achieved through peer observation with a focus on assessment, engagement in online CPDs centred on assessments and other allied topics such as teaching and learning, and, perhaps, the periodical reading of assessment-related literature.

Finally, findings from this study have implications for researchers too. In particular, the finding that indicated that teachers' assessment attitudes evolve and are never really static calls on researchers to take into consideration the evolutionary nature of assessment attitudes when carrying out long-term related studies. This, they can achieve by the periodic collection of data during the study. This recommendation not only allows the corroboration of the evolutionary nature of teachers' assessment attitudes, but allows a valid discussion of the study findings as they evolve. This means that researchers should consider the time of study in order to accommodate the different experiences that exist at different periods of a research project. Therefore, the time and length of the study should also be considered as variables in long-term assessment studies.

References

Abell, S. and Siegel, M. (2011) 'Assessment literacy: What science teachers need to know and be able to do?' In: Corrigan, D. *et al.* (eds.) *The professional knowledge base of science teaching.* New York: Springer 205–221.

Absolum, M. (2011) *Clarity in the classroom: Using formative assessment for building learning-focussed relationships.* Winniperg: Portage & Main Press
Livre N.Z. Ltd.

Absolum, M., Flockton, L., Hattie, J., Hipkins, R. and Reid, I. (2009) *Directions for assessment in New Zealand (DANZ): Developing students' assessment capabilities*. Available at: http://assessment.tki.org.nz/Media/Files/Directions-for-Assessment-in-New-Zealand (Accessed: 20 January 2016).

Ade-Ojo, G. O. (2011) *From symptom to Cure: Adult Literacy policy and practice in the Uk from the 1970s to the Moser Committee*. Lambert Academic Publishing, Hamburg.

Ade-Ojo, G. (2009) 'Socialising young literacy learners into a discourse of failure: Dominant discourses in literacy teaching and assessment and their impact on the progression of young literacy learners into employment.' *Occasional papers in Education and Lifelong Learning: An International Journal*, 3(1-2), 95-112.

Ainsworth, L. and Viegut, D. (2006) *Common Formative Assessments: How to Connect Standards-Based Instruction and Assessment*. Thousand Oaks: Corwin press.

Ajzen, I. (1989) 'Attitude structure and behaviour.' In: Pratkanis, A. *et al* (eds.) *Attitude structure and function*. Hillsdale, New Jersey: Lawrence Eribaum associates.

Ajzen, I. (1998) *Attitudes, personality and behaviour*. Chicago: The Dorsey press.

Ajzen, I. (2005) *Attitudes, personality and behaviour*. 2nd edn. Maidenhead: Open University press.

Alexander, P., Schallert, D. and Hare, V. (1991) 'Coming to terms: How researchers in learning and literacy talk about knowledge.' *Review of Educational Research*, 61, 315-343.

Alkharusi, H. (2011) 'A logistic regression model predicting assessment literacy among in-service teachers.' *Journal of Theory and Practice in Education*, 7, 280–291.

Alkharusi, H., Aldhafri, S., Alnabhani, H. and Alkalbani, M. (2012) 'Educational assessment attitudes, competence, knowledge, and practices: An exploratory study of Muscat teachers in the Sultanate of Oman.' *Journal of Education and Learning*, 1(2), 217-232.

Allanson, J., Kavanagh, D. and Thomas, N. (1990) 'Assessment and the National Curriculum: The standing of teachers and children.' *Curriculum Journal*, 1(2), 129 - 137.

Anderson, G. and Arsenault, N. (1998) *Fundamentals of educational research*. 2nd edn. London: RoutledgeFalmer.

Arce-Ferrer, A., Cab, V. and Cisneros-Cohernour, E. (2001) *Teachers' assessment competencies*. American Educational Research Association Annual meeting, 10-14 April, Seattle, WA. Available at: http://files.eric.ed.gov/fulltext/ED455280.pdf (Accessed: 12 January 2016).

Argyris, C. and Schön, D. (1974) *Theory in practice: Increasing professional effectiveness*. San Francisco: Jossey-Bass.

Arpan, L., Rhodes, N. and Roskos-Ewoldsen, D. (2007) 'Attitude accessibility: Theory, methods, and future directions', In: Roskos-Ewoldsen and Monahan (eds.) *Communication and social cognition: Theories and methods*. Mahwah, NJ: Lawrence Erlbaum Associates, 351-376

Ary, D., Jacobs, L., Sorensen, C. and Walker, D. (2013) *Introduction to research in education*, 9th edn. Wadsworth: Cengage learning.

Ashford, J. and LeCroy, C. (2009) *Human behaviour in the social environment: A multidimensional perspective*. 4th edn. Belmont: Cengage learning.

Assessment Reform Group (1999) *Assessment for Learning: Beyond the black box*. Cambridge: University of Cambridge, School of Education.

Assessment Reform Group (2002) *Assessment for learning: 10 principles*. Available at: http://cdn.aaia.org.uk/content/uploads/2010/06/Assessment-for-Learning-10-principles.pdf (Accessed: 21st April 2016).

Assessment reform group (2006) *The role of teachers in the assessment of learning*. Available at: http://cdn.aaia.org.uk/content/uploads/2010/06/The-role-of-teachers-in-the-assessment-of-learning.pdf (Accessed: 15 December 2015).

Atjonen, P. (2014) 'Teachers' views of their assessment practice.' *The Curriculum Journal*, 25(2), 238-259.

Avargil, S., Herscovitz, O. and Dori, Y. (2012) 'Teaching thinking skills in context-based learning: Teachers' challenges and assessment knowledge.' *Journal of Science Education and Technology*, 21(2), 207-225.

Aypay, A. (2011) 'The adaptation of the Teaching-Learning Conceptions questionnaire and its relationships with epistemological beliefs.' *Educational sciences: Theory and practice*, 11(1), 21-29.

Babbie, E (2011) *The practice of social research*. 13th edn. Belmont, CA: Wadsworth.

Babione, C. (2015) *Practitioner teacher inquiry and research.* San Francisco: Jossey-Bass.

Baker, L. (2008) 'Metacognition in comprehension instruction: What we've learned since NRP.' In Block. C and Parris, S. (eds.) *Comprehension instruction: Research based best practices*. New York: The Guilford Press 65-79.

Ball, J. (2003) 'The teacher's soul and the terrors of performativity' *Journal of Educational policy*, 18(2), 215 -228.

Banaji, M. and Heiphetz, L. (2010) 'Attitudes' In: Gilbert, D. and Fiske, S. (eds.) *Handbook of social psychology*. Hoboken, NJ: John Wiley & Sons 353-393.

Bassey, M. (1999) *Case study research in educational settings*. Buckingham: Open University press.

Bell, B. (2005) *Learning in science: The Waikato research*. London: RoutledgeFalmer.

Bell, B. and Cowie, B. (2001) *Formative assessment and science education*. New York: Kluwer academic publishers.

Benjamin, A. (2008) *Formative assessment for English language arts: A guide for middle and high school teachers*. New York: Eye on education.

Bennett, D. (2001) 'How can I deal with missing data in my study?' *Australian and New Zealand Journal of Public Health*, 25, 464 – 469.

Bennett, J., Braund, M., and Lubben, F. (2010) *The impact of targeted Continuing Professional Development (CPD) on teachers' professional practice in science*. *Main Report.* Report commissioned by the DFCS through the National Science Learning Centre. York: University of York, Department of Educational Studies.

Berliner, D. (2002) 'Educational research: The hardest science of all.' *Educational researcher*, 31(8), 18-20.

Berry, R. (2008) *Assessment for Learning*. Aberdeen: Hong Kong University Press.

Berry, R. (2010) ‘Teachers’ orientations towards selecting assessment strategies.’ *New Horizons in Education*, 58(1), 96-107.

Berry, R. (2013) ‘Assessment as learning framework for teaching and learning – The AaL wheel.’ *Assessment and learning*, 2, 51-70.

Berry, R. and Adamson, B. (2013) ‘Assessment reform past, present and future.’ In: Berry, R. and Adamson, B. (eds.) *Assessment reform in education: Policy and practice*. New York: Springer 3-14.

Beziat, T. and Coleman, B. (2015) ‘Classroom assessment literacy: Evaluating pre-service teachers.’ *The Researcher*, 27(1), 25-30.

Biggs, J. (1998) ‘Assessment and Classroom Learning: A role for summative assessment?’ *Assessment in Education*: *Principles, Policy and Practice,* 5 (1), 103–110.

Birenbaum, M., Breuer, K., Cascallar, E., Dochy, F., Dori, Y., Ridgway, J. and Wiesemes, R. (2006) ‘A learning integrated assessment system.’ *Educational Research Review*, 1, 61-67.

Black, P. (1998) *Testing, friend or foe: The theory of assessment and testing*. London: Falmer Press.

Black, P. and Atkin, M. (2014) ‘The central role of assessment in pedagogy.’ In: Lederman, N. and Abell, S. (eds.) *Handbook of research on science education.* Vol. II. New York: Routledge 775-790.

Black, P., Harrison, C., Hodgen, J., Marshall, B. and Serret, N. (2011) ‘Can teachers’ summative assessments produce dependable results and also enhance classroom learning?’ *Assessment in Education: Principles, Policy and Practice*, 18(4), 451-469.

Black, P., Harrison, C., Lee, C., Marshall, B. and Wiliam, D. (2003) *Assessment for learning: Putting it into practice*. Maidenhead: Open University press.

Black, P., Harrison, C., Lee, C., Marshall, B., and Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 86*(1), 8-21.

Black, P. and Wiliam, D. (1998) *Inside the black box: Raising standards through classroom assessment.* London: King's College London, School of Education.

Black, P. and Wiliam, D. (2006) 'Assessment for learning in the classroom.' In: Gardner, J. (ed.) *Assessment and learning*. 1st edn. London: SAGE 9-26.

Black, P. and Wiliam, D. (2009) 'Developing the theory of formative assessment.' *Educational assessment, evaluation and accountability*, 21(1), 5-31.

Blaikie, N. (2003) *Analyzing quantitative data*. London: SAGE Publications.

Blaikie, N. (2009) *Designing social research*. 2nd edn. Cambridge: Polity Press.

Bohner, G. and Wanke, M. (2002) *Attitudes and attitude change*. New York: Psychology Press.

Boone, H. and Boone, D. (2012) 'Analyzing likert data.' *Journal of extension*, 50 (2), 1-5.

Booth, B., Hill, M. and Dixon, H. (2014) 'The assessment-capable teacher: Are we all on the same page?' *Assessment Matters*, 6, 137 -157.

Bordens, K. and Horowitz, I. (2002) *Social psychology*. 2nd edn. Mahwah, NJ: Lawrence Erlbaum Associates.

Boud, D. (1988) 'Moving towards autonomy.' In: Boud, D. (ed.) *Developing students autonomy in learning*. Abingdon, Oxon: Taylor and Francis 17-39.

Boud, D. (1995) *Enhancing learning through self-assessment.* Abingdon: Routledge Falmer.

Braden, G. (2008) *The Spontaneous healing of belief: Shattering the paradigm of false limits*. Carlsbad: Hay House.

Broadfoot, P. (2007) 'Assessment for learners: Assessment literacy and the development of learning power.' In: Havnes, A. and McDowell, L. (eds.) *Balancing dilemmas in assessment and learning in contemporary education*. New York: Routledge 213-224.

Broekaert, J. (2005) 'The intrinsic multiplicity of science: Its internal and external confrontations.' In Aerts, D. *et al* (eds.) *Worldview, science and us: Re-demarcating knowledge and its social and ethical implication*. Singapore: World Scientific. 59-72.

Brookhart, S. (1999) 'The art and science of assessment: The missing part of pedgagogy.' *ASHE-ERIC Higher Education Report*, 21(1). Washington, DC: The George Washington University, Graduate School of Education and Human Development.

Brookhart, S. (2001) 'Successful students' formative and summative uses of assessment information.' *Assessment in Education: Principles, Policy and Practice*, 8(2), 153-169.

Brookhart, S. (2011) 'Educational assessment knowledge and skills for teachers.' *Educational Measurement: Issues and Practice*, 30 (1), 3 -12.

Brown, G. (2002) *Teachers' conceptions of assessment*. Unpublished Doctoral dissertation. Auckland, NZ: University of Auckland.

