ENHANCING TECHNOLOGY LITERACY THROUGH ASSESSMENT PRACTICES IN THE SENIOR PHASE

BY

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DECLARATION

I declare that the dissertation, Enhancing Technology Literacy through Assessment Practices in the Senior Phase, submitted for the qualification of Master of Education at the University of the Free State, is my own, independent work. All the sources that I used have been indicated and acknowledged by means of a complete reference list.

I further declare that this work has not been previously submitted by me at another institution for the purpose of obtaining a qualification.

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ABSTRACT

The aim of this study was to explore the assessment practices senior phase Technology teachers employ in their classrooms to enhance technological literacy in the Motheo school district of the Free State province. The study analysed literature on Technology Education and assessment practices as a means to understand the nature of the subject and the teacher pedagogical knowledge required to enhance technological literacy (through assessment practices). Furthermore, the study explored the factors that influence the enhancement of technological literacy through the assessment practices that teachers employ in their Technology classrooms. A case study research approach was used to generate empirical data from the experiences of knowledgeable individuals in the Technology Education sphere, in an attempt to discover best practices. The case study research approach served as a suitable data generation tool for the study, as it enriched the study with multiple perspectives of Technology teachers' teaching and learning assessment practices, because the participants have various technical and teaching backgrounds. The study employed bricolage as a theoretical lens. Bricolage is described as a process through which the likelihood of an outcome is affected by a variety of factors, among social life and norms, traditions and routines. Bricolage makes it possible for a researcher to analyse teacher understanding and application of discipline-specific assessment practices that have been designed to enhance technological literacy. In this study, the researcher observed and discussed the teaching and learning practices of two Technology teachers' experiences; and information gathered through open-ended questionnaires and follow–up discussions with twenty three (23) Technology teachers. The researcher uncovered the best strategies employed by participants in the study with regard to assessment practices. The study analysed the assessment methods used by the participating Technology teachers and presents three common assessment methods used by teachers to cultivate and enhance technological literacy of senior phase learners in three Technology-related learning domains, namely, the cognitive, psychometric and affective. The study also offers insight into the choice of assessment, its design and its shortcomings. The study, therefore, calls for discipline-specific (Technology) teacher training and teacher development programmes that would enable such teachers to deliver the multiple assessment approaches they need

if they are to be able to apply multiple assessment strategies while they engage in assessment practices.

Keywords: Technology education, Technological literacy, Assessment, Assessment practices

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LIST OF ABBREVIATIONS AND ACRONYMS

ABET	Adult Basic Education and Training
ACE	Advanced Certificate in Education
CAPS	Curriculum Assessment Policy Statement
FET	Further Education and Training
EGD	Engineering Graphics and Design
PAT	Practical Assessment Tasks
PGCE	Postgraduate Certificate in Education
PLC	Professional learning communities
UNESCO	United Nations Educational, Scientific and Cultural Organization

CHAPTER 1:
SCOPE OF THE STUDY

1.1 INTRODUCTION

This study sought to investigate the assessment practices senior phase Technology teachers employ in their classes. The researcher evaluated how these teachers cultivate technological literacy throughout their engagement in Technology assessment practices. Technology, as a subject, was introduced in South African schools to contribute to the development of a technologically literate society. The aim of the Curriculum Assessment Policy Statement (CAPS) for Technology is to produce "engineers, technicians and artisans" who could contribute to fulfilling the technological needs of modern society (DBE, 2011:8). Technological literacy refers to, (i) the technology of artefacts, and (ii) the knowledge, (iii) the activities and (iv) the aspect of humanity (adapted from Jones, Buntting and De Vries, 2011:192). Technology Education is, therefore, mandated to develop technological literacy at schools by creating opportunities for learners to demonstrate their ability to,

> *develop and apply specific design skills to solve technological problems; understand the concepts and knowledge used in Technology Education and use them responsibly and purposefully; and appreciate the interaction between people's values and attitudes, technology, society and the environment* (DBE, 2011:8).

These envisaged educational objectives pose a real challenge to the South African technology community, which grapples with understanding and interpreting the underlying principles and philosophies of the newly introduced school subject (Teis, 2014:185). The study outlines the extent to which technological literacy can be enhanced in Technology Education through assessment practices in the senior phase.

1.2 BACKGROUND OF THE STUDY

Compton and Harwood (2003:7) state that assessment practices "should be seen as an integral part of the teaching and learning process, rather than adjunct to it". The term assessment practices is defined as the "process of evaluating the effectiveness

of sequences of instructional activities" (Wiliam, 2011:3), which includes planning beforehand (Boud and Falchikov, 2006:402), active learner involvement (Boud and Falchikov, 2006:399; Compton and Harwood, 2003:7), constructive feedback (Boud and Falchikov, 2006:399; MacLellan, 2001:316; Moreland, Jones and Northover, 2001:163), and the need to be related to both present and future learning needs (Boud and Falchikov, 2006:404). Boud reinforces these notions (2000:151), by emphasising that the aim of teaching is not to prepare learners for assessment, but rather to equip learners with the "ability to assess their future learning*"* accordingly. This study uses these perspectives on assessment as the foundation of this research assignment. The researcher argues that active engagement in discipline-specific assessment practices contributes significantly to learners cognitive, psychomotor and affective learning domains. These objectives coincide with the broader educational intentions alluded to in the definitions presented in Section 2.3. Boud, furthermore, defines the ability to assess future learning activities as "sustainable assessment", which is a process of "building on summative and formative assessment to foster longer-term goals" (2000:151). The research argues that these processes encompass all teaching, learning and assessment activities that take place in the Technology classroom (Boud and Falchikov, 2006:405). Pope (2012:6) cites Gibson, who states that assessment "must encourage positive steps towards greater community… sustainability, towards a future that is more viable, pleasant and secure".

1.3 SIGNIFICANCE OF THE STUDY

Verheem, as cited by Pope (2012:3), states that the aim of sustainable assessment "is to ensure that plans and activities make optimal contributions to sustainable development". The researcher evaluated the assessment instruments Technology teachers employ, in an attempt to determine the extent to which such assessment instruments enhance technological literacy and, in so doing, enhance the sustainability of the class, school and broader community. Compton and Harwood (2003:2) note that teachers found it difficult to create Technology programmes that recognise the skills and abilities that learners are expected to demonstrate, and Technology programmes that support learning. They, furthermore, allude to a need for teachers to link Technology Education goals to the assessment instruments they employ, in a manner that is meaningful and effective for enabling learners to develop technological

literacy (Compton and Harwood, 2003:2). Roth, as quoted by Compton and Harwood (2003:4), argues that Technology Education programmes "need to focus on enhancing learners' technological practice in ways that allow them to become empowered decision makers, participating as mutually constitutive members within their learning community". These perspectives from literature outline the research intentions, namely, to investigate the conceptualisation of assessment and effective assessment practices by South African Technology teachers, as critical contributors to the realisation of the educational objectives of the subject.

1.4 STATEMENT OF THE PROBLEM

Technological literacy can be defined as "a person's ability to competently understand and undertake technological practice within contemporary technological discourses in which they are situated" (Compton and Harwood, 2003:4). Technology Education is seen "as a learning domain [that] has [its own] knowledge base" and, therefore, should be seen as a subject in its own right (Compton and Harwood, 2003:1). In this study the researcher argues that the type of assessment strategies used by senior phase teachers influences learners' ability to reach the specified outcome, i.e. to be technologically literate citizens.

Moreland *et al.* (2001:158) recognise that the judgments assessors must make, especially for a new subject such as Technology, become complex due to a "lack of shared subject subculture…, insufficient accumulated practical classroom experience and a limited understanding of the discipline-specific assessment structure". The researcher explored the extent to which this complexity applies to senior phase teachers in the Motheo school district in the Free State province. Furthermore, Boud and Falchikov (2006:400) suggest that assessment practices should be judged on whether they "effectively equip students for a lifetime of assessing their own learning". They state that learners are recipients of the "actions of others", as learners are not involved in the assessment process itself (2006:402). This study explores the extent to which learners are involved in the assessment process, and the way they are involved. Boud and Falchikov (2006:403) discuss the importance of collaboration between the learner and the teacher, as well as between the learners themselves. Ronfeldt, Farmer, McQueen, and Grissom (2015:475) discuss the importance of

collaboration for the success of learners. Compton and Harwood (2003:7) also argue that collaboration is necessary, as it enables the teacher to assess the learning environment, and to establish whether learners are on track to achieve the intended outcomes. Collaboration also enables teachers to evaluate their practices in terms of meaningfulness and validity, which assists teachers, not only in their current teaching experiences, but also for future practices (Compton and Harwood. 2003:7).

The literature suggests that Technology teachers should be aware of their perceptions, intentions and preconceived educational goals, which were set when assessment tasks were designed. Moreland *et al.* (2001:159) note that teachers who are unsure about how to engage learners in subject content and planned tasks often "revert to their traditional teaching and subject subculture". Abbott (2014: online) identifies several forms of educational assessment that Technology teachers could employ to develop and assess learners' technological literacy, among which,

- Pre-assessment – assessment carried out before the learners engage in Technology content and activities. This type of assessment is generally used to determine the baseline against which teachers establish and measure learning progress.
- Standardised assessments – Technology assessments that are designed, administered, and scored in a consistent manner. Standardised assessment types include short-answer questions, multiple-choice questions, and computer-based assessment.
- Performance assessment – assessment described as "authentic tasks" that require learners to write assignments or perform a presentation or speech relating to the Technology content.
- Portfolio-based assessment – assessment described as collections of academic work, such as assignments and projects tests. These tasks are collected over a period of time and are used to evaluate whether learners have met the required Technology Educational goals.
- Standards-based assessment – assessments designed to measure how well a learner has mastered the specific Technology knowledge and skills described in the learning standards set by the Department of Basic Education and/or by the teacher.

- Screening assessment – assessments that determine whether learners need specialised assistance with Technology activities and to determine progression.
- Summative assessment – assessments that include graded tests and projects on which the learner is evaluated, usually at the end of an instructional period.
- Formative assessment – described as assessment for learning, generally used to modify and improve Technology teaching techniques in teaching and learning activities.

According to the DBE (2011:40), learners' total summative assessment marks are calculated by four Practical Assessment Tasks (PATs), three standardised tests and one main exam. A PAT is defined as,

> *a set of short practical assessment tasks… in the form of an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process* (DBE, 2011:41).

Ideally, teaching Technology through the application of PATs is designed to integrate teaching by applying effective assessment processes, and will be most relevant to the study, as it gives an indication of good assessment practices. This research argues that, for the quest to enhance technological literacy so that it achieves success, it is essential that the Technology teacher understands the alignment between Technology teaching practices and appropriate assessment instruments. Ramsden, as quoted by MacLellan (2001:307), states that assessment determines the quality of learning, which ultimately determines the learners' progression. Assessment is, therefore, a central process of effective teaching (Wiliam, 2011:3), and assessment practices should prepare learners for a lifetime of learning, and for the assessment challenges they will face in the future (Boud and Falchikov, 2006:400).

While it is challenging for Technology teachers to combine complex discipline-specific content with effective pedagogical practices that lead to the realisation of the subject's educational objectives, requiring teachers to develop a "coherent, technological content base and appropriate assessment practices" could also pose challenges (Moreland *et al.*, 2001:158). This research argues that it is important to develop teachers' understanding of the purpose and processes of relevant assessment practices, and teachers' role in nurturing technologically literate citizens. The study,

therefore, explores existing assessment practices and examines the extent to which teachers promote the development of technological literacy through their assessment practices.