Brown, G. (2004b) 'Teachers' conceptions of assessment: Implications for policy and professional development.' *Assessment in Education: Principles, Policy and Practice*, 11(3), 301-318.

Brown, G. (2006) 'Teachers' conceptions of assessment: Validation of an abridged instrument.' *Psychological Reports, 99*(1), 166-170.

Brown, G. (2011) 'Teachers' conceptions of assessment: Comparing primary and secondary teachers in New Zealand.' *Assessment Matters, 3*, 45-70.

Brown, S. (2004a) 'Assessment for learning.' *Learning and teaching in higher education* 1, 81-89. Available at: http://www2.glos.ac.uk/offload/tli/lets/lathe/issue1/articles/brown.pdf (Accessed: 26 January 2016).

Brown, G., Bull, J. and Pendlebury, M. (1997) *Assessing student learning in higher education*. London: Routledge.

Brown, G. and Gao, L. (2015) 'Chinese teachers' conceptions of assessment for and of learning: Six competing and complementary purposes.' *Cogent Education*, 2 (1), 2-18.

Brown, G. and Harris, L. (2009) 'Unintended consequences of using tests to improve learning: How improvement-oriented resources heighten conceptions of assessment as school accountability' *Journal of MultiDisciplinary Evaluation*, 6(12), 68-91.

Brown, G. and Michaelides, M. (2011) 'Ecological rationality in teachers' conceptions of assessment across samples from Cyprus and New Zealand.' *European Journal of Psychology of Education*, 26(3), 319-337.

Brown, G. and Remesal, A. (2012) 'Prospective teachers' conceptions of assessment: A cross-cultural comparison' *Spanish Journal of Psychology*, 15(1), 75-89.

Bryman, A. (2006) 'Integrating quantitative and qualitative research: How is it done?' *Qualitative Research,* 6 (1), 97-113.

Butt, G. (2010) *Making assessment matter*. London: Continuum.

Byrne, B. (2012) 'Qualitative interviewing.' In: Searle, C. (ed.) *Researching Society and Culture*. 3rd edn. London: SAGE 205-226.

Cakir, M. (2008) 'Constructivist approaches to learning in science and their implications for science pedagogy: A Literature review.' *International Journal of Environmental and Science Education*, 3(4), 193-206.

Calderhead, J. (1996) 'Teachers: Beliefs and knowledge.' In: Berliner, D. and Calfee, R. (eds.) *Handbook of educational psychology*. New York: Macmillan Library Reference 709-725.

Calveric, S. (2010) *Elementary teachers' assessment beliefs and practices*. Doctoral dissertation, Virginia Commonwealth University, Virginia, USA. Available at: http://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=3331&context=etd (Accessed: 20 November 2015).

Carless, D. (2005) 'Prospects for the implementation of assessment for learning.' *Assessment in Education: Principles, Policies and Practice,* 12(1), 39–54.

Chan, K. (2001) *Validation of a measure of personal theories about teaching and learning*. Paper presented in the AARE 2001 Conference held at Fremantle, Perth from 2nd Dec. to 6th Dec.

Chan, K. (2004) 'Preservice teachers' epistemological beliefs and conceptions about teaching and learning: Cultural implications for research in teacher education. *Australian Journal of Teacher Education, 29*(1), 2-13.

Chan, K. and Elliot, R. (2004) 'Relational analysis of personal epistemology and conceptions about teaching and learning.' *Teaching and Teacher Education*, 20(8), 817- 831.

Chappuis, S., Stiggins, R., Arterr, J. and Chappuis, J. (2004) *Assessment for learning: An action guide for school leaders*. Portland, Oregon: Assessment training institute.

Charlton, B. (2005) *Informal assessment strategies*. Markham, Ontario: Pembroke Publishers.

Chin, P., Munby, H., Hutchinson, N., Taylor, J. and Clark, F. (2004) 'Where's the science? Understanding the form and function of workplace science.' In: Murphy, P. *et al* (eds.) *Reconsidering science learning*. London: RoutledgeFalmer 118-134.

Cizek, G., Fitzgerald, S. and Rachor, R. (1995) 'Teachers' assessment practices: Preparation, isolation, and the kitchen sink.' *Educational Assessment*, 3(2), 159-179.

Clark, I. (2011) 'Formative assessment: Policy, perspectives and practice.' *Florida Journal of Educational Administration and Policy,* 4 (2), 158-180.

Clark, I. (2012) 'Formative assessment: Assessment is for self-regulated learning.' *Educational Psychology Review*, 24 (2), 205-249.

Clark-Carter, D. (2009) *Quantitative psychological research: The complete student's companion.* 3rd edn. Hove, East Sussex: Psychology Press.

Cochran, K. (1997) 'Pedagogical content knowledge: Teachers' integration of subject matter, pedagogy, students and learning environments.' *Research Matters- to the science teacher,* 9702. Available at: https://www.narst.org/publications/research/pck.cfm (Accessed: 15 February 2016).

Cochran, K., DeRuiter, J. and King, R. (1993) 'Pedagogical content knowing: An integrative model for teacher preparation.' *Journal of Teacher Education*, 44(4), 263-272.

Cohen, L., Manion, L. and Morrison, K. (2007) *Research methods in education*. 6th edn. Abingdon: Routledge.

Cohen, L., Manion, L. and Morrison, K. (2011) *Research methods in education*. 7th edn. Abingdon: Routledge.

Cohen, V. and Cowen, J. (2006) *Literacy for children in an information age: Teaching reading, writing and thinking*. Belmont, CA: Thompson Higher Education.

Cole, R., Aloisi, C., Higgins, S. and Major, L. (2014) *What makes great teaching? Review of the underpinning research*. Available at: http://www.suttontrust.com/wp-content/uploads/2014/10/What-makes-great-teaching-FINAL-4.11.14.pdf (Accessed: 10 January 2015).

Commission on Assessment without levels final report (2015) Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483058/Commission_on_Assessment_Without_Levels_-_report.pdf (Accessed: 14 April 2016).

Coon, D. and Mitterer, J. (2015) *Introduction to psychology: Gateways to mind and behaviour*. 14th edn. Boston: Cengage learning.

Corder, G. and Foreman, D. (2009) *Nonparametric statistics for non-statisticians*. Hoboken, N.J.: Wiley.

Corrigan, D., Buntting, C., Jones, A. and Gunstone, R. (2013) 'Valuing assessment in science education: An introductory framework.' In: Corrigan, D. *et al* (eds.) *Valuing assessment in science education: Pedagogy, curriculum, policy*. New York: Springer 1 -10.

Creswell, J. (2013) *Research design: Qualitative, quantitative and mixed methods approaches*. 4th edn. Thousand Oaks: SAGE publications.

Creswell, J. and Plano Clark, V. (2011) *Designing and conducting mixed methods research*. 2nd edn. Thousand Oaks, CA: SAGE.

Crotty, M. (1998*) The Foundations of Social Research: Meaning and perspective in the research process.* London: SAGE publications.

Dake, D. and Weinkein, J. (1997) ‘A user-friendly guide to assessment in visual arts’ In: Phye, G. (ed.) *Handbook of classroom assessment: Learning, adjustment and achievement*. San Diego: Academic press 417-480.

Das, R. (1985) Science teaching in schools. New Delhi: Sterling publishers.

Davis, D. and O'Donohue, T. (2004) ‘The road to perdition: "Extreme influence" tactics in the interrogation room.’ In: O'Donohue, V. and Levensky, E. (eds.) *Handbook of forensic psychology: Resource for mental health and legal professionals.* New York: Elsevier Academic Press 897-996.

DeBoer, G. (2000) ‘Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform.’ *Journal of Research in Science Teaching*, 37(6), 582-601.

DeLuca, C., LaPointe-McEwan, D. and Luhanga, U. (2015) ‘Teacher assessment literacy: A review of international standards and measures.’ *Educational Assessment, Evaluation and Accountability*, 1-22.

Department for Children, Schools and Families (2008) *The Assessment for learning strategy.* Nottingham: DCSF publications.

Department of Education (2013a) *Teachers’ Standards*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208682/Teachers__Standards_2013.pdf (Accessed: 21 November 2013).

Department of Education (2013b) Assessing without levels. Available at: http://www.education.gov.uk/schools/teachingandlearning/curriculum/nationalcurriculum2014/a00225864/assessing-without-levels (Accessed: 23 November 2013).

Department of Education (2013c) *Science programmes of study: Key stage 3 National curriculum in England*. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335174/SECONDARY_national_curriculum_-_Science_220714.pdf (Accessed: 20 August 2015).

Descheemaeker, M., Spruyt, A., Fazio, R. and Hermans, D. (2016) 'On the generalization of attitude accessibility after repeated attitude expression' *European Journal of Social psychology*. Available at: http://onlinelibrary.wiley.com/doi/10.1002/ejsp.2206/epdf (Accessed: 12 August 2016).

De Vries, S., Van de Grift, W. and Jansen, E. (2014) 'How teachers' beliefs about learning and teaching relate to their continuing professional development.' *Teachers and Teaching: Theory and Practice*, 20(3), 338-357.

DfES (2007) *Assessment for learning 8 schools project report*. London: DfES

Dixon, H., Hawe, E. and Parr, J. (2011) 'Enacting assessment for learning: The beliefs practice nexus.' *Assessment in Education: Principles, Policy and Practice*, 18(4), 365-379.

Drummond, M. (2003) *Assessing children's learning.* 2nd edn. Abingdon, Oxon: Routledge.

Duschl, R., Schweingruber, H. and Shouse, A. (eds.) (2007) *Taking science to school: Learning and teaching science in grades K-8*. Washington, D.C: National Academies Press.

Eagly, A. and Chaiken, S. (1998) 'Attitude structure and function.' In: Gilbert, D. *et al* (eds.) *The handbook of social psychology*. 4th edn. Boston: McGraw-Hill 269-322.

Earl, L. (2003) *Assessment as learning: Using classroom assessment to maximise student learning*. California: Corwin Press.

Earl, L. (2013) *Assessment as learning: Using classroom to maximise student learning.* 2nd edn. Thousands Oaks: Corwin.

Edwards, F. (2013) 'Quality assessment by science teachers: Five focus areas.' *Science Education International*, 24(2), 212 -226.

Elmore, R. (2003) 'Accountability and capacity.' In: Carnoy *et al* (eds.) *The new accountability: High schools and high-stakes testing*. New York: RoutledgeFalmer 195-209.

Ember, C. and Ember, M. (2009) *Cross-cultural research methods*. 2nd edn. Lanham: Altamira.

Erber, M. and Hodges, S. (1995) 'Attitude strength, attitude stability, and the effects of analysing reasons' In: Petty. R. and Krosnick, J. (eds.) *Attitude strength: Antecedents and consequences*. Mahwah, NJ: Erlbaum 433-454.

Ercikan, K. (2006) 'Development in assessment of student learning and achievement.' In: Alexander, P. and Winne, P. (eds.) *Handbook of educational psychology*.2nd edn. Mahwah, NJ: Lawrence Erlbaum 929-952

Fabrigar, L., MacDonald, T. and Wegener, D. (2005) 'The structure of attitudes.' In: Albarracin, D. *et al* (eds.) *The handbook of attitudes*. New York: Psychology press 79-124.

Farmery, C. (2002) *Teaching science 3-11: The essential guide*. London: Continuum.

Farmery, C. (2005) *Getting the buggers into science*. London: Continuum.

Fazio, R., Powell, M. and Williams, C. (1989) 'The role of attitude accessibility in the attitude-to-behavior process.' *The Journal of Consumer Research*, 16 (3), 280-288.

Fazio, R. and Roskos-Ewoldsen, D. (2005) 'Acting as we feel: When and how attitudes guide behavior.' In: Brock, T. and Green, M. (eds.), *Persuasion: Psychological insights and perspectives*. 2nd edn. Thousand Oaks, CA: SAGE 41-62.

Fazio, R. and Zanna, M, (1981) 'Direct experience and attitude-behavior consistency.' *Advances in Experimental Social Psychology*, 4, 161-202.

Fensham, P. (2013) 'International assessments of science learning: Their positive and negative contributions to science education' In: Corrigan, D. *et al* (eds.) *Valuing assessment in science education: Pedagogy, curriculum, policy.* New York: Springer 11-32.

Fien, J. (2007) 'Care and compassion: Values commitment and attitude clarification in education' In: Maclean, R. (ed.) *Education in learning and teaching for the twenty-first centur*y: *Festschrift for Professor Philip Hughes*. New York: Springer 197 – 232.

Fishbein, M. and Ajzen, I. (2010) *Predicting and changing behavior: The reasoned action approach.* New York: Psychology press.

Flórez, M. and Sammons, P. (2013) *Assessment for learning: Effects and impact*. Berkshire: CfBT Education Trust.

Fox, S. and Surtees, L. (2010) Mathematics across the curriculum: Problem-solving, reasoning and numeracy in primary schools. London: Continuum.

Freeman, R. and Lewis , R. (1998) *Planning and implementing assessment*. London: RoutledgeFalmer.

Gadsby, C. (2012) *Perfect assessment for learning*. Carmarthen: Independent thinking press.

Gannon-Slater, N. (2014) *Reframing teachers' conceptions of assessment and data use.* Doctoral dissertation, University of Illinois, Urbana, USA. Available at https://www.ideals.illinois.edu/bitstream/handle/2142/49730/Nora_Gannon-Slater.pdf? sequence=1&isAllowed=y (Accessed: 20 April 2016).

Gardner, J., Harlen, W., Hayward, L. and Stobart, G. (2008) *Changing assessment practice: Process, principles and standards*. Available at: http://www.aaia.org.uk/content/uploads/2010/06/ARIA-Changing-Assessment-Practice-Pamphlet-Final.pdf (Accessed: 20 October 2015).

Gareis, C. and Grant, L. (2015) *Teacher-made assessments: How to connect curriculum, instruction and student learning*. 2nd edn. New York: Routledge.

Gawronski, B., Hofmann, W. and Wilbur, C. (2006) 'Are "implicit" attitudes unconscious?' *Consciousness and Cognition*, 15, 485-499.

George, S. (2013) 'Teachers' goal orientations and conceptions of teaching and learning: An exploratory study' *International Journal of pedagogy and curriculum*, 19(3), 109-118.

Gillard, D. (2011) *Education in England: A brief history*. Available at: http://www.educationengland.org.uk/history/ (Accessed 23 March 2016).

Gillham, B. (2008) *Developing a questionnaire*. 2nd edn. London: Continuum.

Giner-Sorolla, R. (2004) 'Is affective material in attitudes more accessible than cognitive material? The moderating role of attitude basis.' *European Journal of Social Psychology* 34(6), 761-780.

Glasson, T. (2009) *Improving student achievement: A practical guide to assessment for learning*. Victoria: Curriculum Corporation.

Glynn, S. and Duit, R. (1995) 'Learning science meaningfully: Constructing conceptual models.' In: Glynn, S. and Duit, R. (eds.) *Learning Science in the Schools: Research reforming practice*. Mahwah, New Jersey: Lawrence Erlbaum Associates 1-34.

Goldman, A. (1986) *Epistemology and cognition*. Cambridge, MA: Harvard University Press.

Goldschmidt, P. and Phelps, G. (2007) *Does teacher professional development affect content and pedagogical knowledge: How much and for how long?* Available at: https://www.cse.ucla.edu/products/reports/R711.pdf (Accessed: 20 November 2015).

Golombek, P. (1998) 'A study of language teachers' personal practical knowledge.' *TESOL quarterly*, 32(3), 447-464.

Goodwin, C. (2009). *Research in psychology*: *Methods and design*. 6th edn. New York : Wiley.

Gotch, M. (2012) *An investigation of teacher educational measurement literacy*. Ph.D. thesis, Washington state University. Available at: http://research.wsulibs.wsu.edu/xmlui/bitstream/handle/2376/4284/Gotch_wsu_0251E_10513.pdf?sequence=1 (Accessed on 10 November 2013).

Gotch, C. and French, B. (2014) 'A systematic review of assessment literacy measures.' *Educational Measurement: Issues and Practice*, 33(2), 14-18.

Gottheiner, D. and Siegel, M. (2012) 'Experienced middle school science teachers' assessment literacy: Investigating knowledge of students' conceptions in genetics and ways to shape instruction.' *Journal of Science Teacher Education*, 23(5), 531-557.

Gray, D. (2009) *Doing research in the real world*. 2nd edn. London: SAGE publications.

Green, D. (2014) *Give me a chance to grow up*. Bloomington, IN: AuthorHouse.

Greene, J., Caracelli, V. and Graham, F. (1989) 'Toward a conceptual framework for mixed-method evaluation designs.' *Educational evaluation and policy analysis*, 11(3), 255-274.

Gregoire, M. (2003) 'Is it a challenge or a threat? A dual-process model of teachers' cognition and appraisal processes during conceptual change.' *Educational Psychology Review*, 15 (2), 147-179.

Griffiths, T., Gore, J. and Ladwig, J. (2006) *Teachers' fundamental beliefs, commitment to reform, and the quality of pedagogy*. Australian Association for Research in Education annual conference, 26-30 November, Adelaide.

Gruenert, S. and Whitaker, T. (2015) *School culture rewired: How to define, assess, and transform it.* Alexandria, VA: ASCD.

Gu, Q. (2007) *Teacher development: Knowledge and context.* London: Continuum.

Guba, E. (1990) 'The alternative paradigm dialog.' In: Guba, E. (ed.) *The Paradigm dialog*. Newbury Park, CA: SAGE publications 17-28.

Guba, E. and Lincoln, Y. (1994) 'Competing paradigms in qualitative research.' In: Denzin, N. and Lincoln, Y. (eds.) *Handbook of qualitative research.* Thousand Oaks, CA: SAGE publications 105-117.

Hall, R. (2008) *Applied social research: Planning, designing and conducting real-world research*. South Yarra: Palgrave Macmillan.

Hargreaves, E. (2005) 'Assessment for learning? Thinking outside the (black) box.' *Cambridge Journal of Education,* 35 (2), 213-224.

Harlen, W. (2005) 'Teachers' summative practices and assessment for learning – tensions and synergies.' *Curriculum Journal*, 16(2), 207-223.

Harlen, W. (2006) 'On the relationship between assessment for formative and summative purposes.' In: Gardner, J. (ed.) *Assessment and learning.* 1st edn. London: SAGE 103 -118.

Harlen, W. (2007) *Assessment of learning*. London: SAGE Publications.

Harlen, W. (2010) 'What is quality teacher assessment?' In: Gardner *et al* (eds.) *Developing Teacher Assessment.* Maidenhead: Open University McGraw-Hill 29-52.

Harlen, W. (2012) 'On the relationship between assessment for formative and summative purposes.' In: Gardner, J. (ed.) *Assessment and learning* 2nd edn. London: SAGE 87-102.

Harlen, W and Deakin Crick, R (2002) 'A systematic review of the impact of summative assessment and tests on students' motivation for learning', *Research Evidence in Education Library*. London: EPPI-centre, Institute of Education, University of London. Available at: http://eppi.ioe.ac.uk/eppiwebcontent/reel/review_groups/assessment/ass_rv1/ass_rv1.pdf (Accessed: 20 January 2015).

Harlen, W and Deakin Crick, R (2003) 'Testing and motivation for learning.' *Assessment in Education: Principles, Policy and Practice*, 10 (2), 169-207.

Harlen, W., Gipps, C., Broadfoot, P. and Nuttall, D. (1992) 'Assessment and the improvement of education.' *The Curriculum Journal*, 3 (3), 215-230.

Harris, L. and Brown, G. (2008) 'The complexity of teachers' conceptions of assessment: Tensions between the needs of schools and students.' *Assessment in Education Principles Policy and Practice*, 16(3), 347-363.

Hartas, D. (2010) 'Educational research and inquiry: Key issues and debates.' In: Hartas, D. (ed.) *Educational research and inquiry*: *Qualitative and quantitative approaches.* London: Continuum 13-32.

Hassanein, E. (2015) *Inclusion, disability and culture*. Rotterdam: Sense publishers.

Hatch, A. (2002) *Doing qualitative research in education settings*. Albany: State University of New York.

Hattie, J. and Timperley, H. (2007) 'The power of feedback.' *Review of Educational Research*, 77(1), 81–112.

Hewstone, M. (2011) *Understanding attitudes to the European community: A social-psychological study in four member states*. Cambridge: Cambridge university press.

Hill, M (2011) ‘‘Getting traction’: Enablers and barriers to implementing assessment for learning in secondary schools.’ *Assessment in Education: Principles, Policy and Practice*, 18(4), 347-364.

Hodgson, C. and Pyle, K. (2010) A literature review of assessment for learning in science. Slough: NFER. Available at http://www.nfer.ac.uk/nfer/publications/AAS01/AAS01.pdf (Accessed: 3 Feburary 2013).

Hodson, D. (1998) ‘Science Fiction: The continuing misrepresentation of science in the school curriculum.’ *Curriculum Studies,* 6(2), *191-216.*

Holbrook, J. and Rannikmae, M. (2009) ‘The Meaning of scientific literacy.’ *International Journal of Environmental and Science Education,* 4(3), 275-288.

Holmes, J. and Singh, S. (2012) *Social psychology: Student handbook to psychology*. Vol 7. New York: Facts on file.

Hoque, S. (2013) ‘Effect of reinforcement on Teaching – Learning process.’ *IOSR Journal of Humanities and Social Science,* 7(1), 13-16.

Hornby, W. (2003) ‘Assessing using grade-related criteria: A single currency for universities?’ *Assessment and Evaluation in Higher Education,* 28 (4), 435 – 454.

House of Commons, Childrens, Schools and Families committee (2009) *National Curriculum: Fourth report of session 2008-09*. Vol. 1. London: The stationery office.

House of Commons, Childrens, Schools and Families committee (2010) *Training of teachers: Fourth report of session 2009-10*. Vol. 1. London: The stationery office.

Howley, M., Howley, A., Henning, J., Gilla, B. and Weade, G. (2013). ‘Intersecting domains of assessment knowledge: School typologies based on interviews with secondary teachers.’ *Educational Assessment*, 18(1), 26-48.

Hsieh, H. and Shannon, S. (2005) 'Three approaches to qualitative content analysis.' *Qualitative Health Research*, 15(9), 1277-1288.

Hui, S.(2012) 'Missing conceptions of assessment: Qualitative studies with Hong Kong curriculum leaders.' *The Asia-Pacific Education Researcher*, 21, 375–383.

Institute for Learning (2012) *Professionalism: Education and training practitioners across further education and skills*. Available at: https://set.et-foundation.co.uk/media/110497/2012_10-IfL-professionalism-paper.pdf (Accessed: 26 February 2016)

Isaacs, T., Zara, C., Graham, H., Coombs, S. and Smith, C. (2013). *Key concepts in educational assessment*. London: SAGE.

James, M. and Pedder, D**.** (2006) 'Beyond method: Assessment and learning practices and values.' *The Curriculum Journal,* 17(2), 109-138.

Jameson, J. and Hillier, Y. (2003) *Researching post-compulsory education*. London: Continuum.

Jamieson S. (2004) 'Likert scales: how to (ab)use them.' *Medical. Education*, 38(12), 1212-1218.

Johnson, B. and Boynton, M. (2010) 'Putting attitudes in their place: Behavioural prediction in the face of competing variables' In: Forgas, J. *et al* (eds.) *The psychology of attitudes and attitude change*: *The Sydney symposium of social psychology*. New York: Psychology Press 19-39.

Johnson, B. and Christensen, L. (2014) *Educational research*. 5th edn. Los Angeles: SAGE Publications.

Johnson, B. and Onwuegbuzie, A. (2004) 'Mixed methods research: A research paradigm whose time has come.' *Educational Researchers*, 33(7), 14-26.

Jones, M. and Leagon, M. (2014) 'Science teacher attitudes and beliefs: Reforming practice.' In: Lederman, N. and Abell, S. (eds.) *Handbook of research on science education* Vol 2 New York: Routledge 830-847.

Kagan, D. (1992) 'Implications of research on teacher belief.' *Educational Psychologist*, 27(1), 65-90.

Kahl, S. (2005) 'Where in the world are formative tests? Right under your nose!' *Education Week*, 25(4), 11.

Kahl, S., Hofman, P., and Bryant, S. (2013) *Assessment literacy standards and performance measures for teacher candidates and practicing teachers*. Dover, NH: Measured Progress.