This study uses bricolage as a theoretical framework to understand teachers' understanding and application of discipline-specific assessment practices that are designed to enhance technological literacy in Technology classes. Bricolage, as described by Aagard (2009:82), is a process of "generating something new out of resources available". For this study, the researcher draws on the experiences and expertise of teachers, colleagues, and co-researchers, through collaborative engagement, in an attempt to understand the alignment of assessment practices with technological literacy goals. Aagard (2009:82) describes how institutions can be moulded through the use of bricolage, whereby, "an individual in an institution uses the ideas and philosophies already at work in that institution to transform it". By employing bricolage, a researcher can involve various sources within teaching and learning spheres to gain valuable knowledge and information about experiences from these role players, to not only enrich the study, but to transform Technology assessment practices at schools. This study is urgently needed, as literature suggests that, (i) Technology teachers do not align assessment practices with their teaching objectives; and (ii) Technology teachers do not demonstrate understanding of the importance of such alignment (Boud and Falchikov, 2006; Compton and Harwood, 2003; MacLellan, 2001; Moreland *et al.*, 2001).

1.5 RESEARCH QUESTION, AIMS AND OBJECTIVES

1.5.1 Research question

The research question is as follows:

How do senior phase Technology teachers integrate discipline-specific assessment practices to enhance technological literacy?

1.5.2 Research aim

This study aims to explore how teachers in senior phase Technology classes integrate discipline-specific assessment practices to enhance technological literacy in their classes.

1.5.3 Research objectives

The following research objectives helped the researcher to answer the main research question of the study:

- To explore, through a literature review, the assessment principles and strategies relating to theory integration in teaching practice;
- To determine the degree to which senior phase Technology teachers integrate assessment principles and strategies to enhance learner capabilities in assessment tasks;
- To explore senior phase Technology teachers' perceptions and understanding of technological literacy as the educational intention of the discipline, and
- To make recommendations for the integration of assessment practices that enhance teaching and learning through the assessment processes applied in senior phase Technology classes.

1.6 RESEARCH DESIGN AND RESEARCH METHODOLOGY

The study seeks to assist Technology teachers to develop effective assessment tools that support the development of technological literacy. The researcher used qualitative research methods. Qualitative research is an "intensive, holistic description and analysis of a bounded phenomenon" (Merriam, 1998: xiii). A case study is used as research methodology. According to Baxter and Jack (2008:544), "there is often misunderstanding about what a case study is and how it can inform professional practice". A case study, according to Cohen, Manion and Morrison (2011:289), is a "specific instance used to illustrate a more general principle". Case studies illustrate how theories or principles can be used in a more practical sense, instead of burdening the reader with complex and abstract information. In other words, case studies illustrate how theory or principles can be linked to practice. Furthermore, Shuttleworth (2008:online) emphasises that, although case studies can be very reliable, they should

not be used to generalise to an entire population. For the purpose of this study, embedded single case study design was used as the researcher involved two senior phase teachers in the Motheo school district by interviewing and observing their teaching and learning assessment practices; and twenty three (23) teachers involved in open-ended questionnaires and follow-up discussions.

Shuttleworth (2008:online) lists the steps used in a case study: When conducting a case study, the researcher deliberately isolates a small group or an individual. The first step (Shuttleworth, 2008:online) is to identify the main aim, as discussed in Section 1.5.2, and the research participants – this study observed the teaching practices of two Technology teachers in the Motheo school district.

The next step is to determine the method that will be used to collect data; planning and design is, therefore, of the utmost importance. For the purpose of this study, the researcher observed Technology teachers' teaching practices, and generated supporting data. Observations included the recording of lessons. The researcher conducted discussions with teachers whose lessons she recorded, in order to gain insight into the assessment practices they applied.

The study also focused on assessment instruments, teacher perceptions and intentions, and experiences when assessment practices are carried out. More specifically, the study aimed to determine how assessment instruments were designed to develop learners' technological literacy. With reference to Compton and Harwood (2003:2), who state that research found that teachers experienced difficulty creating Technology programmes, and Boud and Falchikov (2006:400), who claim that current higher education assessment practices do not "equip learners well for a lifetime of learning and the assessment challenges they would face in the future", there seem to be gaps in Technology assessment practices. This study, therefore, seeks to make a contribution to the development of assessment instruments that could assist Technology teachers in the senior phase to align their teaching conduct with the educational aims of Technology Education as a stipulated in the CAPS for Technology (DBE, 2011:8). Embedded single case study design as a research methodology for this study is further discussed in Chapter 3 of the study.

1.7 DELIMITATIONS OF THE STUDY

Demarcating the research serves the purpose of making the research topic manageable from a practical point of view. The omission of certain aspects from study does not imply that there is no need for further research. The empirical study has been limited to a case study investigation of Technology teachers of the senior phase. The Technology teachers' races, genders, ages, and years of experience did not influence their participation. Two senior phase Technology teachers' assessment practices; and twenty three (23) selected Technology teachers from the Motheo school district who were willing to engage in this study were involved in the empirical data collection process. Participants were purposefully chosen from the Motheo school district for practical purposes, as the researcher is located in the Bloemfontein, Free State, area.

1.8 ORGANISATION OF THE STUDY

The chapters of this study comprise the following topics:

Chapter 1:	Scope of the study
Chapter 2:	Theoretical framework, literature review and definitions of operational concepts
Chapter 3:	Research methodology
Chapter 4:	Findings of the study
Chapter 5:	Summary of findings, conclusion and recommendations

1.9 CONCLUSION

In this chapter, the researcher presented the background and significance of the study, the problem statement, aim and objectives of the study, the research design and methodology; and the delimitations of the study. The next chapter contains the literature review, which outlines the theoretical framework that was used by this study. Chapter 2 provides information regarding the theories that were found to be fundamental to the collection and analysis of the research data. The definitions of the operational concepts is given. Chapter 2 further provides more information regarding

the Technology assessment teaching practices, from national and international sources, in line with the aim and objectives of this study.

CHAPTER 2:
THEORETICAL FRAMEWORK, LITERATURE REVIEW AND DEFINITIONS OF OPERATIONAL CONCEPTS

2.1 INTRODUCTION

This study investigated the assessment practices that Technology teachers employ to enhance technological literacy in their classes. The chapter serves as a literature review on Technology assessment teaching practices that seek to enhance technological literacy with the intention of providing a conceptual basis for this study. The chapter starts with a discussion of bricolage, as the theoretical framework that underpins the study; the underlying principles of bricolage that guided the data generation and analysis process, enabled the researcher to respond to the research question, the aim and the objectives of the study. In this chapter, the origins of bricolage, the objectives of bricolage, the role of the researcher and the relationship between these key role players are discussed. The operational concepts that underpin the study are discussed, followed by an extensive literature review on enhancing technological literacy through the application of effective assessment practices in Technology classes.

2.2 THEORETICAL FRAMEWORK UNDERLYING THE STUDY

This study uses bricolage as a theoretical framework to interpret complex teachers' understanding and application of discipline-specific assessment practices that are designed to enhance technological literacy in senior phase Technology classes.

2.2.1 Origins of bricolage

The term bricolage was first introduced by Claude Lévi-Strauss in 1962. Lévi-Strauss, who was born in 1908, was a celebrated philosopher and anthropologist, described as, "one of the most celebrated thinkers in of the twentieth century" (Wilcken, 2014:i). He is the author of a several books, among which, *A World on the Wane, The Savage Mind, Myth and Meaning,* and *Mythologiques* (Parker and Sim, 2014:193). It is in *The Savage Mind* that Lévi-Strauss introduced bricolage, which he describes as the "build[ing] up of structures by fitting together events, or rather the remains of events"

(Elwell, 2010:161). For this study, teaching and learning assessment practices were analysed in an attempt to understand how technological literacy is developed through assessment.

2.2.2 Characteristics of bricolage

Bricolage is a metaphor for a research approach that allows the bricoleur (the individual who employs bricolage) to create something out of nothing; and to use that which is available to achieve new goals (Kincheloe, 2005:232; Mahlomaholo, 2013:392; Wibberley, 2012:3). Bricolage is, thus, a process of understanding the basic principles of Technology Education and the assessment practices that guide teachers and learners to reaching educational outcomes. Bricolage offers further understanding, and facilitates improvisation regarding problems that are created in dynamic solutions (Cantliff and Thompson, 2016:1). Bricolage encourages the bricoleur to seek knowledge and understanding of, not only the resources that are available, but also the context in which the bricoleur finds him/herself, so that challenges can be overcome effectively. According to Stritar (2012:6), Baker and Nelson identified five characteristics of bricolage, which the researcher finds relevant to the study.

a) Bricolage engages with the problem

Initially, it is necessary to define and understand what the problem is; thereafter, participants engage with the problem. This study is necessary because literature suggests that, (i) Technology teachers do not align assessment practices with their teaching objectives; and (ii) Technology teachers do not demonstrate understanding of the importance of such alignment (Boud and Falchikov, 2006; Compton and Harwood, 2003; MacLellan, 2001; Moreland *et al.*, 2001). As noted by Wibberley (2012:2) and the researcher, Kincheloe is a frequently cited source in the field of bricolage. Kincheloe (2005:325) describes the process of bricolage as one that involves “construction and deconstruction, contextual diagnosis, negotiation and readjustment”. Cantliff and Thompson (2016:1) state that bricolage acknowledges “how organizations recombine their resources when things do not go as planned” – this experience is recognised as sub-problems that may arise and that cannot be avoided. It is, therefore, important to analyse the problem, so that it can be overcome

effectively. From this research perspective, the researcher argues that teachers' theoretical and practical understanding affects assessment practices and, therefore, the outcome of the teaching and learning process. Such a perspective can assist the researcher to understand the assessment practices employed in the Technology Education classroom and the reasons for the choice of assessment instruments. It is important that teachers deliberately select assessment instruments, and are aware of the effect of their choices on the intended Technology outcomes. The researcher, thus, asked the following question in an attempt to fully engage and understand the problem: To which extent do teachers in senior phase Technology classes integrate assessment practices to enhance technological literacy?

b) Bricolage disregards limitations

Bricolage enabled the researcher to identify the challenges teachers experience when they design their teaching activities and assessment practices. The researcher employed the case study methodology (see Chapter 3) to understand teachers' Technology background, to identify any other challenges that the teacher may face when designing and employing assessment practices, and to identify factors that affect the realisation of the educational objectives. Cantliff and Thompson (2016:1) describe limitations as a means to "promote the use of recombining [limited] resources to create a solution". Kincheloe (2005:324) supports this notion, and states that the bricoleur focuses on the

> *clarification of his or her position in the web of reality and the social locations of other researchers and the ways they shape the production and interpretation of knowledge.*

It is, therefore, imperative that participants, especially Technology teachers, as bricoleurs, understand their societal role in a broader educational context, and that they make use of the human and physical resources available to them.

c) Bricolage combines existing resources for new purposes

As participants collaborated with the researcher, various perspectives were illuminated. The bricoleur is described as being "adept at performing a large number of diverse tasks", and as having the ability to recognise that "the rules of his game is to always make do with whatever is at hand" (Aagard, 2009:82; Lévi-Strauss, 1962:11; Stritar, 2012:6; Wibberley, 2012:3), therefore, participants, as bricoleurs, were

encouraged to discuss the resources they use in their Technology classes, where these resources are obtained and how these resources influence assessment practices. In this context, bricolage, as the theoretical lens, implies that the Technology teacher should be aware of all the possibilities/limitations, and should make use of that which is available. A case study research design enabled the researcher to gain various perspectives from the twenty five (25) Technology teachers who collaborated in the study, in order to understand the assessment practices carried out in the Motheo school district senior phase Technology classes.

d) Bricolage facilitates use of economical or inexpensive resources

The participants identified the resources that are available to them and that can improve Technology assessment practices so that technological literacy can be enhanced. Furthermore, participants reported on factors that hinder the availability of such resources, and proposed possible solutions. According to Lévi-Strauss (1962:13), bricoleurs are always on the lookout for “messages” to assist them in their purpose. He also describes a bricoleur as a person who retains resources as “they may always come in handy” (1962:11). Participants were encouraged to evaluate the extent to which they made use of the available resources.