Kahn, E. (2000) 'A case study of assessment in a grade 10 English course.' *The Journal of Educational Research*, 93, 276-286

Kallgren, C., and Wood, W. (1986) 'Access to attitude-relevant information in memory as a determinant of attitude-behavior consistency.' *Journal of Experimental Social Psychology*, 22, 328–338.

Karaağac, M. and Threlfall, J. (2004) 'The tension between teacher beliefs and teacher practice: The impact of the work setting.' In: Høines, J. and Fuglestad, A. (eds.) *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education*, 3 , 137-144.

Kaser, L. and Halbert, L. (2009) *Leadership mindsets: Innovation and learning in the transformation of schools*. New York: Routledge.

Keller, G. (2014) *Statistics for Management and Economics*. 10th edn. Stamford: Cengage learning.

Kelly, A. (2009) *The curriculum: Theory and practic*e. 6th edn. London: SAGE publications.

Keogh B. and Naylor S. (1996) *Teaching and learning in science: A new perspective.* Paper presented at the BERA Conference, Lancaster, UK. Available at: http://www.leeds.ac.uk/educol/documents/000000115.htm (Accessed: 12 March 2015).

Killam, L. (2013) *Research terminology simplified: Paradigms, axiology, ontology, epistemology and methodology*. Sudbury, ON: Author.

Kind, V. and Taber, K. (2005) *Science: Teaching school subjects 11-19*. Abingdon: Routledge.

Kitiashvili, A. (2014) 'Teachers' attitudes toward assessment of student learning and teacher assessment practices in general educational institutions: The case of Georgia.' *Improving Schools*, 17(2), 163-175.

Klenke, K. (2008) *Qualitative research in the study of leadership*. Bingley: Emerald Group Publishing.

Koretz, D. (2008) *Measuring up: What educational testing really tells us*. Cambridge, Massachusetts: Harvard university press.

Kuzon W., Urbanchek M. and McCabe S. (1996) 'The seven deadly sins of statistical analysis.' *Annals of Plastic Surgery*, 37(3), 265-272.

Krosnick, J. and Smith, W. (1994) 'Attitude strength.' In: Ramachandran, V. (ed.) *Encyclopedia of human behavior*. San Diego, CA: Academic Press 279-289.

Lambert, D. and Lines, D (2000) *Understanding assessment: Purposes, perceptions, practice*. Abingdon Oxon: Routledge.

Leong, W. (2014) 'Understanding classroom assessment in dilemmatic spaces: Case studies of Singaporean music teachers' conceptions of classroom assessment.' *Music Education Research*, 16(4), 454-470.

Loddington, S. (2008) *Peer assessment of group work: A review of the literature*. Available at: http://webpaproject.lboro.ac.uk/files/WebPA_Literature%20review%20.pdf (Accessed : 03 May 2012).

Lodico, M., Spaulding, D. and Voegtle, K. (2010) *Methods in educational research: From theory to practice*. 2nd edn. San Francisco: Jossey-Bass.

Loucks-Horsley, S., Hewson, P., Love, N. and Stiles, K. (1998). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: SAGE.

Loughran, J., Berry, A. and Mulhall, P. (2012) *Understanding and developing Science teachers' pedagogical content knowledge*. 2nd edn. Rotterdam: Sense publishers.

Lumpe, A., Haney, J. and Czerniak, C. (2000) 'Assessing teachers' beliefs about their science teaching context.' *Journal of Research in Science Teaching*, 37(3), 275–292.

Lyon, E. (2011) 'Beliefs, practices and reflection: Exploring a science teacher's classroom assessment through the assessment triangle model.' *Journal of Science Teacher Education*, 22, 417-435.

Lyon, E. (2013) 'Learning to assess science in linguistically diverse classrooms: Tracking growth in secondary science preservice teachers' assessment expertise.' *Science Education*, 97(3), 442-467.

Mackey, A. and Gass, S, (2015*) Second language research: Methodology and design.* 2nd edn. New York: Routledge.

Magnusson, S., Krajcik, J. and Borko, H. (1999) 'Nature, sources and development of pedagogical content knowledge for science teaching.' In: Gess-Newsome, J. and Lederman, N. (eds.) *Examining pedagogical content knowledge*. Dordrecht: Kluwer Academic publishers 95-132.

Maio, G. and Haddock, G. (2015) *The psychology of attitudes and attitude change*.2nd rev edn. London: SAGE Publications.

Maio, G., Olson, J., Bernard, M. and Luke, M. (2003) 'Ideologies, values, attitudes and behaviour.' In: DeLamater, J.(ed.) *Handbook of social psychology*. New York: Kluwer Academic 283-308.

Mansour, N. (2009) 'Science teachers' beliefs and practices: Issues, implications and research agenda.' *International Journal of Environmental & Science Education*, 4(1), 25-48.

Marshall, C. and Rossman, G. (2010) *Designing qualitative research*. 5th edn. Thousand Oaks, California: SAGE Publications.

Maughan, S., Teeman, D. and Wilson, R. (2012) *What leads to positive change in teaching practice.* Slough: NFER.

Marzano, R. (2006) *Classroom assessment and grading that work*. Alexandria: ASCD.

McKellar, E. (2002) *Change our assessment practices? Why should we? The theory behind assessment practices*. Available at: http://www.leeds.ac.uk/educol/documents/00002239.htm (Accessed: 18 October 2015).

McKenzie, W. (2005) *Multiple intelligences and instructional technology* 2nd edn. Eugene, Oregon: International Society for Technology in Education.

McMillan, J. (2000) 'Fundamental assessment principles for teachers and school administrators.' *Practical assessment, research and evaluation*, 7 (8). Available at: http://pareonline.net/getvn.asp?v=7&n=8 (Accessed: 4 April 2015).

Meho, L. (2006) 'E-mail interviewing in qualitative research: A methodological discussion.' *Journal of the American Society for Information Science and Technology*, 57(10), 1284-1295.

Mertler, C. (2003) *Pre service versus inservice teachers' assessment literacy: Does classroom experience make a difference*? Mid-Western Educational Research Association, Annual meeting, 15-18 October, Columbus, OH. Available at: http://wps.ablongman.com/wps/media/objects/1530/1567095/tchassesslit.pdf (Accessed: 20 September 2013).

Mertler, C. (2004) 'Secondary teachers' assessment literacy: Does classroom experience make a difference?' *American Secondary Education, 33*(1) 49–64.

Mertler, C. and Campbell, C. (2005) *Measuring teachers' knowledge and application of classroom assessment concepts: Development of the assessment literacy inventory*. American Educational Research Association Annual meeting, 11-15 April, Montréal, Quebec. Available at http://files.eric.ed.gov/fulltext /ED490355. pdf (Accessed: 10 September 2013).

Millar, R. (2013) 'Improving science education: Why assessment matters.' In: Gunstone, R. *et al* (eds.) *Valuing assessment in science education: Pedagogy, curriculum, policy*. Dordrecht: Springer 55-68.

Miller, P. (2011) 'Epistemic shifts in Caribbean teacher identify: Overseas trained teachers in England.' In:Manik and Singh (eds.) *Global mobility and migration of teachers: Issues, identities and infringements*. Delhi: Kamla – Raj enterprises 71-82.

Miller, P., Potter, I.., Bennett, K., Carter, T., Hylton-Fraser, K., WilliamsonTeape, K. and Nelson-Maye, S. (2015) 'Crossing the border: Reconstructing and re-aligning teacher and principal identities through a study tour.' *Journal of Adult and Continuing Education*, 21 (1), 31-47.

Minstrell, J., Anderson, R., Kraus, P. and Minstrell, J. (2008) 'From practice to research and back: Perspectives and tools in assessing for learning.' In: Coffey, J. *et al* (eds.) *Assessing science learning: Perspectives from research and practice*. Washington, DC: NSTA Press 37-72.

Moliner, P. and Tafani, E. (1997) 'Attitudes and social representations: A theoretical and experimental approach.' *European Journal of Social Psychology*, 27(6), 687–702.

Moiinvaziri, M. (2015) 'University teachers' conception of assessment: A structural equation modeling approach.' *Journal of Language, Linguistics and Literature* 1(3), 75-85.

Msendekwa, M.(2015) *Epistemological and pedagogical beliefs of pre-service and in-service teachers in a Tanzanian context*. Education Dissertations. Paper 2.

Murphy, K and Mason, L. (2006) 'Changing knowledge and changing beliefs.' In Alexander, P. and Winne, P. (eds.) *Handbook of Educational Psychology*. 2nd edn. New York: Routledge 305-326.

Murray, J (2013a) *Designing and implementing effective professional learning*. Thousand Oaks: Corwin.

Murray, J. (2013b) 'Likert Data: What to use, parametric or non-parametric?' *International Journal of Business and Social Science*, 4(11), 258-264.

National Union of Teachers (2014) *Teachers and workload*: *Report of an NUT survey about teachers' views on workload, its impact on teachers and their families and on teacher supply, and the steps needed to make the situation better*. Available at: https://www.teachers.org.uk/files/teachers-and-workload-survey-report-september-2014.pdf (Accessed: 23 October 2015).

Newfields, T. (2006) '*Teacher development and Assessment literacy*. Authentic communication: Proceedings of the 5th Annual JALT Pan-SIG Conference, 13-14

May, Tokai University College of Marine Science Shizuoka, Japan: Available at: http://jalt.org/pansig/2006/HTML/Newfields.htm (Accessed: 9 January 2013).

Nonaka, I. and Takeuchi, H. (1995). *The knowledge-creating company*. New York: Oxford University Press

Norman, G. and Streiner, D. (2008) *Biostatistics*: *The bare essentials*. 3rd edn. Hamiliton: BC Decker.

O'Dwyer, L. and Bernauer, J. (2013) *Quantitative research for the qualitative researcher*. Thousand Oaks, California: SAGE publications.

OECD (2005a) *Formative Assessment: Improving learning in secondary classrooms*. Paris: OECD.

OECD (2005b) 'Formative assessment: Improving learning in secondary classrooms.' *Policy brief*. Available at: https://www.oecd.org/edu/ceri/35661078.pdf (Accessed: 21 January 2016).

OECD (2009) *Creating effective teaching and learning environments: First results from TALIS*. Paris: OECD publishing.

OECD (2013) *PISA 2015 draft science framework*. Available at: https://www.oecd.org/pisa/pisaproducts/Draft%20PISA%202015%20Science%20Framework%20.pdf (Accessed: 17 January 2016)

Office for Standards in Education (2003) *Good assessment in secondary schools*. Available at: http://www.ofsted.gov.uk/Ofsted-home/Forms-and-guidance/Browse-all-by/Other/General/Good-assessment-in-secondary-schools (Accessed: 10 May 2012).

Ofsted (2013) *Maintaining curiosity: A survey into science education in schools.* Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_

data/file/379164/Maintaining_20curiosity_20a_20survey_20into_20science_20education_20in_20schools.pdf (Accessed: 17 January 2016).

Olson, J. and Maio, G. (2003) 'Attitudes in social behavior.' In: Millon, T. and Lerner, M. (eds.) *Comprehensive handbook of psychology: Personality and social psychology*. Vol 5. Hoboken, NJ: Wiley 299-325.

Osborne, J. (2007) 'Science education for the twenty first century.' *Eurasia Journal of Mathematics, Science and Technology Education,* 3(3), 173-184.

Osborne, J. (2010) 'Science for citizenship.' In: Osborne, J. and Dillon, J. (eds) *Good practice in science teaching: What research has to say.* 2nd edn. Maidenhead: Open university press 46-67.

Osborne, J. (2014) 'Scientific practices and inquiry in the science classroom.' In: Lederman, N. and Abell, S. (eds.) *Handbook of research on science education.* Vol. II. New York: Routledge 579 - 599.

Osgood, C., Tannenbaum, P. and Suci, G, (1957) *The Measurement of Meaning*. Urbana: University of Illinois Press.

Oskamp, S. and Schultz, P. (2005) *Attitudes and opinions*. 3rd edn. New York: Psychology press.

Pajares, M. (1992) 'Teachers' beliefs and educational research: Cleaning up a messy construct.' *Review of Educational Research*, 62(3), 307-332.

Patton, M. (2002) *Qualitative research and evaluation methods*. Thousand Oaks, CA: SAGE.