Thus far, several references have been made to the term bricolage. The researcher, therefore, discusses the term further to provide clarification. The term bricolage is derived from the term bricoleur (Mosia, 2016:27), which describes a person who generates something new out of what is available to him or her, in order to solve a problem or answer a question (Aagard, 2009:82). The researcher and participants in this study serve as bricoleurs. Johnson (2012:358) describes the difference between bricolage and bricoleur as follows.

- Bricolage is seen as an activity; being combinational in nature. Johnson (2012:359) states that Lévi-Strauss describes bricolage as the process of “destruction; or de-construction and recombination”. This process enables participants, who possess the required teacher knowledge competencies, to develop effective Technology assessment instruments that enhance technological literacy.

- The bricoleur is, thus, seen as being someone who carries out an activity (i.e. bricolage). Johnson states that a bricoleur is “not exactly coincident with the contemporary definition of *handyman* or *handywoman*” (2012:360). Johnson states that Lévi-Strauss’s English translator preferred to leave the term *bricolage* in its French form, “as a kind of translatable” (Johnson, 2012:360); Johnson describes a bricoleur as someone who takes on many different odd jobs, or “a kind of professional do-it-yourself man”, which is not the same as an “odd job man” (2012:360). Instead, participants were seen as subject specialists who engage with bricolage in the Technology classroom. Cantliff and Thompson (2016:1) note that the individual engaging in the practice of bricolage (i.e. the bricoleur) considers all the possible solutions to a problem to discover the “best approach within the current conditions”. Participants were encouraged to make use of all the resources that are available to them, both within the school and within the community.

2.2.3 Formats of bricolage

Bricolage can take on various formats (Kincheloe, 2005:335), and the following are applicable to this study.

- **Methodological bricolage** refers to the employment of various research methods, such as “interviewing techniques…, historical research methods, discursive and rhetorical analysis of language, [and] psychoanalytical methods” (Kincheloe, 2005:335) to analyse and unfold research problems. By employing methodological bricolage, the researcher is given the opportunity to make use of various strategies to generate data. Methodological bricolage also provides the researcher with opportunities to be flexible, yet practical, regarding the methods used to obtain empirical data. The researcher employed a case study research methodology, and primarily focused on observations, interviews open-ended questionnaires and discussions to generate data as a means of employing methodological bricolage.
- **Theoretical bricolage** refers to the use of a variety social theoretical positions, such as “constructivism, critical constructivism, enactivism, feminism, postmodernism, poststructuralism, and cultural studies” (Kincheloe, 2005:335).

According to Mosia (2016:44), such an approach provides the researcher with opportunities to "construct a collage of pictures that enable us to design a responsive framework to enhance teaching and learning". Theoretical bricolage enabled the various participants to express their theoretical approach to teaching and learning practices as aligned with this study.

- **Interpretive bricolage**: Denzin and Lincoln (2005:4) describe this approach to bricolages as a means of telling various stories, with there being no single, correct "truth". The researcher concluded that interpretive bricolage is a reflective approach. According to Kincheloe (2005:335), bricoleurs

> *work to discern their location in relation to intersecting axes of personal history, autobiography, race, socioeconomic class, gender, sexual orientation, ethnicity, religion, geographical place, and numerous other dynamics.*

  By employing such an approach, the researcher was able to gain various perspectives from various role-players "in relation to one another and in relation to larger social, cultural, political, economic, psychological, and educational structures" (Kincheloe, 2005:335). In the same way as theoretical bricolage, the researcher gained rich, empirical data from diverse Technology teachers. This data was supplemented by their diverse Technology backgrounds (see Section 4.2).

- **Political bricolage**: According to Mosia (2016:44), this approach creates awareness of the connection that exists between knowledge and power. Kincheloe (2005:335) states that, "bricoleurs attempt to document the effects of ideological power, disciplinary power, regulatory power, and coercive power". By employing political bricolage, the researcher identified relationships that exist within Technology Education contexts. Such relationships assisted the researcher to identify hierarchical support structures and the way these relationships affect teaching and learning processes in Technology.
- **Narrative bricolage**: According to Kincheloe (2005:336), this approach "appreciates the notion that all research knowledge is shaped by the types of stories inquirers tell about their topics". Rogers (2012:6) states that "objective reality can never really be captured, research texts can only represent specific

interpretations of a phenomenon". This approach assisted the researcher to gain rich data that is based on honest experiences from various perspectives. These various perspectives may also be based on one single event. The researcher agrees with the notion that narrative bricoleurs "draw on techniques from multiple perspectives, voices and sources" (Rogers, 2012:7).

The researcher, thus, employed a variety of formats of bricolage in the study. Johnson (2012:360) states that, "it is *bricolage* which thinks, or operates, through the *bricoleur,* rather than the reverse". When bricoleurs generate something new, they use tools and resources confined to their environment (Aagard, 2009:82) – the word confined is emphasised. As Johnson (2012:361) explains, a bricoleur makes use of the odds and ends that are available because "there is quite literally nothing else (at) hand", and that bricoleurs' tools are taken from the environment they find themselves in. Bricoleurs, confined to their environment, will, therefore, have a limited number of possibilities to make do with. The researcher had to identify the restrictions facing Technology teachers, and collaboratively evaluate the extent to which such restrictions affect assessment practices.

The world can be seen to exist in multiple spheres – the physical, the social, the cultural, the psychological, and the educational – that are all interwoven, and bricoleurs are encouraged to participate in all of them. Participants in the study, especially teachers, were encouraged to engage in all of these spheres. In the process of achieving construction and reconstruction, bricoleurs tend to "defend what we assert we know and the process by which we know it" (Kincheloe, 2005:325). Some institutions may limit the bricoleur; however, "the bricoleur should possess the knowledge and resources that can be effective in bringing about this change" (Aagard, 2009:82). Doing so requires that bricoleurs evaluate and understand their own knowledge base and its origins – to critically think about their consciousness. Kincheloe (2005:325), furthermore, states that such thinking will result in a refusal to passively accept external forces that use tactful "modes [to] justify knowledge that is decontextualized". Instead, as explained by Aagard (2009:82), tools and resources that are available to teachers are "shaped and adapted" in order to resolve the problem. In the context of this study, the researcher wished to understand the

boundaries that technology teachers face, and if and how they overcome such boundaries.

This study evaluates the importance of teachers' conceptualisation of the alignment between Technology teaching practices and appropriate assessment tasks in their quest to enhance technological literacy. Bricolage, therefore, serves as a relevant theoretical framework to this study. Furthermore, the bricoleur strives to make a difference and avoid *monological knowledge*. Monological knowledge, according to Kincheloe (2005:326), is the result of seeking order and certainty. Kincheloe (2005:326) elaborates that monological knowledge is one-dimensional and lacks rich descriptions; someone who relies on monological knowledge is satisfied with "right" and "wrong" answers/methods, as they offer simplicity and certainty. The researcher discouraged such a mentality. Technology education aims to inspire creativity and innovation (DBE, 2011:8), which enables the participants and therefore the learners to make positive contributions to society. If a teacher limits learners to right and wrong answers/methods, learners can also develop monological knowledge.

Aagard (2009:82) describes how institutions can be moulded through the use of bricolage, whereby "an individual in an institution uses the ideas and philosophies already at work in that institution to transform it". The views and experiences of the bricoleurs involved in this study are necessary, as these multiple perspectives informed the study. Aagard (2009:82) asserts that some institutions limit bricoleurs, however, "the bricoleur should possess the knowledge and resources that can be effective in bringing about this change". Using bricolage, the researcher and participants not only gained valuable insight required for the study, but also assisted teachers and various role players to become bricoleurs in their classrooms and surrounding environments.

According to Kincheloe (2005:324), bricolage "highlights the relationship between the individual's way of seeing and the social location of his/her personal history". There is an origin to the paradigm that each individual uses – it is based on personal experience. The study, therefore, reports on the participants' technological background and the experiences that led to their stance on Technology. In this study, a variety of teachers with various backgrounds provided various perspectives (see Section 4.2).

Kincheloe (2005:326) states that, when perception is mistaken for truth, it reduces our ability to make sense of the world and harms those who have the “least power to pronounce what is true”. It is, thus, important for Technology teachers to be subject content experts, in order avoid the likelihood of perception being “mistaken for truth”. Bricolage requires on-your-feet thinking, which encourages the bricoleur to improvise – the bricoleur will need to plan and implement solutions simultaneously (Cantliff and Thompson, 2016:1). By employing bricolage, the researcher was able to collaborate with teachers in different teaching and learning spheres, in order to gain valuable knowledge from the participants’ experiences, to not only enrich the study, but to transform Technology assessment practices at schools.

Bricoleurs are active participants in the construction of their worlds. Their thoughts and actions should be questioned, and realities should be reshaped. According to Cantliff and Thompson (2016:2), the bricoleur must design and combine “available resources, often under pressure”. These authors (2016:3) explain that an individual’s engagement in bricolage is rooted in “an individual’s specific skills and experiences”. In the study, the researcher attempted to understand participants’ views, skills and experiences; and reports on how participants constructed Technology class activities that are meaningful (i.e. the researcher incorporated their knowledge of Technology Education and aligned it with their class activities). The duty of the bricoleur is to confront the conscious and unconscious dynamics of participants, uncover the hidden influences on cultures that underlie thoughts, and the powers that influence these thoughts, and to document the nature of these influences (Kincheloe, 2005:324).

Bricolage encourages elasticity and active involvement (Kincheloe, 2005:325). Bricoleurs should not be stagnant in the manner in which they engage with the task at hand, and they should avoid concrete ideas. Teachers in this study were encouraged to evaluate tasks and activities given to learners; doing so provided a means of continuously questioning the relevance of these tasks and activities. Bricolage is therefore imperative, because it aims to uncover complications that exist, and to question perceived reality of everyday life (Wibberley, 2012:6). According to Kincheloe (2005:328), these complications are embedded in the following notions.

- **Polysemy**: According to Ravin and Leacock (2000:1), polysemy is defined as having “multiple meanings”. In schools, not all the processes and activities that learners and teachers engage in are understood and/or interpreted in the same way. This variety of perceptions should be encouraged as it can spark creativity and improve understanding amongst the learners and the teacher. According to Kincheloe (2005:328), “research processes may be more complex than initially perceived”. Technology teachers should be open to and embrace various processes and perceptions. For the purpose of this study, polysemy is obtained through the process of interviews, open-ended questionnaires and follow-up discussions with twenty five (25) Technology teachers.
- **The ontology of relationships and connections**: Kincheloe (2005:328) emphasises the importance of the self in social, cognitive and psychological research. The self is complex and dependent on connections and relationships; it is the culture that shapes us. In this regard, it is important for role players to familiarise themselves with and concretise their cultures/self-perceptions, so that positive connections and relationships can be developed within the Technology discipline. It is also essential that participants in this study understand “the self”, so that they could identify and understand the influences and barriers that exist in Technology Education assessment practices that they encounter in their teaching and learning activities.
- **The fictative dimension of research findings**: No representation is “pure” (Kincheloe, 2005:329) and, as a result, assumptions about purity could lead to misconstructions. As Technology teachers provide qualitative data that may contain various fictative elements based on their perceptions and understanding, the researcher can gain multiple perspectives, so that core, underlying “truths” emerge. The researcher, therefore, engaged with a total of twenty five (25) Motheo school district Technology teachers of the senior phase, who represent various biographical backgrounds (see Section 4.2) and discussed their various views to the assessment practices employed in their classes discussed in Section 4.3.
- **The relationship between power and knowledge**: Power greatly influences the production of knowledge. As a result, power creates the assumption that there are “legitimate ways of seeing” (Kincheloe, 2005:330). It is, therefore,

important to trace the “footprints of power” and to uncover the forces that influence participants’– that is, who/what shapes participants’ perceptions on Technology Education, assessment and engagement in activities; and what influence do these powers have on the assessment practices employed (see Section 4.2).