Pellegrino, J. (2009) *The design of an assessment system for the race to the top: A learning sciences perspective on issues of growth and measurement*. Exploratory seminar: Measurement challenges within the race to the top agenda, December 2009.

Available at: http://www.ets.org/Media/Research/pdf/PellegrinoPresenterSession1.pdf (Accessed: 29 March 16).

Pellegrino, J. (2012) 'The design of an assessment system focused on student achievement: A learning sciences perspective on issues of competence, growth and measurement.' In: Bernholt, S. *et al* (eds.) *Making it tangible: Learning outcomes in science education*. Münster: Waxmann 79-108.

Pellegrino, J. (2013) 'Proficiency in science: Assessment challenges and opportunities.' *Science*, 340(6130), 320-323.

Pellegrino, J. (2014) 'Assessment as a positive influence on 21st century teaching and learning: A systems approach to progress.' *Psicología Educativa* 20 (2) 65-77.

Pellegrino, J., Chudowsky, N. and Glaser, R. (2001) *Knowing what students know: The science and design of educational assessment.* Washington: National Academy press.

Pellegrino, J. and Wilson, M. (2015) 'Assessment of complex cognition: Commentary on the design and validation of Assessments.' *Theory into Practice*, 54(3), 263-273.

Phellas, C., Bloch, A. and Seale, C. (2011) 'Structured methods: Interviews, questionnaires and observation.' In: Searle, C. (ed.) *Researching society and culture*. 3rd edn. London: SAGE 181-205.

Philipp, R. (2007) 'Mathematics teachers' beliefs and affects.' In: Lester, F. (ed.) *Second handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics*. Charlotte, NC: Information age publishing 257-318.

Phillips, R., McNaught, C. and Kennedy, G. (2012) *Evaluating e-learning: Guiding research and practice*. New York: Routledge.

Pickford, R. and Brown, S. (2006) *Assessing skills and practice*. Abingdon: Routledge.

Plake, B., Impara, J. and Fager, J. (1993) 'Assessment competencies of teachers: A national survey.' *Educational Measurement: Issues and Practice*, *12*(4), 10–12.

Ponce, O. and Pagan-Maldonado, N. (2015) 'Mixed methods research in education : Capturing the complexity of the profession.' *International Journal of Educational Excellence*, 1(1), 111–135.

Popham, J. (2004) 'All about accountability / Why assessment illiteracy is professional suicide.' *Teaching for Meaning*, 62 (1), 82-83.

Popham, J. (2008) *Transformative assessment*. Alexandria: ASCD.

Popham, J. (2011) 'Assessment literacy overlooked: A teacher educator's confession.' *The Teacher Educator*, 46, 265 -273.

Postareff, L., Virtanen, V., Katajavuori, N. and Lindblom-Ylanne, S. (2012) 'Academics' conceptions of assessment and their assessment practices.' *Studies in Educational Evaluation* 38, 84–92.

Pritchard, A. (2014) *Ways of learning: Learning theories and learning styles in the classroom*. 3rd edn. Abingdon: Routledge.

Qualifications and Curriculum Authority (2004) *The National Curriculum: Handbook for secondary teachers in England*. Available at: http://webarchive.nationalarchives.gov.uk/20130401151715/http://www.education.gov.uk/publications/eOrderingDownload/QCA-04-1374.pdf (Accessed: 17 January 2016).

Randel, B. and Clark, T. (2013) 'Measuring classroom assessment practices' In: McMillan, J. (ed) SAGE handbook on research on classroom assessment. Thousand Oaks, California: SAGE publications, 145-164.

Rea-Dickins, P. (2004) 'Understanding teachers as agents of assessment.' *Language Testing*, 21 (3), 249–258.

Reiss, M (2004) 'What is teaching? Teaching science in secondary school.' In: Murphy, P. *et al* (eds.) *Reconsidering science learning*. London: RoutledgeFalmer 3 -12.

Remesal, A. (2011) 'Primary and secondary teachers' conceptions of assessment: A qualitative study.' *Journal of Teaching and Teacher Education*, 27(2), 472-482.

Richardson, V. (1996) 'The role of attitudes and beliefs in learning to teach.' In: Sikula, J. (ed.), *Handbook of research on teacher education*. New York: Macmillan 102-199.

Ricketts, C. and Ricketts, J. (2010) Leadership: Personal development and career success. 3rd edn. New York: Delmar Cengage learning.

Robert, D. and Bybee, R. (2014) 'Scientific literacy, science literacy and science education.' In: Lederman, N. and Abell, S. (eds.) *Handbook of research on science education.* Vol. II. New York: Routledge 545 - 558.

Robert, L. (2006) 'Opportunities and constraints of electronic research.' In: Reynolds, R. *et al* (eds.) *Handbook of research on electronic surveys and measurements*. London: Idea group 19-27

Rossman, G. and Rallis, S. (2011) *Learning in the field*. 3rd edn. Thousand Oaks: California: SAGE Publications.

Rowntree, D. (1987) *Assessing students: How shall we know them?* rev. edn. London: Kogan page.

Rubin, A. (2012) *Statistics for evidence-based practice and evaluation*. 3rd edn. Belmont, CA.: Brooks/Cole.

Rubin, A. and Babbie, E. (2009) *Essential research methods for social work*. 2nd edn. Belmont, CA: Brooks/Cole.

Ryan, K., Cooper, J. and Tauer, S. (2012) *Teaching for student learning: Becoming a master teacher*. 2nd edn, Belmont: Wadworth

Sach, E. (2015) 'An exploration of teachers' narratives: What are the facilitators and constraints which promote or inhibit 'good' formative assessment practices in schools?' *Education 3-13*, 43(3), 322-335.

Sadler, D. (1989) 'Formative assessment and the design of instructional systems.' *Instructional Science*, 18, 119-144.

Sadler, D.(1998) 'Formative assessment: revisiting the territory.' *Assessment in Education*, 5(1), 77-84.

Sahlberg, P. (2011) 'The fourth way of Finland' *Journal of Educational Change*, 12(2), 173-185.

Samuelowicz, K. and Bain, J. (2002) 'Identifying academics' orientations to assessment practice.' *Higher Education*, 43 (2), 173-201.

Schreier, M. (2012) *Qualitative content analysis in practice*. Thousand Oaks, California: SAGE publications.

Schutt, R. (2011) *Investigating the social world*. 7th edn. Thousand Oaks, California: Pine Forge Press.

Sebba, J., Brown, N., Stewart, S., Galton, M. and James, M. (2007) *An investigation of personalised learning approaches used by schools*. Nottingham: DfES Publications.

Segers, M, and Tillema, H. (2011) 'How do Dutch secondary teachers and students perceive the purpose of assessment.' *Studies in Educational Education*, 37(1), 49-54.

Seidman, I. (2013). *Interviewing as qualitative research*. 4th edn. New York: Teachers College Press.

Sethusha, M. (2012) 'Sixth grade teachers' conceptions of classroom assessment.' *Literacy Information and Computer Education Journal*, 3(2), 663-670.

Settlage, J. and Southerland, S. (2012) *Teaching science to every child: Using culture as a starting point*. 2nd edn. New York: Routledge.

Shavelson, R., Yin, Y., Furtak, E., Ruiz-Primo, M., Ayala, C., Young, D., Tomita, M., Brandon, P. and Pottenger, F. (2008) 'On the role and impact of formative assessment on science inquiry teaching and learning.' In: Coffey, J. *et al* (eds.) *Assessing science learning: Perspectives from research and practice*. Washington, DC: NSTA Press 21-36.

Shepard, (2000) *The role of classroom assessment in teaching and learning.* Available at : https://www.cse.ucla.edu/products/reports/TECH517.pdf (Accessed: 4 April 2015)

Shermis, M. and Di Vesta, F. (2011) *Classroom assessment in action*. Lanham, Maryland: Rowman & Littlefield Publishers.

Shulman, L. (1987) 'Knowledge and teaching: Foundations of the new reform.' *Harvard Educational Review,* 57 (1), 1-22.

Siegel, M. and Wissehr, C. (2011) 'Preparing for the plunge: Preservice teachers' assessment literacy.' *Journal of Science Teacher Education,* 22, 371- 391.

Sloan, K. (2012) ‘Meeting the challenges of high-stake testing: Towards a culturally relevant assessment literacy.’ In: Hill-Jackson, V. and Lewis, C. (eds.) *Transforming teacher education: What went wrong with teacher training, and how can we fix it*. Sterling: Stylus publishing 178-196.

Smit, B. (2003) *The emotional state of teachers during educational policy change*. Paper presented at the European conference on educational research, 17- 20 September, University of Hamburg, Germany.

Smith, K (2016) *Working Scientifically: A guide for primary science teachers*. Oxon: Routledge.

Smithers, A. and Robinson, P. (2003) *Factors affecting teachers’ decisions to leave the profession: Research report 430*. Nottingham: DfES.

Snowman J. and McCown R. (2013) *Ed Psych*. Belmont, CA: Wadsworth.

Solomonidou, G. (2014) *A mixed methods investigation into the perceptions of lower secondary school students and teachers in Cyprus on the purposes and approaches of assessment*. Doctoral dissertation, University of Leicester, Leicester, UK. Available at https: //lra.le.ac.uk/bitstream/2381/33016/1/2015SOLOMONIDOUGPhD.pdf

Sood, S., Menard, T. and Witte, K. (2003) ‘The theory behind entertainment-education.’ In: Singhal, A. *et al* (eds), *Entertainment-education and social change: history, research and practice*. Mahwah, NJ: Lawrence Erlbaum 117- 150.

Sowe, N. and Ade-Ojo, G. (2014) ‘Teacher trainers’ attitudes towards the use of digital recordings in collaborative feedback: A qualitative study.’ *International Journal of Multidisciplinary Comparative Studies*, 1(1), 50—63.

Spector, M. (2012) ‘Belief formation.’ In: Seel, N. (ed.) *Encyclopaedia of the sciences of learning*. New York: Springer 442-444.

Stake, R. (1995) *The art of case study research*. Thousand Oaks, CA: SAGE.

Stiggins, R. (1995) 'Assessment literacy for the 21st century.' *Phi Delta Kappan*, 77(3), 238-245.

Stiggins, R. (2004). 'New assessment beliefs for a new school mission.' *Phi Delta Kappan*, 86(1), 22-27.

Stiggins, R. (2007) 'Assessment through the student's eye.' *Educational Leadership*, 64 (8), 22-26.

Swaffield, S. and Dudley, P. (2015) *Assessment literacy for wise decisions.* Available at: https://www.atl.org.uk/Images/Assessment_and_literacy_for_wise_decisions_May_2015.pdf (Accessed: 10 January 2016).

Swaffield, S. (2009) *The misrepresentation of Assessment for Learning – and the woeful waste of a wonderful opportunity*. AAIA National conference, 16-18 September, Bournemouth. Available at: http://www.aaia.org.uk/content/uploads/2010/07/The-Misrepresentation-of-Assessment-for-Learning.pdf (Accessed: 20 November 2015).

Swain, J. (2010) 'Summative assessment: Gold or glitter?' In: Osborne, J. and Dillion, J. (eds.) *Good practice in science teaching: What research has to say*. 2nd edn. Maidenhead: McGraw-Hill/Open university press 211-237.

Taras, M. (2005) 'Assessment - Summative and formative - Some theoretical reflections.' *British Journal of Educational studies*, 53(4), 466 – 478.

Taras, M. (2009) 'Summative assessment: The missing link for formative assessment.' *Journal of Further and Higher Education*, 33(1), 57-69.

Taylor, G. and MacKenney, L. (2008) *Improving human learning in the classroom*. Lanham, Md.: Rowman and Littlefield Education.

Teddlie, C. and Tashakkori, A. (2009) *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioural*

sciences. Thousand Oaks: SAGE Publications.

Telese, J. (1996) *Hispanic teachers' views of mathematics and its effects on instructional practice*. Annual meeting of the American Education Research Association, 25 April, Chicago.

Teo, T. and Chai, C. (2008) 'Confirmatory factor analysis of the Conception for Teaching and Learning Questionnaire (CTLQ)' *The Asia-Pacific Education Researcher*, 12 (2), 215-224.