Technology is based on an inquiring mind (Barnes, 2005:7); therefore, learners should not only engage in activities that extend to outside the classroom, but in activities that involve the global community they live in. By employing bricolage, the researcher can collaborate with various sources within teaching and learning environments, in order to gain knowledge about role players’ experiences, to not only enrich the study, but to transform Technology assessment practices at schools.

2.2.4 Objectives and bricolage

The duty of the bricoleur is to confront the conscious and unconscious dynamics of participants, uncover hidden influences on teaching and learning cultures that underlie thoughts, and the powers influencing these thoughts, and to document the nature of these influences (Kincheloe, 2005:324). The researcher, therefore, embraced the complexity of bricolage in relation to the objectives of this study.

The researcher’s aim was to understand the challenges that exist in a senior phase Technology class when assessment practices are employed with the intention of developing and promoting technological literacy. According to Kincheloe (2005:327), bricoleurs “propose compelling insights into their engagement with reality and the unresolved contradictions that characterize such interaction”. As the world is ever changing, bricolage was the appropriate theoretical framework for this study, as the aim was not to provide an “ultimate” truth but, rather, to enrich our understanding and to accept uncertainty.

2.2.5 The role of the researcher

The role of the researcher is to unfold bricolage with participants in order gain an understanding of how teachers develop and enhance technological literacy through assessment practices. In this study, the researcher was able to observe, interview, distribute open-ended questionnaires and engage in follow-up discussions with

Technology teachers in order to generate rich, empirical data from a case study investigation – specifically through engagement with Technology teachers about the assessment practices they employ, that are aimed at enhancing learners' technological literacy. Further distinguishable from the researcher's role in bricolage is that, according to Johnson (2012:368), "the bricoleur may not ever complete his purpose but he always puts something of himself into it". The role of the researcher was, therefore, to contribute collectively towards the knowledge, skills and understanding of Technology Education and technological literacy necessary to responding to the research objectives. Moreover, the researcher role was to contribute towards existing literature and provide recommendation for further research. A case study methodology was employed as a means to involve knowledgeable individuals within the Technology Education sphere to discover the best practices employed by teachers.

2.2.6 Relationship between the researcher and the participants

In this study, participants provided a variety of perspectives on conducting integrated assessment to achieve the educational objectives of Technology Education. As stated in Section 2.2.3, the world exists in multiple spheres, and schooling involves these multiple spheres; a single sphere cannot be isolated from the rest, nor should it be limited to one frame of mind. Participants, therefore, engaged in interviews, completed open-ended questionnaires regarding their individual roles, with the intention of enhancing technological literacy and engaged in follow-up discussions that provided clarity.

A case study, according to Cohen, Manion and Morrison (2011:289), is a "specific instance used to illustrate a more general principle". Case studies illustrate how theories or principles can be used in a practical sense, instead of burdening the reader with complex and abstract information. In other words, case studies illustrate how the theory or principle can be linked to practice. Kincheloe (2005:326) warns that, when perception is mistaken for truth, it can reduce our ability to make sense of the world. As bricolage "highlights the relationship between the researcher's way of seeing and the social location of his/her personal history" (Kincheloe, 2005:324), the origin of participants' knowledge, which is based on their experiences, needs to be uncovered.

The study aimed to understand participants' background in relation to Technology Education, and their experiences. It is therefore necessary to define concepts clearly.

2.3 DEFINITION OF OPERATIONAL CONCEPTS

In this section, the key operational concepts of this study are defined for meaning making and interpretation.

2.3.1 Technology

The Academic Press Dictionary of Science and Technology (Morris, 1992:2176) describes Technology as "the application of scientific knowledge for practical purposes; the employment of tools, machines, materials, and processes to do work, produce goods, perform services, or carry out other useful activities". A more general definition is also given: "any use of objects by humans to do work or otherwise manipulate their environment".

The CAPS for Technology (DBE, 2011) builds on this general perspective, by defining Technology as "the use of knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration". This perspective coincides with the interpretation of the Greek word *techne*, which Osborne (1970:8) describes as "manual skill cultivated in accordance with non-specifiable rules of workshop tradition" and as "a branch of knowledge, a form of practical science".

The definitions above outline two views of Technology, namely, (i) the application of scientific knowledge; and (ii) technological knowledge used to solve problems.

2.3.2 Technology education

Literature defines Technology Education as an educational discipline that seeks to develop technological literacy at schools by creating opportunities through which learners demonstrate their ability to

> *develop and apply specific design skills to solve technological problems; understand the concepts and knowledge used in Technology Education and use them responsibly and purposefully; and appreciate the interaction*

> *between people's values and attitudes, technology, society and the environment"* (DBE, 2011:8).

Technology education is, therefore, seen as "a learning domain [that] has [its own] knowledge base", and should be considered a subject in its own right (Compton and Harwood, 2003:4). Brown and Wyatt (2010:35) state that Technology Education implements design thinking processes as a way of moving beyond conventional problem-solving.

2.3.3 Literacy

According to the Merriam Webster Online Dictionary (2017: online), literacy is described as "knowledge that relates to a specified subject".

Deane (2004: online) provides a simple definition of literacy, namely, that it is "the basic set of skills required to function on a job". However, other sources, such as Keefe and Copeland (2011:92), and Scribner (1984:6) suggest that there is no clear definition of literacy.

According to UNESCO,

> *a person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his (her) group and community and also for enabling him (her) to continue to use reading, writing and calculation for his (her) own and the community's development* (Keefe and Copeland, 2011:93).

For the purpose of this study, literacy is described as a set of specific skills an individual obtains through engagement in activities that are linked to Technology; and that enables them to carry out tasks effectively and function efficiently in society.

2.3.4 Technological literacy

The Academic Press Dictionary of Science and Technology (Morris, 1992:2176) describes technological attribute as "a characteristic of an artefact that is directly the result of how it was made or the raw materials which formed it". Technological literacy is, therefore, an attribute of technology. Other sources agree, such as Jones, Buntting and De Vries (2011:192), who define technological literacy with reference to (i) the

technology of artefacts, (ii) the knowledge, (iii) the activities, and (iv) the aspect of humanity. Brown and Brown (2010:50) state that learners demonstrate technological literacy through a conceptual understanding of technology and its value in the broader social context.

This perspective of technological literacy is captured in most educational outcomes and aims of the subject of Technology as analysed in the literature of Technology Education (DBE, 2011:3; ITEA, 2000:4). The International Technology Education Association (ITEA) (2003:10) advocates for a more general perspective of technological literacy, by proposing that it "is what every person needs in order to be an informed and contributing citizen for the world of today and tomorrow". ITEA also alludes to technological literacy as "the ability to use, manage, evaluate and understand technology".

An early study by Gagel (1997:10) analysed frequently cited works of diverse authors in different institutions and disciplines, including anthropology, education, history, technology, and theology, and found that there is little agreement regarding the terms technology and literacy. These findings complicate the creation of a precise definition of technological literacy. This study, therefore, draws on these sources and builds an argument for the following definition of technological literacy: the ability of an individual to use knowledge, skills, resources and artefacts to engage, understand and expand human potential in a technological society whilst considering the ethical impacts thereof. Five distinct categories of technological literacy are discussed further in Section 2.4.

2.3.5 Assessment

The term assessment practices is defined as the "process of evaluating the effectiveness of sequences of instructional activities" (Wiliam, 2011:3), which includes planning beforehand (Boud and Falchikov, 2006:402), active learner involvement (Boud and Falchikov, 2006:399; Compton and Harwood, 2003:7), feedback (Boud and Falchikov, 2006:399; MacLellan, 2001:316; Moreland *et al.*, 2001:163), and the need to be related to both present and future learning needs (Boud and Falchikov, 2006:404).

Assessment is thus seen as a process of making judgments on activities that have been given to learners, and providing them with feedback. The assessment practices of senior phase Technology classes include the assessment of formal tests/exams and a mini PAT.

2.3.6 Practical Assessment Tasks (PAT)

Technology teachers and learners engage in a discipline-specific assessment practice designed to develop and evaluate technological literacy in a structured and coherent manner. The CAPS for Technology (DBE, 2011) defines PATs as,

> *a set of short practical assessment tasks which make up the main formal assessment of a learner's skills and application of knowledge during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC). It is composed of a variety of forms of assessment suited to the range of activities that make up a mini-PAT.*

Practical assessment tasks are, therefore, mandatory tasks that enable learners to develop technological literacy skills over a prescribed period. The tasks include the use of the design process, and contributes to the summative assessment of learners.

2.4 LITERATURE REVIEW RELATED TO ASSESSMENT PRINCIPLES AND STRATEGIES

Education provides the foundation for individuals to learn. It is seen as a mass production effort that quickly and efficiently produces learned individuals, who are moulded by their educated superiors, who are ready and able to convey knowledge to the next generation (Hickey, 2014:16). Furthermore, it can be described as a process "to bring up; give intellectual and moral training to; development of character and moral power" (Heystek, Niemann, Van Rooyen, Mosoge and Bipath, 2008:133). Teachers are the "educated superior[s]" who produce such learned individuals through the process of developing intellectual and moral power. This view is supported by Heystek *et al.* (2008:133), who describe teaching, furthermore, as a process of "giv[ing] instruction, explain[ing], show[ing], and stat[ing] by way of instruction" to reach objectives set by an organisation.

According to the CAPS for Technology (DBE, 2011:9), the subject is designed to cultivate learners' ability to solve problems using the design process, to develop practical skills and knowledge, and to teach them to apply this knowledge in a responsible manner. This research study, therefore, argues that it essential for Technology teachers to reflect on their teaching and learning objectives when they design learning activities, because learning should be a process that aids learners in the pursuit of "self-discovery" (Hickey, 2014:17).

Education theorists, such as Dewey, Vygotsky and Piaget, support the notion that learners need to be actively involved in the learning process, so that they can construct their own understanding of what the world is. These theorists contend that experiences play a vital role in learning – as learning is not about obtaining information, but also involves the construction of meaning through various processes (Hickey, 2014:17). It is therefore necessary that Technology teachers fully understand the nature of their teaching, the intent of their discipline-specific knowledge production processes and, furthermore, to interpret and critique the techniques that they use to enhance technological literacy in their classes. Technological literacy is a critical knowledge framework that is needed by every person, "in order to be an informed and contributing citizen for the world of today and tomorrow" (Brown and Brown, 2010:50).

This research builds on the perspectives of Brown and Brown (2010:49), that Technology Education is a process designed to "produce learners with a more conceptual understanding of technology and its place in society". This entails teachers who are able to identify and evaluate technological systems and analyse their positions in teaching and learning contexts. This perspective coincides with that of the South African CAPS for Technology (DBE, 2011:8), which outlines the following aims:

- To develop and apply specific design skills to solve technology problems;
- To understand the concepts and knowledge used in Technology Education and use them responsibly and purposefully; and
- To appreciate the interaction between people's values and attitudes, technology, society and the environment.

Brown and Brown (2010:51) suggest that a Technology class should provide learners with opportunities to engage in "cognitive, affective and psychomotor activities that foster critical thinking, decision making, and problem solving skills". These assessment

activities should be authentic and enable learners to use and maintain technology knowledge and skills (Brown and Brown, 2010:51). These views are supported by Teis (2014), who argues that Technology Education is designed to develop cognitive, psychomotor and affective skills. Brown and Brown (2010:51) suggest that the Technology classroom environment should reflect crucial process-oriented teaching and learning activities. These views coincide with Compton and Harwood's early descriptions of a technological learning environment. Compton and Harwood describe this environment as "dynamic and responsive to the changing needs established through ongoing consultation"; and based on the "freedom to experiment and explore innovative and creative ways" (2003:8). A Technology class should, therefore, enable learners to engage actively in challenging and stimulating activities that reflect the world around them.

These views excite critical questions about Technology Education. Brown and Brown (2010:52) cite Zilbert and Mercer, who state that Technology has no defined place in the curriculum that is taught. As a result, we can ask why technological literacy is regarded as an important educational objective for Technology Education. According to Brown and Brown (2010:52), developing an understanding of technology and becoming technologically literate is believed to help learners "achieve a better understanding of the technological society in which they live, not only through vocational or specific job training, but by developing a holistic understanding of technology". This view is supported by Pace-Marshall (2009:50), who argues that we must create atmospheres that "invite [learners] to develop a full range of their talents and potentials". Teachers are encouraged to constantly challenge learners' abilities and knowledge structures, and to disrupt learners' conventional thinking. Developing teaching and learning practices that are based in the aforementioned aims is vital to the development and enhancement of technological literacy through assessment practices that correspond with the educational goals of Technology Education.

As technological literacy becomes the key outcome of Technology Education, it is important that it is clearly understood. As stated in Section 2.3.4, in this study technological literacy is the ability of an individual to use knowledge, skills, resources and artefacts to engage, understand and expand human potential in a technological society, whilst considering the ethical impacts thereof. Brown and Brown (2010:49),

however, offer the view that technological literacy can be divided into five distinct categories that promote a deeper understanding, as follows.

- Nature of Technology
    - Comprises the understanding that technology expands human potential and takes into account knowledge, resources and artefacts; and
    - Includes the relationship of Technology to other subjects, such as mathematics, biology/natural sciences, and physical sciences.
- Technology and society
    - Focus is on the “influence, roles and effect of Technology”; and
    - Addresses social, political, economic and cultural effects that Technology has; whether good or bad.
- Design
    - Focus is on the design/technological process, which includes
        - Identifying and analysing the problem,
        - Designing,
        - Planning and Making,
        - Evaluating, and
        - Investigating and communicating.
- Abilities for a technological world
    - This category links to the previous, as it develops various skills associated with the application of the design process, such as problem-solving, critical thinking, drawing/sketching skills, computer skills, body-kinaesthetic skills, abilities to assess and evaluate, to conduct research, and so forth.
- The designed world
    - This area focuses on the manner in which technology is applied in contexts such as transport, where a learner will need to understand, for instance, the mechanics, the systems and controls, transportation designs, and environmental impacts of technology.

Technological literacy encompasses all three domains of learning; and involves itself in past, present and future artefacts. Moreland *et al.* (2001:158), however, argue that Technology teachers need to develop three dimensions of knowledge in order to be

effective. These dimensions are knowledge about the nature of technology and technological practice; knowledge in technology (i.e. technological concepts and procedures); and general technological pedagogical knowledge. Brown and Brown (2010:52) note a gap between "the average citizen, those who use technology and those who design and develop technology". This implies that there is a gap between the dimensions of Moreland *et al*. Brown and Brown (2005:52) note that members of society have recognised and realised the importance of technological literacy in the technological world, but feel uninformed and uninvolved in technology-related issues, such as "automobile efficiency, road construction in the community, and genetically modified foods". It is, therefore, imperative that technological literacy be developed. If the gap reported by Brown and Brown is not closed, technologically illiterate individuals will be unable to adapt to society and its ever-advancing technological breakthroughs. It is, therefore, necessary that this gap be filled, not only so that individuals are able to live in a technological world, but also so that individuals can make valuable contributions to society. Society and the world are developing at a rapid pace; learners need to recognise such developments in order to become contributing citizens.

According to Pace-Marshall (2009:48), it is important to develop minds that are able to "discern, analyse and integrate patterns within vast amounts of unstructured data". The need for this ability coincides with the need to develop technologically literate citizens. Furthermore, Pace-Marshall states that these citizens should be able to "ethically unravel and resolve complexity; generate new knowledge, ideas, question and globally collaborate", as these are seen as skills needed for the development of a sustainable future (2009:48). The DBE lists content knowledge that needs to be taught to realise technological goals aimed at developing technological literacy. These technological goals include, amongst others, the ability (DBE, 2011:9):

- *To solve problems in creative ways;*
- *To use authentic contexts rooted in real situations outside the classroom;*
- *To combine thinking and doing in a way that links abstract concepts to concrete understanding;*
- *To evaluate existing products and processes; and to evaluate their own products;*
- *To use and engage with knowledge in a purposeful way;*

- *To deal with inclusivity, human rights, social and environmental issues in their tasks;*
- *To use a variety of life skills in authentic contexts (such as decision making, critical and creative thinking, cooperation, problem solving and needs identification);*
- *To work collaboratively with others:*
    - *Through practical projects using a variety of technological skills (investigating, designing, making, evaluating and communicating) that suit different learning styles.*

These various technological goals, which are aimed at developing technological literacy, coincide with a statement by Heystek *et al.* (2008:150), namely, that there are "no universal criteria for good teaching". Effective learning is based on effective teaching, and it is unclear what effective learning is. These authors elaborate on the problem by stating that it is almost impossible to develop a rigid checklist of criteria, as doing so, leaves teachers with little room to be innovative and to encourage innovation (Heystek *et al*., 2008:150). Assessment practices can, however, assist teachers to fulfil their own potential, as well as that of their learners. Wiliam (2011:13), Taras (2005:468), and Compton and Harwood (2003:7) emphasise that assessment forms the core of effective instruction and learning. Wiliam (2011:3) states that assessment can be described as the "process of evaluating the effectiveness of sequences of instructional activities". Teachers should, thus, focus considerable attention on the assessment processes they employ in their teaching and learning activities. Ramsden, as quoted by MacLellan (2001:307), states that assessment practices determine the quality of the learning, and learners' perception of the (assessment) content will determine the success of the assessment task. According to Heystek *et al.* (2008:150), effective teaching can be measured by the quality of the assessment activity and the standard of achievement. These authors state that, "it is difficult to determine results if the goals are unclear" or too complex to determine whether they have been achieved (2008:150). The CAPS document, therefore, serves as a foundation that outlines what goals are anticipated by the Department of Basic Education. According to Pace-Marshall (2009:48), the quality of our thinking, our habits and our experiences ultimately express who we are, and who we are shapes the world that we live in. It is, therefore, important for teachers to be aware of how they teach and how they assess learning. Pace-Marshall (2009:48-49), furthermore,

explains that, when learners engage in inquiry, investigation and exploration, they are able to develop various critical skills, such as creativity and problem-solving, ethical considerations; autonomy and other crucial behaviours. Such engagements encourage the development of learners' technological literacy, given that the assessment task is linked to appropriate technological goals. Teachers, therefore, need to be aware of their motives when they assign assessment activities to learners.

2.4.1 Teacher subcultures

According to Hickey (2014:18), "teachers often act on intuition, experience, or advice rather than consciously adopting a specific learning philosophy; [as a result, such choices] will impact on perception, practice and effectiveness". This means that teachers should make conscious decisions about the assessment activities they design. Teachers should also re-evaluate the assessment activities that are already in place in their classrooms in relation to the feasibility, authenticity and outcomes of such activities – goals and intended objectives, therefore, need to be clear. The CAPS for Technology (DBE, 2011) stipulates various aims, which serve as a framework to guide teachers in their teaching and learning activities. Such a framework provides opportunities for teachers to be flexible about their teaching. According to Teis (2014:202), it is vital that teacher training programmes support teachers' philosophical understanding of what the intention of Technology is. Teis (2014:203) explains that, through such programmes, subject content knowledge and pedagogical content knowledge can be fostered, to gain a clear understanding of Technology as a subject that is aligned with national imperatives.

Bliem and Davinroy (1997:19) state that teachers sometimes have a "discrete goal or target" in their assessment tasks, and that the manner in which they implement different methods of assessment, depends "on their beliefs and knowledge regarding measurement and its relation to instruction". It is, therefore, necessary that teachers, as recommended by Moreland *et al.* (2001:159), develop certain subject subcultures that direct their teaching, influence the structure of the lesson, and influence the development of classroom strategies. However, Moreland *et al.* (2001:159) argue that the teaching strategies that are used to enable learners to reach the specified outcomes relate more to a teacher's particular subject subculture, than to stated technological outcomes. According to Hickey (2014:17), "people often act in ways that

defy logic". The judgements teachers make about learners should not restrict the learning process, or disadvantage learners, but, instead, encourage them to be creative and test the boundaries of logic.

Moreland *et al*. (2001:158) recognise that judgments relating to assessment, especially for a new subject such as Technology, are complex due to a "lack of shared subject subculture…, insufficient accumulated practical classroom experience and a limited understanding of the discipline-specific assessment structure". Moreland *et al.* (2001:158) state, furthermore, that it becomes challenging for teachers to combine content with pedagogy, for the same reason that makes it, in turn, problematic when teachers need to develop a "coherent, technological content base and appropriate assessment practices". Boud and Falchikov (2006:400) advise that, if it is to be sustainable, assessment should link present and future learning needs. From the above, it is evident that assessment practices are sometimes carried out in Technology teaching in the absence of alignment with the envisaged subject objective of developing technological literacy. Subject-focus alignment is critical, as assessment practices will ultimately determine whether learners realise the subject objectives – it is, therefore, imperative that technology teachers carry out their assessment practices in line with Technology goals and, thereby, develop technological literacy. This view is supported by Boud and Falchikov (2006:400), who suggest that assessment practices should be judged on whether they "effectively equip learners for a lifetime of assessing their own learning". They state that learners are recipients of the "actions of others", as learners are not involved in the assessment process (2006:402). Compton and Harwood (2003:7) agree, and state that assessment practices need "to involve high quality collaborative relationships if learning is to be enhanced". These collaborative relationships should not exist only between the teacher and the learner, but also among Technology teachers of various schools, so that they can gain clarity and uniformity.

2.4.2 Summative vs formative assessment

Assessment is generally associated with terror in the educational context; and these terrors have distorted the necessity of assessment, its centrality and its potentially neutral position (Taras, 2005:469). As there are two different types of assessment,

namely, summative and formative; it is necessary to clarify the differences between the types.

Summative and formative assessment form part of similar assessment processes; only, formative assessment requires feedback from the teacher, which clarifies how the judgement has been made and what needs to be done further (Taras, 2005:468). Summative assessment, according to Taras (2005:466), is assessment that is "judged", whereas formative assessment is described as "assessment for learning". Gòmez-Puente, Van Eijck and Joechems (2013:726) recognise the following assessment characteristics that are generally used in teaching contexts that are closely related to Technology Education.