Thomas, M. (2012) 'Teachers' beliefs about classroom assessment and their selection of classroom assessment strategies.' *Journal of Research and Reflections in Education*, 6(2), 103-112.

Thomas, R. (2003). *Blending qualitative and quantitative research methods in theses and dissertations*. Thousand Oaks, California.: Corwin Press.

Thompson, A. (1992) 'Teachers' beliefs and conceptions: A synthesis of the research.' In: Grouws, D. (ed.) *Handbook of research on mathematics teaching and learning*. New York: Macmillan 127-146.

Timperley, H. (2008) *Teacher professional learning and development*: *Educational practices series-18*. Brussels and Geneva: International academy of Education and International bureau of education. Available at: http://www.ibe.unesco.org/fileadmin/user_upload/Publications/Educational_Practices/EdPractices_18.pdf (Accessed: 28 November 2015).

Timperley, H., Wilson, A., Barrar, H., and Fung, I. (2007) *Teacher professional learning and development: Best evidence synthesis iteration*. Wellington: New Zealand Ministry of Education. Available at: http://www.oecd.org/edu/school/48727127.pdf (Accessed: 28 November 2015).

Toohey, S. (1999) *Designing courses for higher education*. Buckingham: Society for Research into Higher Education and Open University Press.

Topping, K. (2009) 'Peer assessment.' *Theory into Practice*, 48(1), 20 -27.

Torrance, H. and Pryor, J. (1998). *Investigating formative assessment*: *Teaching, learning and assessment in the classroom*. Buckingham: Open University Press.

Torrance, H. and Pryor, J. (2001) 'Developing formative assessment in the classroom: Using action research to explore and modify theory'. *British Educational Research Journal*, 27 (5), 615-631.

Torrie, M. and Van Buren, J. (2008) 'Student and program assessment: Assessment literacy, the basis for student assessment.' *Journal of Family and Consumer Sciences*, 26(National teacher standards 3), 36-49. Available at: http://www.natefacs.org/Pages/v26Standards3/v26Standards3Torrie.pdf (Accessed: 26 January 2016).

Trafimow, D. (2004) 'Problems with change in R2 as applied to theory of reasoned action research.' *British Journal of Social Psychology*, 43(4), 515-530.

Van Driel, J., Verloop, N., and De Vos, W. (1998) 'Developing science teachers' pedagogical content knowledge.' *Journal of Research in Science Teaching*, 35(6), 673-695.

Van Driel, J. (2010) *Model-based development of science teachers' Pedagogical content knowledge*. Paper presented at the International seminar, Professional reflections, February, National Science Learning Centre, York.

Vaughan, L. (2001). *Statistical methods for the information professional: A practical, painless approach to understanding, using, and interpreting statistics* . Medford, N.J.: Information Today.

Visser, P., Bizer, G. and Krosnick, J (2006) 'Exploring the latent structure of strength-related attitude attributes.' *Advances in Experimental Social Psychology*, 38, 1-67.

Volante, L. and Fazio, X. (2007) 'Exploring teacher candidates' assessment literacy: Implications for teacher education reform and professional development.' *Canadian Journal of Education*, 30(3), 749-770.

Wang, J., Kao, H. and Lin, S. (2010) 'Preservice teachers' initial conceptions about assessment of science learning: The coherence with their views of learning science.' *Teaching and Teacher education,* 26(2010), 522-529.

Webb, N. (2002) *Assessment literacy in a standards-based urban education setting*. American Educational Research Association Annual meetings, 1-5 April, New Orleans, Louisiana Available at: http://www.wcer.wisc.edu/archive/mps/AERA2002/Assessment%20literacy%20NLW%20Final%2032602.pdf (Accessed: 19th January 2013).

Weber, R. (1990) *Basic content analysis.* 2nd edn. Newbury Park: SAGE publications

Weiten, W. (2013) *Psychology: Themes and variations, briefer version*. 9th edn. Belmont, CA: Cengage learning.

Whitcomb, J. (2003) 'Learning and pedagogy in initial teacher preparation.' In: Weiner, I. *et al* (eds.) *Handbook of psychology*. New York: Wiley 533-556.

Whitehouse, M. (2013) 'Embedding assessment to improve learning.' *Science School Review*, 95(351), 52-56.

Wiliam, D. (2006) 'Assessment: Learning communities can use IT to engineer a bridge connecting teaching and learning.' *Journal of Staff Development, 27*(1), 16–20.

Wiliam, D. (2007) 'Keeping learning on track: Classroom assessment and the regulation of learning' 1n: Lester, F. (ed) *Second handbook of research on mathematics, teaching and learning,* Charlotte, NC: Information Age publishing 1053-1098.

Wiliam, D. (2011a) 'What is assessment for learning?' *Studies in Educational Evaluation,* 37, 3-14.

Wiliam, D. (2011b) Embedded formative assessment. Bloomington, IN: Solution Tree.

Williams, B. (2007) *Multiple intelligences for differentiated learning*. Thousand Oaks: Corwin.

Wilson, V. and Kendall-Seatter, S. (2010) *Developing professional practice, 7-14*. Harlow, England: Longman/Pearson.

Winne, P. and Butler, D. (1994) 'Student cognition in learning from teaching.' In: Husen, T. and Postlethwaite T. (eds.), *International encyclopaedia of education: Student cognition in learning from teaching*. 2nd edn. Oxford: Pergamon 5738-5745.

Wood, W., Rhodes, N. and Biek, M. (1995) 'Working knowledge and attitude strength: An information-processing analysis.' In Petty, R. and Krosnick, J. (eds.), *Attitude strength: Antecedents and consequences*. Mahwah, NJ: Erlbaum. 283-314.

Woolfolk Hoy, A. and Murphy, K. (2001) 'Teaching educational psychology to the implicit mind.' In: Sternberg, R. and Torff, B. (eds.) *Understanding and teaching the implicit mind*, Erlbaum, Mahwah, NJ, 145–185.

Yamtim, V. and Wongwanich, S. (2014) 'A study of classroom assessment literacy of primary school teachers.' *Procedia - Social and Behavioral Sciences*, 116, 2998-3004.

Yencken, D., Fien, J. and Sykes, H. (2000) 'The research' in Yencken *et al* (eds) *Environment, education and society in the Asia-pacific: Local traditions and global discources.* London: Routledge 28-50

Yilmaz, K. (2011) 'The cognitive perspective on learning: Its theoretical underpinnings and implications for classroom practices.' *Clearing House*, 84(5), 204-212.

Yilmaz, H. and Sahin, S. (2011) Pre-service teachers' epistemological beliefs and conceptions of teaching. *Australian Journal of Teacher Education*, 36(1), 73-88.

Zhang, Z. and Burry-Stock, J. (1994) *Assessment Practices Inventory*. Tuscaloosa, AL: The University of Alabama

Zhang, Z. and Burry-Stock, J. (2003) 'Classroom practices and teachers' self-perceived assessment skills.' *Applied Measurement in Education*, 16(4), 323–342.

Zheng, H. (2009) 'A review of research on EFL pre-service teachers' beliefs and practices.' *Journal of Cambridge Studies*, 4 (1), 73-81.

Appendix

1. Research tools

(a) Questionnaire

Section one: Personal details

Please provide your personal information in this section by selecting the answers that apply to you.

How many years of experience do you have as a teacher?

NQT ☐ 1 – 5 years ☐ 6 – 15 years ☐ 16 – 35 years ☐

Which of the following school type best describes your current place of work?

Academy ☐ Independent ☐ Comprehensive ☐ Foundation ☐

Which of these roles below best applies to you?

Class teacher ☐ Deputy subject leader/2nd in department ☐ KS3/KS4 coordinator ☐ Subject leader/Head of department ☐ SLT ☐ Others (please specify)……..

Which region of the country best describes your current place of work?

Eastern ☐ London ☐ South-east ☐ South-west ☐ North ☐ Midlands ☐ Others (please specify)……

Which of the following best describes your highest level of educational attainment?

BSc/Ba/BEng ☐ MSc/Ma/MEng ☐ PhD /EdD ☐ Others (please specify)……..

Which of the following best describes your teacher training route?

PGCE ☐ GTP ☐ Teach first ☐ Others (please specify)…….

Section Two: Your belief and understanding of assessment

Please indicate your level of agreement or disagreement with each of these statements regarding assessments. Please tick one box for each statement.

	Strongly disagree	Slightly disagree	Agree	Mostly agree	Strongly agree
1. Assessment provides information on how well schools are doing.	☐	☐	☐	☐	☐
2. Assessment places students into categories.	☐	☐	☐	☐	☐
3. Assessment provides feedback to students about their performance.	☐	☐	☐	☐	☐
4. Assessment is integrated with teaching practice.	☐	☐	☐	☐	☐
5. Teachers conduct assessments but make little use of the results.	☐	☐	☐	☐	☐
6. Assessment is an accurate indicator of a school's quality.	☐	☐	☐	☐	☐
7. Assessment is assigning a grade or level to student work.	☐	☐	☐	☐	☐
8. Assessment informs students of their learning needs.	☐	☐	☐	☐	☐
9. Assessment information modifies ongoing teaching of students.	☐	☐	☐	☐	☐
10. Assessment results are consistent.	☐	☐	☐	☐	☐
11. Assessment is unfair to students.	☐	☐	☐	☐	☐
12. Teachers should take into account the error and imprecision in all assessment.	☐	☐	☐	☐	☐
13. Assessment helps students improve their learning.	☐	☐	☐	☐	☐
14. Assessment interferes with teaching.	☐	☐	☐	☐	☐
15. Assessment is an imprecise process.	☐	☐	☐	☐	☐

Section Three: Your views on assessment practices

Please indicate your level of agreement or disagreement with each of these statements regarding assessment. Please tick one box for each statement.

	Please tick one box				**Please tick one box**				
	Very valuable	Valuable	Of little value	Of no value	Always	Most of the times	Some times	Rarely	Never
1. Assess students' academic achievement through a written test	☐	☐	☐	☐	☐	☐	☐	☐	☐
2. Involve students in the discussion of the standards to be expected in their work.	☐	☐	☐	☐	☐	☐	☐	☐	☐
3. Give oral and written feedback to students	☐	☐	☐	☐	☐	☐	☐	☐	☐
4. Provide time for students to act on feedback	☐	☐	☐	☐	☐	☐	☐	☐	☐
5. Provide students with suggestions to enable them monitor their progress in learning.	☐	☐	☐	☐	☐	☐	☐	☐	☐
6. Provide opportunities for students to reflect on their work	☐	☐	☐	☐	☐	☐	☐	☐	☐
7. Compare students' performances to each other when assigning their	☐	☐	☐	☐	☐	☐	☐	☐	☐

overall grades.									
8. Use assessment outcome to adapt learning activities	☐	☐	☐	☐	☐	☐	☐	☐	☐
9. Use assessment results to make decisions about students (e.g putting into groups/sets)	☐	☐	☐	☐	☐	☐	☐	☐	☐
10. Train students to assess tasks done by other students	☐	☐	☐	☐	☐	☐	☐	☐	☐

Section Four: Your views on teaching and learning

Please indicate your level of agreement or disagreement with each of these statements regarding teaching and learning. Please tick one box for each statement.

	Strongly disagree	Slightly disagree	Agree	Mostly agree	Strongly agree
1. The ideas of students are important and should be carefully considered	☐	☐	☐	☐	☐
2. No learning can take place unless students are controlled	☐	☐	☐	☐	☐
3. The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication.	☐	☐	☐	☐	☐
4. Teaching is simply telling, presenting or explaining the subject matter	☐	☐	☐	☐	☐
5. Teaching is to provide students with accurate and complete knowledge rather than encourage them to discover it	☐	☐	☐	☐	☐
6. Learning means students have ample opportunities to explore, discuss and express their ideas.	☐	☐	☐	☐	☐

7. Teachers should have control over what students do all the time	☐	☐	☐	☐	☐
8. Different objectives and expectations in learning should be applied to different students.	☐	☐	☐	☐	☐
9. Students have really learned something when they can remember it later	☐	☐	☐	☐	☐
10. The major role of a teacher is to transmit knowledge to students	☐	☐	☐	☐	☐
11. Learning means remembering what the teacher has taught	☐	☐	☐	☐	☐
12. Learning mainly involves absorbing as much information as possible	☐	☐	☐	☐	☐

Thank you for taking part in this survey

For further information, please contact me: Ngozi Oguledo: on017@gre.ac.uk Supervisors: Professor J. Jameson: j.jameson@gre.ac.uk and Dr G. Ade-Ojo: G.O.Ade-Ojo@gre.ac.uk: Faculty of Education and Health, Mansion House, Bexley Road, Eltham, London SE9 2PQ Tel. 0208 331 8058.