Summative assessment:

- Individual contribution to project group
- Examinations
- Presentations, reports
- Continuous assessment tasks ➡ peer and self-assessment
- Involvement of industry representatives in assessment

Formative assessment:

- Individual and group tasks
- Weekly assessments
- Laboratory work
- Weekly presentations, reports, concept design

Bliem and Davinroy (1997:1) consider assessment tasks to be mainly summative in nature. Pellegrino and Quellmalz (2010:122) support this view and state that summative assessment practices are used "typically for grading and accountability purposes". Bansilal, James and Naidoo (2010:155) state that any assessment practice should have both formative and summative purposes. Formative assessment practices should be implemented to "modify and diagnose the conditions of learning

and instruction" and "significantly benefit learner achievement" (Pellegrino and Quellmalz, 2010:122), however, this achievement is dependent on factors such as aligning the assessment outcomes with the standards envisaged in the curriculum, providing quality feedback, involving the teacher and learners in self-reflection and action activities, and teachers who differentiate between teaching styles. Moreland *et al.* (2001:158) emphasise that formative assessment can become "distorted if there is lack of subject knowledge and how the subject is constructed". It is, therefore, crucial that teachers have mastery of technological subject content knowledge and, that teachers are masters of their subject. According to Taras (2005:469), summative assessment is often seen as being negative, whereas formative assessment is the "antiseptic version of assessment". It is therefore crucial that teachers, when assessing learners, make unbiased judgements based on outcomes for Technology.

2.4.3 Assessments as judgements

Taras (2005:467) defines assessment as the "judgements of learners' work with relation to specific goals". It is thus clear that all assessment processes are based on judgements. MacLellan (2001:308) asks, if assessment is based on judgements, then, "who makes the judgement, when the judgements are made and what the rules or procedures are for making the judgement"? As judgements cannot be made unless they are compared to goals and standards, it becomes increasingly important that clear and uniform understanding exists amongst the key role players in Technology regarding what is required of technology learners, as well as of Technology teachers.

Taras (2005:469), furthermore, states that the process of making judgements is often misused by society; this, however, does not mean that all judgements are negative. As a solution, an "assessment community" should be created (Taras, 2005:469), which could bring a positive association to judgements, for example, when teachers explain to learners how assessment has been carried out.

Boud and Falchikov (2006: 402) assert that learners must be involved in the assessment process, instead of being the "recipients" of others' judgements; they argue, furthermore, that learners' ability to identify what is important is often ignored. Boud and Falchikov (2006:402) discuss the involvement of learners in the assessment process by offering the view that, too often, learners' ability to determine what needs

to be assessed/learnt is neglected, nor is their ability to plan accordingly acknowledged. In the process of making judgements in assessment it is, therefore, essential, not only that teachers understand what they expect from learners, but also that learners anticipate what is expected of them.

Boud and Falchikov (2006:406) state that assessment is usually an unpleasant experience and that learners seldom seek to be assessed or assess themselves. By providing clarity about judgements affords learners the prospect of reflecting on where they are currently placed and where they need to be, without fearing the judgements made by others. Compton and Harwood (2003:4) explain that providing learners with the opportunity to reflect on Technology practice enables them to gain "a more in-depth understanding of the nature of Technology as they consider social, cultural and environmental implications and influences including ethics, values and beliefs of all stakeholders".

Boud and Falchikov (2006:403) discuss the tendency of learners, when they have to do assessment tasks, to be over-reliant on others' opinions, instead of believing in themselves. According to Killen (2010:350), teachers should assess learners for one or more of the following nine reasons for learner assessment – these goals should guide assessment practice:

a) *To determine how well learners have achieved the learning outcome*
b) *To encourage learners to put effort into learning*
c) *To determine which learners are ready to progress to further learning*
d) *To allocate marks, either for the benefit of the learner or because the system requires it*
e) *To diagnose learner difficulties*
f) *To provide feedback to learners*
g) *To report learner progress to parents/guardians and/or other interested parties*
h) *To determine what things need to be revised or retaught*
i) *To identify ways of improving teaching and learning.*

It is, therefore, clear that learners play a crucial role in assessment. Their cooperation and feedback is needed in the classroom in order for a lesson to be successful.

2.4.4 Sustainable assessment practices

Boud (2000:151) emphasises that the aim of teaching is not to prepare learners for assessment, but, rather, to prepare learners with the "ability to assess their future learning". Boud and Falchikov (2006:400) describe this learner ability as "sustainable assessment", which is a process of "building on summative and formative assessment to foster longer-term goals". This process encompasses all teaching, learning and assessment activities that take place in the technology classroom (Boud and Falchikov, 2006:405). Pope (2012:6) cites Gibson, who states that assessment "must encourage positive steps towards greater community sustainability and towards a future that is more viable, pleasant and secure".

Taras (2005:467) highlights of four key stages that assessment comprises, namely,

- Data-gathering instruments: What assessment tasks/tool will be used?
- Weighting: How will marks be calculated?
- Selecting goals: Which assessment goals will form part of the assessment activity?
- Justifying the judgement against the stated goals and criteria: Is the assessment memo flexible or structured?

These stages indicate the complexity of assessment practices – because assessment determines what learners know or do not know about Technology, it is important that such assessment practices are based on appropriate goals and standards; and that effective assessment tools are used, which are linked to the Technology goals and standards that are aimed at developing technological literacy. Moreland *et al.* (2001:173) state that, "to enhance and sustain learning in technology there needs to be a focus on the teacher knowledge of specific and detailed technological learning outcomes in conjunction with appropriate pedagogical approaches". Assessment, therefore, requires competent individuals who are able to make effective judgements. According to MacLellan (2001:309), some assessment practices not only fail to guide learners or to motivate them; but also fail to assist learners in the learning process (Boud and Falchikov, 2006:399). Teachers should develop a culture of sustainable assessment. Verheem, as cited by Pope (2012:3), states that the aim of sustainable assessment "is to ensure that [lesson] plans and activities make optimal contributions to sustainable development". According to Boud and Falchikov (2006:403-404),

assessment, in spite of being, to a certain extent, beneficial, can have a long-term impact on learners, as they assume that learning occurs only once the specifications have been identified by others. Therefore, assessment practices should promote sustainable learning and sustainable development, in order to encourage learners to achieve Technology teaching and learning goals. Boud and Falchikov (2006:404), furthermore, assert that learners need to become assessors themselves; to be able to judge, and to be able to relate learning goals with specific practices. The assessor – whether the teacher, the learners, or another party such as the moderator or learning facilitator – must be clear about assessment and its requirements. Boud and Falchikov (2006:402) state that the ability to assess a task does not imply the ability to perform well in such an assessment task. An assessor could be someone who can effectively judge, for example, the stability of a structure or its appearance, but this person may not be able to stabilise the structure or beautify it. Gumaelius, Hartell and Svãrdh (2013:198) emphasise that, if assessment practices do not include learners' future learning (i.e. sustainable assessment), then the purpose of such assessment is questionable. Bansilal *et al.* (2010:163) emphasise the need to develop learners who are prepared to cope with change and who demonstrate responsibility; this implies that learners need to make judgements and engage in effective decision-making processes when they are faced with challenges.

The following guidelines can be used to improve assessment outcomes (adapted from Heystek *et al.,* 2008:132).

- **Recognise achievement by acknowledging merit**: this can take the form of praise.
- **Identify and rectify shortcomings and apply remedial measures/ amendments, if necessary**: learners need to know where they are lacking and how they can improve. If possible, such remedial measures should benefit learners in relation to assessment in general.
- **Determine training needs**: determine which areas of learning need to be focused on, such as practical tasks that learners engage in. For instance, should a learner have to use a band-saw or file, the learner must receive prior training to carry out the task effectively.

- **Give feedback**: providing feedback does not involve only a discussion of the memo, but also involves providing learners with clear indications of where they lost marks and where they can improve. Additionally, it requires the teacher to receive feedback from the learners to improve their teaching.
- **Discuss problems**: The teacher should communicate all teaching and learning activities clearly. Should a learner have a problem regarding specific topics, it is important that the teacher discusses the problem with the class.

Boud and Falchikov (2006:407/8) list the following points that can assist in making assessment practices more sustainable for lifelong learning.

- The importance of a standards-based framework, to enable learners to view their own work in the light of acceptable practice;
- A belief by teachers that all learners can succeed;
- The need to foster confidence about learners' capacity as learners, because their beliefs about their potential affects achievement;
- The need to consider separating comments from grades, because grades distract from engaging with feedback;
- The need to focus assessment on learning, rather than on performance;
- The vital role of developing self-assessment abilities;
- Encouraging reflective assessment with peers; and
- Ensuring that comments on assessment tasks are actually used to influence further learning.

Participants, and teachers in collective are encouraged to foster the former in their teaching and learning practices.

2.4.5 Feedback

Feedback is a significant part of assessment. According to Pellegrino and Quellmalz (2010:128), the goal of assessment practices is to make decisions about what further steps need to be taken in relation to teaching and learning practices. Justification of assessment is given in the form of feedback, which not only assists in planning, but also in the development of an assessment community. Pellegrino and Quellmalz (2010:130) state that, "the most useful kinds of assessment… emphasize knowledge

integration and extended reasoning, support a process of individualized instruction, allow for learner interaction, collect rich diagnostic data and provide timely feedback". Feedback is, therefore, a more complex process than simply providing statements about work done. Bansilal *et al.* agree that meaningful and appropriate feedback can serve to guide the development of learners' skills, to improve learning and understanding and to identify learning gaps (2010:155, 159). Taras (2005:470), who adopts the view of Ramasprasad, states that feedback is "information about the gap between the actual level and the reference level". Taras elaborates on three conditions for effective feedback that is aimed at improving learning efficiently and expediently (2005:471); feedback requires:

- knowledge of the goal,
- the skills to make multicriterion comparisons; and
- the development of ways to reduce discrepancies.

According to Bansilal *et al.* (2010:153), feedback by both the teacher and the learner is an essential tool that can be used to improve the quality of education. Feedback from the teacher affords learners the opportunity to identify errors and rectify them; the same opportunity is afforded to teachers when they receive feedback from learners. Wiggens recommends that feedback is given in the middle of assessment tasks, as it assists the teacher to identify gaps in and barriers to learning (cited by Bansilal *et al.,* 2010:155).

The following guidelines for feedback are adapted from Heystek *et al.* (2008: 137):

- Recognise work well done;
- Provide guidance and encouragement where work is not of the expected standard. Provide training when guidance does not work; and
- Reprimand the individual if advice to bring about desired improvement in performance is not observed.

Feedback should not be taken lightly; doing so can have a negative impact on the learners' self-esteem and, ultimately, on Technology as a subject. According to Bansilal *et al.* (2010:156), "learners with a high self-esteem displayed acceptance of feedback… [whereas] learners with a low self-esteem were vulnerable to unfavourable judgements". Moreland *et al.* (2001:157) assert that assessment that only assesses

what learners are not able to do, as opposed to what they are currently able to do, is assessment that is destined to fail. Boud and Falchikov (2006:400) support this perspective, by stating that assessment practices “did not equip learners well for a lifetime of learning and the assessment challenges they will face in the future”. Boud and Falchikov (2006:402) state that some assessment tasks “present inadequate intellectual challenge(s)” and that learners receive feedback too late for them to benefit from it. This presents a problem, as both the learners and the teachers are then unable to identify gaps in their learning and teaching practices respectively. MacLellan (2001:307) argues that learners will engage in higher cognitive levels of thinking and more successfully in the task if they perceive doing it to be a necessity. Teachers, therefore, need to be clear on the technological goals they intend to achieve and must provide learners with beneficial feedback that can assist them in achieving these technological goals. According to the study conducted by Bansilal *et al*. (2010:158), feedback must be viewed as the identification of mistakes by the teacher and learner, identification of the requirements of learning by the teacher, an opportunity to achieve transparency regarding the assessment objectives of the task, as a challenge posed by the teacher, and as a method of remedial teaching. Boud and Falchikov (2006:399) agree, by asserting that feedback informs learners “on their learning and the certification of their achievement”.

Moreland *et al*. (2001:157) reference Sadler, who states that, depending on the learning situation, the sophistication of feedback varies (i.e. “the more complex the learning situation, the more sophisticated the feedback”). Moreland *et al.* (2001:163) note that, in their research, interaction between learners and teachers was primarily praise-based, instead of being aimed at increasing learners’ understanding of the “conceptual and procedural aspects”. A reason for this focus could be that teachers were unable to identify the conceptual and procedural Technology learning outcomes in detail. This implies that, during assessment, teachers focused on aspects other than Technology concepts and procedures; as a result, they confused the learners. Boud and Falchikov (2006:402) emphasise that learners need to be involved in the feedback process, rather simply being receivers. MacLellan (2001:316) reports that, in his study, learners did not find feedback beneficial; therefore, it lacked effectiveness. He also states that, unless learners are “monitoring and regulating the quality of their own

learning, feedback of itself, regardless of its degree of detail, will not cause improvement in learning" (2001:316).

Bliem and Davinroy (1997:4) recommend that teachers share assessment criteria with learners, as doing so enables learners to "become aware of the standards for academic excellence"; it presents both learners and parents/guardians with physical evidence when learners' abilities are communicated; it provides learners with the opportunity to "consolidate and contextualize their learning"; and it motivates learners to learn (1997:29). Feedback must be clear and beneficial if it is to form part of good assessment practices.

2.4.6 Good assessment practices

According to Bansilal *et al*. (2010:163), there is a need to "rethink the relevance of what we expect learners to learn". It is, thus, vital that teaching practices are assessed critically with regard to its purpose. According to Brown and Brown (2010:52), assessment tasks should be used to assist teachers to evaluate learners' understanding of content, and to ensure that learners are achieving the stipulated and desired subject aims. As participation and engagement of learners in Technology activities are encouraged, assessment practices need to be based on developing meaning, engaging in content, innovation, exploration, uniqueness and collaboration, and tasks that are challenging and experiences that are joyful (Pace-Marshall, 2009:49).

Bliem and Davinroy (1997:4) characterise good assessment practices as,

> *tasks (that) require learners to perform in authentic ways;*
>
> *tasks that demand higher order thinking skills;*
>
> *tasks that evaluate skills in an authentic context; and*
>
> *tasks that are embedded in the fabric of classroom activities.*

These authors also state that assessment is more than a "measuring instrument" (1997:4); but that it provides information about "errors and misconceptions in the learners' thinking". Given this information, what do teachers need if they are to re-evaluate the effectiveness of their assessment practices in order to meet both

Technology subject needs and learner needs? Brown and Brown (2010:52) emphasise that teaching and learning activities should engage all three domains of learning, namely, (i) the cognitive domain, (ii) the psychomotor domain, and (iii) the affective domain. According to Brown and Brown (2010:52), cognitive assessment should encourage learners to describe and apply their knowledge; psychomotor assessment should allow learners to "use and apply their tactile knowledge and skills"; and assessment of the affective domain should encourage learners to demonstrate their knowledge of the impacts and concerns of Technology, and to demonstrate their ability and understanding in a critical manner. By including all three domains of learning in assessment, different intelligences that exist are also acknowledged. Killen (2010:363) describes the various intelligences, which are mainly influenced by culture and are never isolated, but rather come together to solve problems. Because some individuals rank higher than others on certain intelligences, teachers must design assessment tasks that draw upon and develop the various intelligences. These intelligences, developed by Howard Gardener, are as follows (Giles, Pitre and Womack, 2003: online).

2.4.6.1 Multiple intelligences

a) Linguistic intelligence

This intelligence is characterised by the desire to read and write, to engage in story-telling, and to learn different languages, their grammars and sentence structures, language rules and word orders. Typically, this intelligence is tested using presentations, tests and examinations.

b) Logical-mathematical intelligence

This intelligence is characterised by the desire to work with numbers. An individual possessing logical-mathematical intelligence uses intellectual and logical reasoning and abstract concepts. In the CAPS for Technology (DBE, 2011), this intelligence is activated when learners solve problems relating to, for instance, mechanical advantage or ratio.

c) Musical intelligence

Musical intelligence is characterised by sensitivity to sounds and its tones, pitch, musical instruments, rhythms, musical keys, tone quality etc.

d) Spatial intelligence

This intelligence is characterised by the ability to understand and present visual aids, such as graphs, pictures and drawings. The CAPS for Technology (DBE, 2011) refers to graphical communication; and having a good visual memory (i.e. photographic memory) and good hand-eye coordination skills. Individuals with spatial intelligence also have a good sense of direction.

e) Bodily- intelligence

This intelligence is characterised mainly by controlled bodily movement. People with high bodily-kinaesthetic intelligence include athletes, actors, swimmers, cyclists and surgeons; though this intelligence also covers movements such as drilling, sawing, filing or sanding.

f) Interpersonal intelligence

Interpersonal intelligence is also known as being “people smart”. Individuals who possess this intelligence are good at organising groups, they are aware of others’ attitudes, moods and motivations, they communicate well and are able to succeed in leadership positions.

g) Intrapersonal intelligence

This intelligence is characterised by self-awareness and the ability to explore, identify and recognise emotions, personal goals and attributions as well as aspirations. Individuals who are intrapersonally intelligent could be writers, psychologists and theologians.

h) Naturalistic intelligence

This intelligence is characterised by the ability recognise and classify different animal and plant species. These individuals enjoy the outdoors and have a deep sensitivity in relation to plants and animals. They could be conservationists and zoologists.

i) Spiritual or existential intelligence

This intelligence is characterised by the desire to question life and death; and to think about that which lies beyond what human beings can see and believe.

Considering the different intelligences, it is, therefore, advisable that assessment tasks are designed to stimulate a multitude of intelligences. Initially, when designing an assessment activity, it is important "to determine the needs of the individual so as to be able to plan both future development and activities" (Heystek *et al.*, 2008:131). Teachers should, thus, demonstrate a clear understanding of curriculum outcomes that are expected by the Department of Basic Education, as well as by the school, in order to promote learner development. Nathan, Tran, Atwood, Prevost and Phelps (2010:409) state that, "the educational experience for learners is dependent on the quality and effectiveness of teachers". These authors elaborate further, that educational goals need to be realised and reinforced by the school, as these goals play an important role in the beliefs and perceptions of teachers (Nathan *et al.*, 2010:410).

2.4.6.2 Reliability, validity and fairness

Three factors play a pivotal role in assessment that aims to ensure that learners' needs are met; these factors are reliability, validity, and fairness and equity.

a) Reliability

According to Sawand, Chandio, Bilal, Rasheed, Raza and Ahmad (2015:170), assessment tasks are reliable when they "produce the same results on re-test, and will produce similar results with a similar cohort of learners, so it is consistent in its methods and criteria". Reliability is, thus, consistency in producing the same or similar results on assessment activities, with little or no discrepancies in the methods by which the results were obtained. Reliability tests enable teachers to determine average results that will allow them to evaluate the effectiveness of their methods and determine how the methods influence teaching and learning processes; and how to improve it. According to Cohen and Spenciner (2007), many factors influence the reliability of an assessment – these factors include the duration of the assessment (shorter assessments generally do not produce reliable results); the time limit, group diversity and test-retest interval. When the teacher designs a test, it is advisable to

ensure that a rubric is designed along with the test and that there is consistency in the administration of the test.

There are various types of reliability (Phelan and Wren, 2005: online), such as test-retest reliability, parallel forms of reliability, inter-rater reliability and internal consistency reliability.

- Test-retest reliability measures reliability by administering the same assessment task to a group of learners more than once over a period of time. The scores from the first and second administration are then evaluated on the correlation in order to check for stability over time.
- Parallel forms of reliability are obtained by administering different assessment tasks, which contain the same construct, knowledge base and application, skills, etc., to the same group of learners. The scores of the tasks are then evaluated and correlated in order to obtain results from different versions of the assessment task.
- Inter-rater reliability refers to a method of assessment that uses different "judges" to assess an activity. There may be different interpretations of the same answer and disagreements about responses, which may mean that different knowledge and skills are being assessed by different judges.
- Internal consistency reliability is a type of reliability that is used to evaluate the correlation between different assessments that produce the same results. Average inter-item correlation is a subtype that can be achieved by taking into account all the questions on the assessment task that questions the same constructs; and then determining the correlation coefficient for similar questions; the average is then taken into account (i.e. the average inter-item correlation). Another subtype is split-half reliability, which involves "splitting" the items in the test that are expected to investigate the same knowledge area in half, so that there are two sets of items available. The full test is then given to a group of learners, the score for each set calculated, to obtain the correlation between the scores of each set.

Reliability correlation also refers to equity. When, for example, a learner completes the same assessment activity again later (i.e. test-retest reliability) and there is no correlation, it shows that the results of the assessment activity may not be a true

representation of what learners were expected to have achieved. The same applies for the other types of reliability. Determining reliability is a way to test stability. Internal consistency is another method of testing reliability. Internal consistency is defined as "the extent to which the individual items on the test appear to be giving similar indications of the knowledge and ability of the person taking the test" (Killen, 2007:352). If a test is shown to present very little correlation, measures must be taken to find the cause of the discrepancy.

b) Validity

According to Messick (1994:1), validity is,

> *an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions based on test scores or other modes of assessment.*

Carmines and Zellar (1979:13) describe assessment tasks to be valid if they measure what they are supposed to measure. Validity is, thus, a measure to see whether outcomes that are envisaged for learners are the outcomes that can be obtained from the assessment practices that are implemented. According to Phelan and Wren (2005:online), there are five types of validity, namely face validity, construct validity, criterion related validity, formative validity and content validity.

- Face validity refers to whether or not the assessment appears to test what it was supposed to. For example, if learners are expected to write a test on different mechanisms; a question that asks about electronics will mean the test is not valid.
- Construct validity refers to what the teacher intends to assess and if the assessment tasks correlate with this intention. For example, the teacher may design a test intending measure learners' understanding of structural support, but the questions refer to different types of structures. This test does not measure learners' knowledge about structural support.
- Criterion-related validity refers to how well the assessment task measures what the teacher expects it to measure. This type of validity is used to anticipate future and/or current performances of learners. For example, a teacher who

intends to assess learner's knowledge on filing methods can use a physical test, in which a learner must demonstrate this knowledge, instead of a language-based test.

- Formative validity refers to using the results of an assessment activity to improve teaching and learning activities. For example, after a teacher has presented a lesson on drawings, and learners take and complete a test, the teacher evaluates the results and may notice that most learners failed to draw accurately in different dimensions. The teacher can then adapt the lesson to improve learners' visual-spatial skills.
- Content validity or sampling validity refers to the content of the assessment. Does a teacher's assessment cover all or most of the aspects required? For example, the teacher, as the teacher, may test learners' ability to design and make a wooden toy. It is not fair to simply evaluate the end product; instead, the effort and skills employed (e.g. drilling, filing, painting, sawing) must all be assessed too.