(b) Categorisation of questionnaire contents

(i) Categorisation of assessment practices

Statements	Assessment practice
Assess students' academic achievement through a written test	AoL
Involve students in the discussion of the standards to be expected in their work.	AfL
Give oral and written feedback to students	AfL
Provide time for students to act on feedback	AfL
Provide students with suggestions to enable them monitor their progress in learning.	AaL
Provide opportunities for students to reflect on their work	AaL
Compare students' performances to each other when assigning their overall	AoL

grades.	
Use assessment outcome to adapt learning activities	AfL
Use assessment results to make decisions about students (e.g putting into groups/sets)	AoL
Train students to assess tasks done by other students	AaL

Table 7.1: A breakdown of the different assessment practices into AaL, AfL and AoL practices.

(ii) Categorisation of the Conception of Teaching and Learning

Statement	**Conception**
1. The ideas of students are important and should be carefully considered	Constructivist
2. No learning can take place unless students are controlled	Directive
3. The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication.	Constructivist
4. Teaching is simply telling, presenting or explaining the subject matter	Teacher-centred
5. Teaching is to provide students with accurate and complete knowledge rather than encourage them to discover it	Teacher-centred
6. Learning means students have ample opportunities to explore, discuss and express their ideas.	Constructivist
7. Teachers should have control over what students do all the time	Directive
8. Different objectives and expectations in learning should be applied to different students.	Constructivist
9. Students have really learned something when they can remember it later	Rote
10. The major role of a teacher is to transmit knowledge to students	Transmissive
11. Learning means remembering what the teacher has taught	Rote
12. Learning mainly involves absorbing as much information as possible	Transmissive

Table 7.2: A breakdown of the different teaching and learning conceptions

(c) Letter for participants

Dear science teachers,

QUESTIONNAIRE: ASSESSMENT LITERACY OF SCIENCE TEACHERS

I am research student at the University of Greenwich. I would like to invite you to participate in a study I am carrying out on the assessment literacy of science teachers. You are invited to participate in this study because you are a science teacher working in England who is often involved in the discussion of science education issues in online forums.

Before you decide whether you want to take part, it is important for you to understand why this research is been done and what your participation will involve. Please take time to read the following information carefully and ask any questions you may have before deciding whether to take part in the study.

The purpose of this study is to understand the different factors that affect science teachers' knowledge of assessment. The study will require you to complete an online questionnaire which will take approximately 10 -15 minutes. The questionnaire will ask questions on your belief of what assessment is, as well as teaching and learning. It will also ask questions on your views on assessment practices. Your participation is entirely voluntary, and you may withdraw from this study at any time by clicking the "exit this survey" icon. All data collected will be stored securely and deleted at the end of the study. Please note that submission of a completed or partially completed questionnaire implies consent to participate. Participation is anonymous, and so it will not be possible for me to withdraw your data once you have returned your questionnaire.

If you decide to continue to take part in this study, please click on the next button.

For further information, please contact me: Ngozi Oguledo: on017@gre.ac.uk. Supervisors: Professor J. Jameson: j.jameson@gre.ac.uk and Dr G. Ade-Ojo: G.O.Ade-Ojo@gre.ac.uk: Faculty of Education and Health, Mansion House, Bexley Road, Eltham, London SE9 2PQ Tel. 0208 331 8058.

Dear science teachers,

INTERVIEWS: ASSESSMENT LITERACY OF SCIENCE TEACHERS

I would like to invite you to participate in a study I am carrying out on the assessment literacy of science teachers. You are invited to participate in this study because you are a science teacher working in England who is often involved in the discussion of science education issues on Twitter.

Before you decide whether you want to take part, it is important for you to understand why this research is been done and what your participation will involve.

Please take time to read the following information carefully and ask any questions you may have before deciding whether to take part in the study.

The purpose of this study is to understand the factors that affect science teachers' knowledge of assessment. The study will require you to take part in a 20 minutes interview. This process will help to understand the issues that were not clear from an earlier survey on teachers' views on assessment. The interview will be carried out through telephone or online chat tools. This will be recorded if it is done by telephone and deleted once the transcript is written up. The transcript will be stored securely in a password protected file and deleted at the end of the study. As part of the presentation of results, your own words may be used in text form. This will be anonymised and so

you cannot be identified from what you said. If you decide to take part in this study, you may also withdraw any data/information you have already provided up until the 30th October 2015 without giving a reason. If you withdraw from the study your data will be withdrawn and destroyed.

If you decide to take part in this study, please reply to this email.

For further information, please contact me: Ngozi Oguledo: on017@gre.ac.uk. Supervisors: Professor J. Jameson: j.jameson@gre.ac.uk and Dr G. Ade-Ojo: G.O.Ade-Ojo@gre.ac.uk: Faculty of Education and Health, Mansion House, Bexley Road, Eltham, London SE9 2PQ Tel. 0208 331 8058.

2. Findings

(a) Demographics of the sampling frame

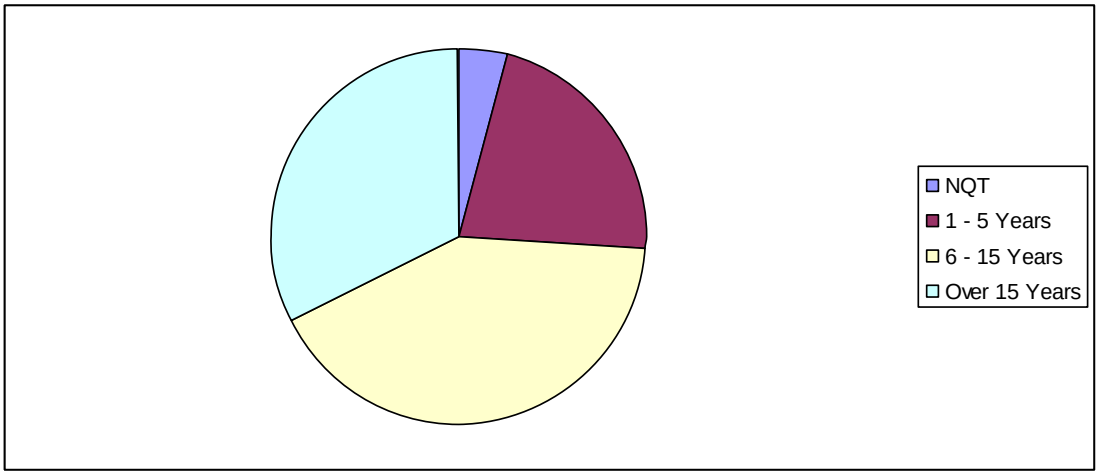

Fig 7.1: Pie chart showing the distribution of participants by years of teaching experience.

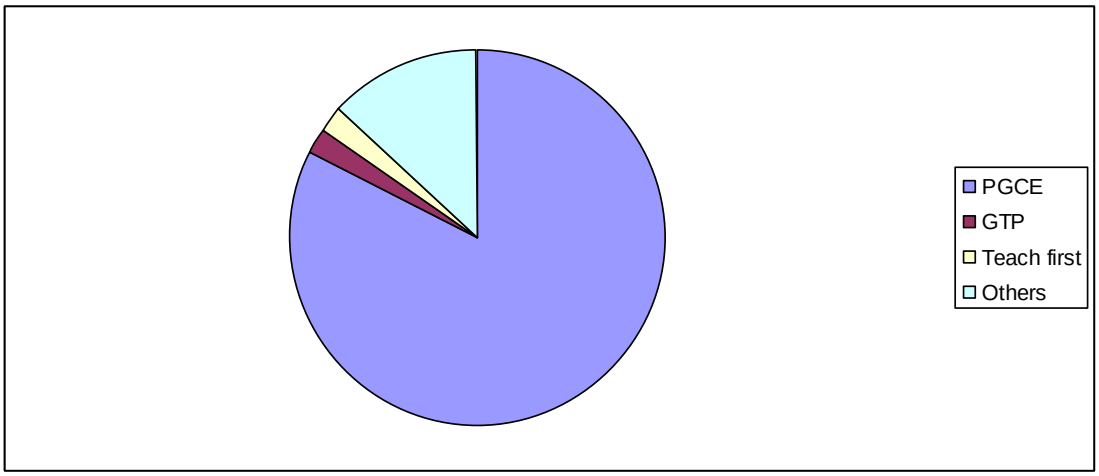

Fig 7.2: Pie chart showing the distribution of participants by their teaching route

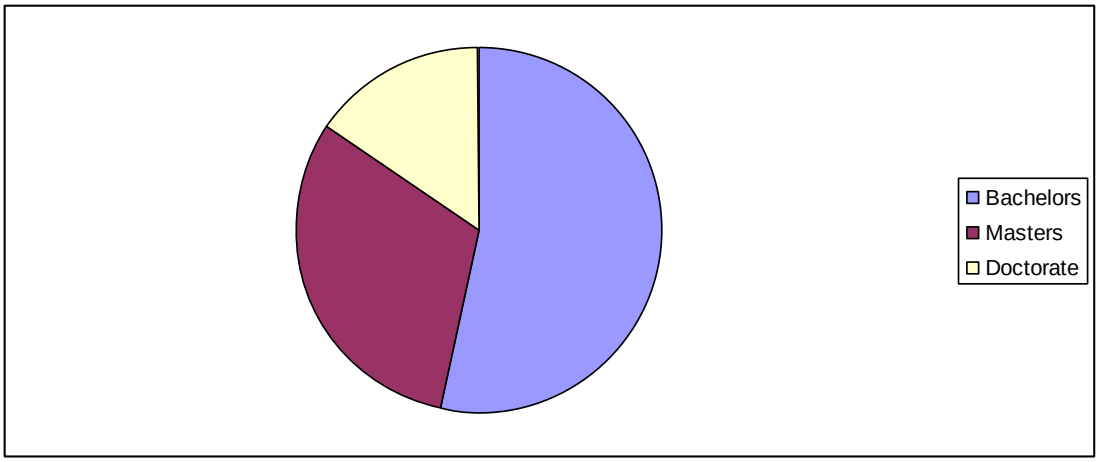

Fig 7.3: Pie chart showing the distribution of participants by their highest educational qualification

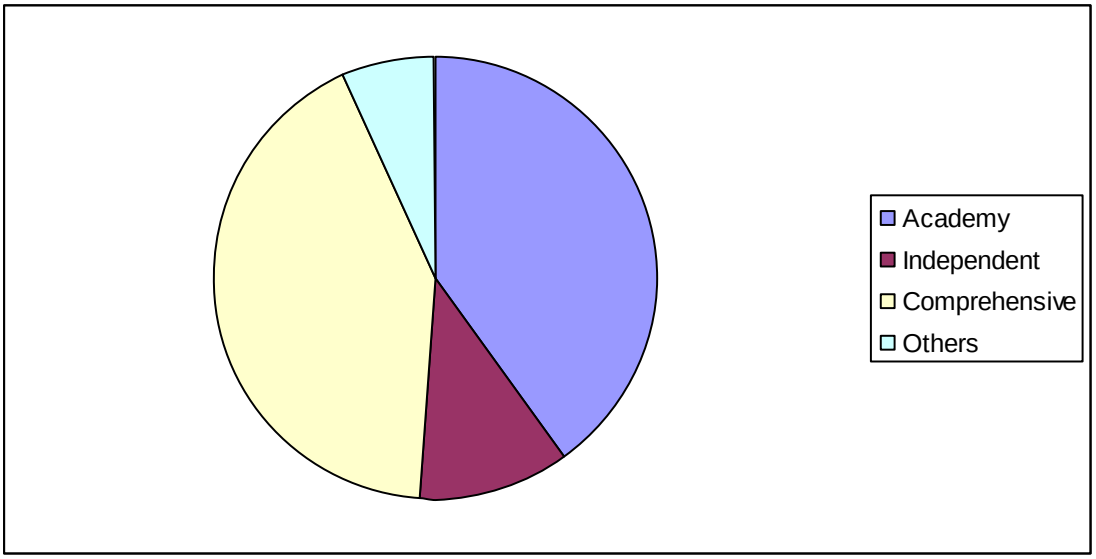

Fig 7.4: Pie chart showing the distribution of participants by the type of school they work in

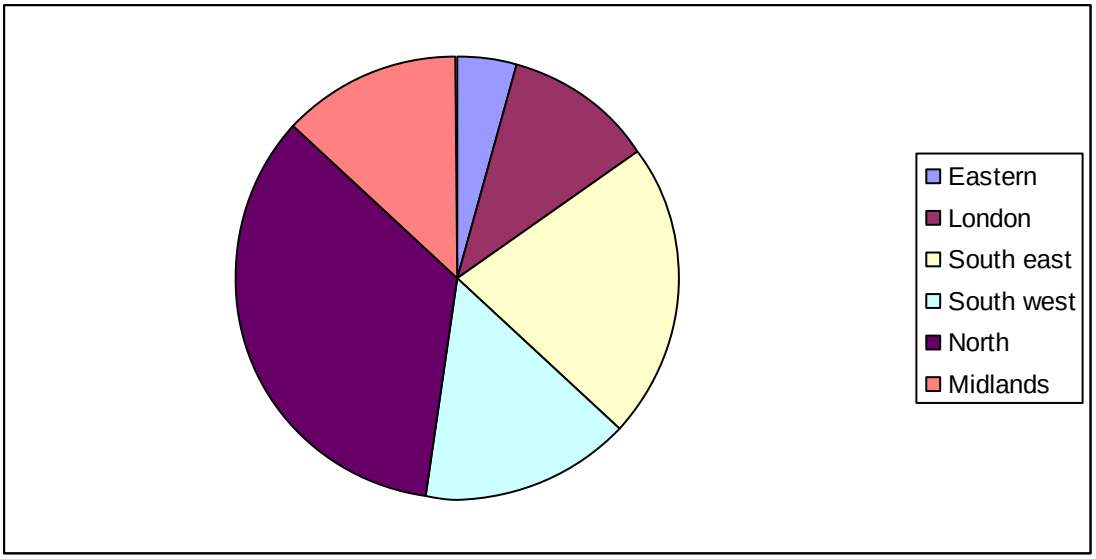

Fig 7.5: Pie chart showing the distribution of participants by the region they work in.

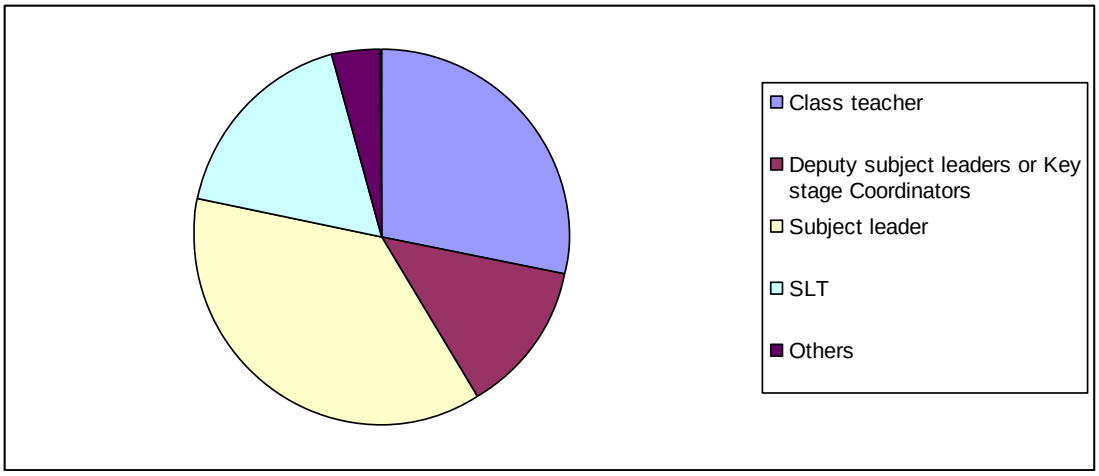

Fig 7.6: Pie chart showing the distribution of participants by their role in school

(b) Descriptive analysis of findings

(i) Conception of assessment

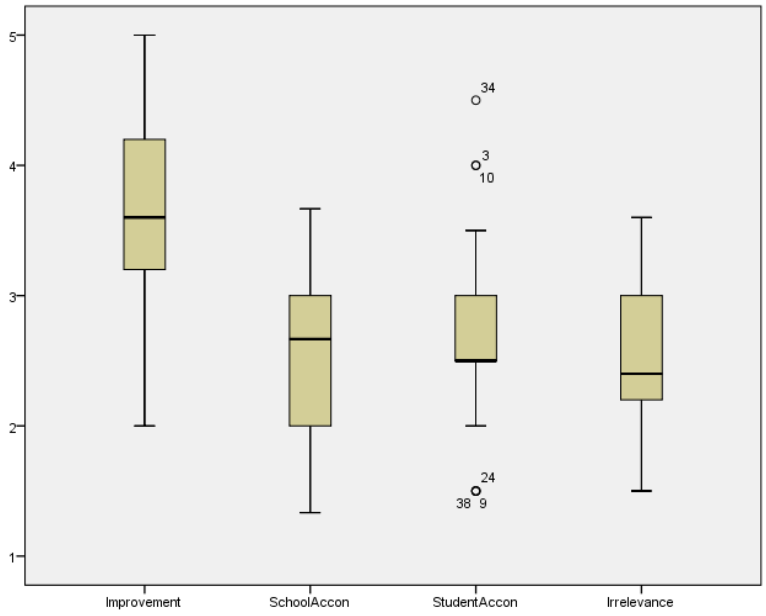

Fig 7.7: Box plots showing the summary of the distribution of the mean score for the different assessment conception

(ii) Assessment practices

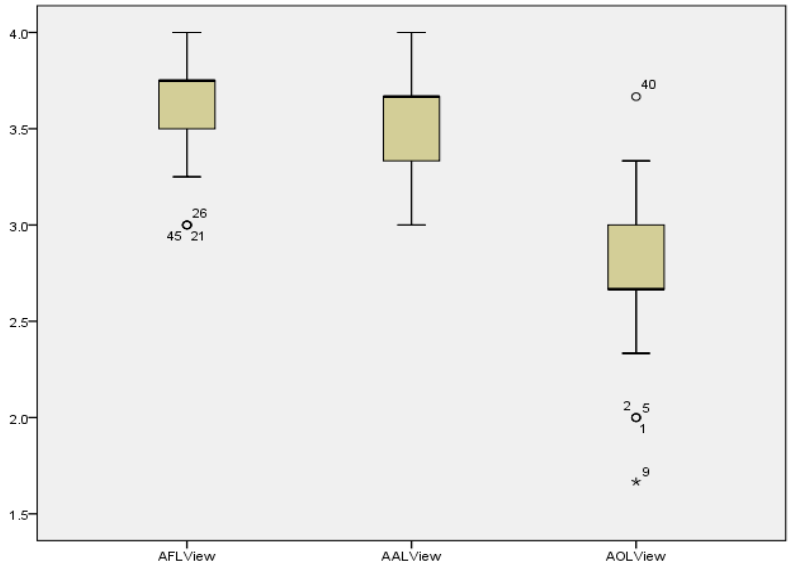

Fig 7. 8: Box plots of the mean score on teachers' views on the different assessment practices

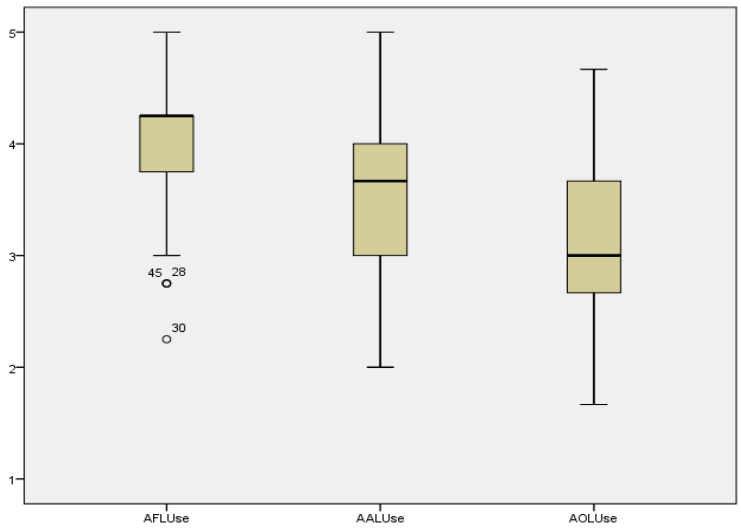

Fig 7.9: Box plots of the rate at which science teachers use the different assessment practices

(iii) Conception of Teaching and Learning

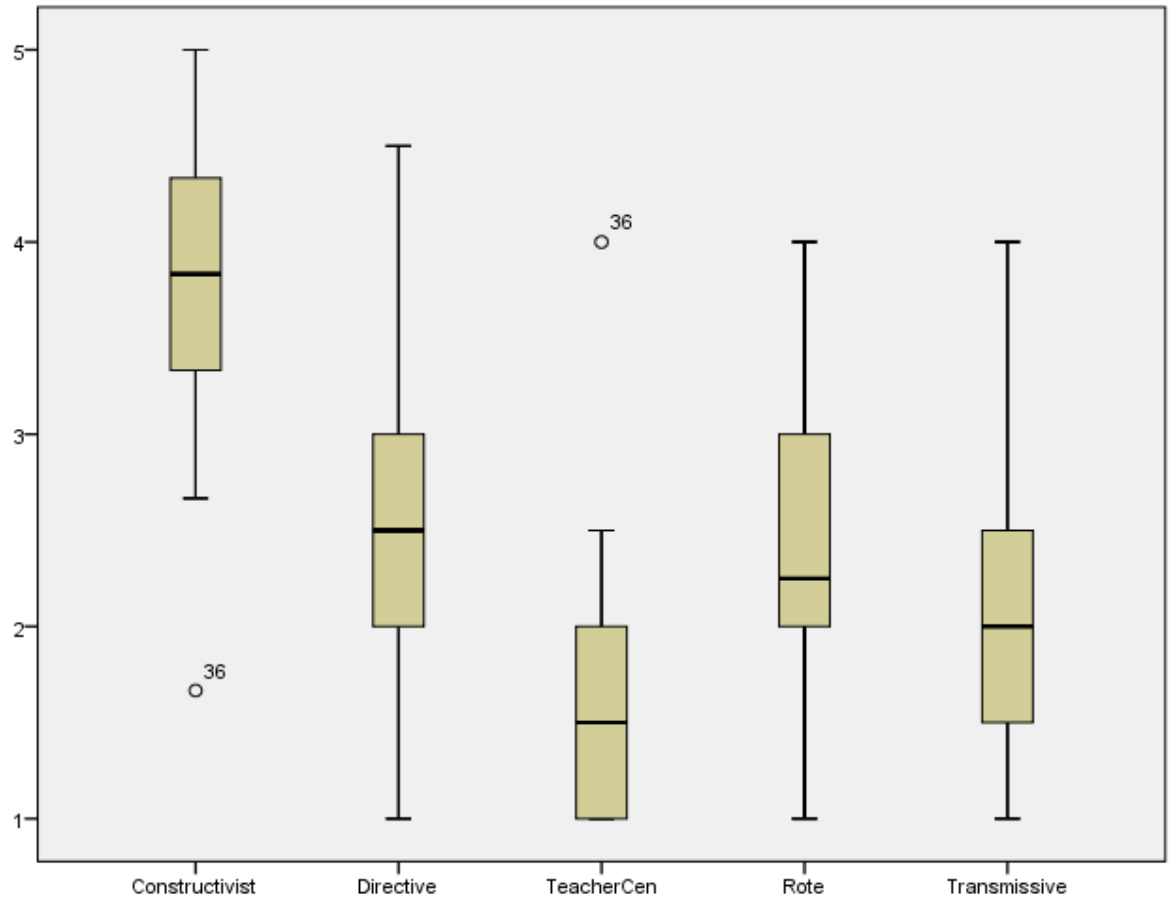

Figure 7.10: Box plot showing the mean score for the different conceptions of teaching and learning.