Validity is considered to be the most important aspect that should be considered when designing and evaluating assessment. A valid assessment must cover a wide range of criteria that need to be evaluated, such as knowledge of the content, application of knowledge, skill and attitudes, abilities and mark allocations.

c) Fairness and equity

According to the Cambridge Dictionary (2017: online), fairness is "the quality of treating people equally or in a way that is right or reasonable". Fairness in the classroom refers to treating all learners the same, across all races, genders, sexual orientations, ages and religions. Equity is described as "the situation in which everyone is treated fairly and equally" (Cambridge Dictionary, 2017: online). Fairness and equity forms the basis of respect (Catlin and Menash, 2009: online). Mutual respect must exist between the teacher and the learners, as well as amongst learners. Quality teaching and learning is formed on the foundation of communication and interaction; when there is disrespect and discrimination, intended teaching and learning activities may fail to take place. To eradicate discrimination, teachers need to teach learners about respect, and be role models for them. Teachers need to evaluate themselves intrinsically and question the expectations they have for learners: Do they expect boys

to excel in drawing? Do they prefer it if girls do not work on machinery? Teachers need to evaluate their attitudes and behaviours regularly, in order to eliminate injustice completely. Learners must be able to voice their opinions in class without fear of being ignored. It is important that teachers question their own views on how they perceive learners to be. One view is that a learner is viewed as *tabula rasa* – a blank slate (Hickey, 2014:16). Believing this means believing learners grasp new information easily and that new information will be imprinted in their minds; teaching and learning activities therefore need to be invaluable, because what is imprinted needs to be relevant for future use. However, Hickey states that learners are not blank slates; instead, each individual is born with the ability to engage with information and "respond differently to a given stimulus" (2014:17). Individuals, therefore, possess prior knowledge that they bring to a classroom, which possibly differs greatly from that of the teacher. Both of these views are equally important, and emphasise the need to develop effective assessment tasks. If a learner is viewed as a blank slate, it indicates that the teacher needs to be a subject area specialist: In order for the learner to grasp the content, it needs to be valuable. When a learner is viewed as an individual who possesses prior knowledge, the sharing of such information enables the Technology teacher to collaborate with learners to provide diverse, content-rich knowledge and, therefore, more holistic assessments that are suitable for diverse learners. Hickey (2014:17) and Pugh, DaRosa and Bell (2010:565) agree that, when learners are viewed as blank slates, the implication is that learners are passive participants in learning. Consequently, learners are not viewed as informative members, which results in a lack of opportunities for them to express feelings and experiences; doing so creates a sense of restriction caused by the idea that only the "superior other" holds valuable knowledge. Regardless whether learners are seen as blank slates, they should be encouraged to participate and collaborate in class and in group activities, such as PATs, so that they can also learn from each other's experiences.

2.4.7 Collaboration in teaching and learning activities

According to the CAPS for Technology (DBE, 2011:3), learners are required to "work effectively as individuals and with others as members of a team". Compton and Harwood state that, by involving learners, teachers become more aware of the learners' backgrounds and the needs and desires specific to each of these learners

(2003:7). Collaboration between teachers and learners in teaching and learning activities is, therefore, a necessity. Killen (2010:192-193) outlines the following benefits of collaboration:

- Collaboration shifts the focus, from a learner being a passive recipient, to being an active participant. Learners in a Technology class engage in assignments and PATs that require them to engage actively with content and resources and to fulfil assessment. These assessments can be individual or group tasks that encourage intrapersonal and interpersonal intelligences.
- Collaboration activates prior knowledge and assists in reconstructing understanding. As learners engage with content, they are encouraged to express their views and understanding. This assists other learners to develop a deeper understanding of what the content entails and to realise outcomes effectively.
- Collaboration enables learners to experience different roles, such as leader, peer, subordinate, team member, and so forth.
- When learners are encouraged to express themselves, for instance, by presenting an assignment, they are given the opportunity to verbalise their feelings and ideas.
- Collaboration is a fun and motivating way to learn.
- Technology education introduces many new terminologies that may be unfamiliar to the learner, and which the learner may fail to grasp. Through collaboration learners help each other when they are expected to define or explain concepts and content in a manner that their peers can relate to.
- Collaboration improves learners' problem-solving skills, as multiple solutions are given to problems.
- When learners work in a group, collaboration encourages cooperation. Group work encourages learners to work together effectively to complete a given task and, thereby, overcome anticipated and unanticipated problems that may arise.
- Collaboration builds respect and mutual understanding by assisting learners to acknowledge personal strengths and weaknesses – their own as well as that of the other.

Boud and Falchikov (2006:403) discuss the notion that teachers assume that, when learners work in collaboration, they are cheating – and, thus, teachers discourage collaboration. MacLellan (2001:310) expands on this notion by stating that, in his research, self- and peer-assessment tasks were infrequent occurrences. Hickey (2014:16) emphasises that social interaction is essential to the education process. He (2014:18) describes The More Knowledgeable Other, who is an individual who "holds more information or greater skills" and is able to assist others with the production of new knowledge. The More Knowledgeable Other can be the learner, the teacher or a parent/guardian. Compton and Harwood (2003:7) state that collaboration is necessary, as it enables the teacher to assess the learning environment, and to establish whether the learners have achieved the intended outcomes. Collaboration also enables teachers to evaluate their practices in terms of meaningfulness and validity, thereby, assisting teachers not only with their current teaching experiences, but also their future practices (Compton & Harwood. 2003:7). According to Stears and Gopal (2010:591), learners have an abundant source of prior knowledge and experiences that that they can display when they are being assessed. However, this knowledge and experience are not necessarily measurable by means of traditional assessment tasks. The first step to encouraging meaningful interaction is to "articulate what constitutes meaningful interactions" (Hickey, 2014:20). The basis of these interactions are located in the content of the discussions; therefore, prior planning and preparation is needed for all classroom activities that take place. At the end of the learning activity, "learners should be in control of the activity, be able to experiment [with it], and collaborate with others" (Hickey, 2014:20). MacLellan (2001:308) and Boud and Falchikov (2006:409) argue that assessment should be authentic, with knowledge and skills based in such authentic situations. Boud and Falchikov (2006:408) encourage teachers and learners to engage with each other in the classroom, with others in communities, and other external parties, to assist in the development of criteria for "good work and peer feedback". Stears and Gopal highlight the importance of collaboration amongst learners further. According to these researchers (2010:598), learners are able to share their authentic experiences, interests and knowledge, which are meaningful to assessment tasks, with others. Hickey (2014:17) agrees, by stating that, if learners are treated as active participants, they will be able to verify their strengths and weaknesses with regard to the learning

process. By encouraging collaboration amongst learners, they share their personal experiences, develop authentic solutions to problems they can relate to, strengthen their social groupings, support each other and build on their self-confidence, which enhance learning (Stears and Gopal, 2010:599).

2.4.8 Factors that influence assessment

According to Bliem and Davinroy (1997:19), teachers hold the general assumption that assessment "is an official event". Due to the nature of the schooling system, more emphasis is, thus, placed on teaching activities intended to transfer content to learners, than on assessment practices that may promote the learning process. Heystek *et al.* (2008:151) state that assessment tasks are time-consuming; this can be discouraging to both the teacher and the learners. Bliem and Davinroy (1997:30) agree, by stating that assessment is seen as a formal task that is time-consuming and disruptive to daily classroom routines; and that evidence needs to be provided of such tasks having taken place. Bliem and Davinroy (1997:30) state that this "conception of assessment is in contrast with the teachers' belief that instruction is an opportunity for learners to practice acquiring a new skill". It is evident that there is a misconnection between instruction and assessment in teaching and learning activities, instead of a link between instruction and assessment. Instruction and assessment should, therefore, be adjusted to accommodate learners. Sato and Atkin, cited by Stears and Gopal (2010:594), acknowledge that conventional methods of assessment do not assess learners' motivation, commitment and participation. These authors also state that factors, such as other social and personal outcomes, need to be assessed "in order for the learner to benefit from schooling" (2010:594); however, conventional assessment methods are still often used, because the "criteria are clearly defined" (2010:595). There is, thus, a need to adjust the assessment tasks that are currently being implemented. This process may give rise to various problems in the initial phase of setting up the assessment task, the employment thereof, and the judgements made. Heystek *et al.* (2008:148-159) cite Heystek, who identifies several problems with assessment, among which the following:

2.4.8.1 The latitude factor

Having various assessors can influence results. As stated by Heystek in Heystek *et al.* (2008:148-159), each assessor has a personal frame of reference that is used to evaluate work. Some assessors may have a high standard, whereas others have a lower standard. Assessors with a high standard are said to have a high latitude factor, and those with a lower standard have a lower latitude factor. According to Heystek *et al.* (2008:148), the latitude factor can be overcome by having one assessor mark activities. Additionally, complete and coherent memos can assist; or assessors should sit together and fully discuss the assessment practice.

2.4.8.2 The halo factor

Some assessors assess learners on their performance in other, unrelated, areas/fields. For example, a learner may perform exceptionally well in natural sciences, and the assessor will expect the same standard in Technology and, therefore, award marks that the learner does not deserve. The halo factor is based on teacher subcultures that have developed over time. To overcome the halo factor, a detailed rubric needs to be developed and learners marked accordingly.

2.4.8.3 Agreement errors

Assessors may value certain qualities highly and, therefore, reward learners who portray these qualities with higher marks than learners who do not. For example, the assessor may regard tidiness as a desirable trait; so, learners who are not tidy receive lower marks, which are not based on the assessment activity. Within a Technology lab, tidiness must be encouraged, if not demanded, to avoid errors and injury. The teacher should not, however, penalise a learner for an untidy work space, given that tidiness is not part of the assessment criteria. Given that criteria make up an important part of the assessment process (Stears and Gopal, 2010:598), the teacher needs to provide a clear assessment rubric and assessors should adhere to the rubric that has been set.

2.4.8.4 Evaluator motivation

If assessors are aware that they may be rewarded for their appraisal, they may be more diligent. An assessor may lack motivation and commitment for other assessment

activities that hold no benefits. To overcome low evaluator motivation, the assessor needs to be dedicated and wiling to assess activities. Assessors need to show commitment and dedication to their job.

2.4.8.5 Failure to differentiate

When assessing, assessors may fall into a pattern of assessment and, thereby, fail to acknowledge individual creativity and ingenuity. An assessor is regarded as having high differentiation when he/she provides more credible results. Assessors, therefore, need to be vigilant when marking activities, and be open to various results.

2.4.8.6 Pressure to meet non-performance criteria

Pressure to meet non-performance criteria occurs when assessors are influenced by performances that have no relation to the assessment task; such factors include popularity, seniority and affiliations. It is recommended that the assessor tries to remain as impartial as possible, and to follow detailed rubrics when assessing learners' performances.

2.4.8.7 Recency

Some assessment tasks may be of more value than others and, therefore, learners will prepare more for one than for the other – doing so does not indicate learners' overall abilities. It is recommended that the teacher should compile assessment activities throughout the quarter/semester/year, in order to obtain an overall mark for the learner.

It is imperative that the aforementioned problems are identified and resolved, to ensure that effective assessment activities are employed in the technology class. Ramsden, quoted by MacLellan (2001:307), states that assessment determines the quality of learning, which ultimately determines the learners' progression. Assessment is, therefore, a central process in effective teaching and learning (Wiliam, 2011:3), and assessment practices should prepare learners for a lifetime of learning, as well as the assessment challenges they could face in the future (Boud and Falchikov, 2006:400). According to Moreland *et al*. (2001:157), "if assessment is to be effective, information has to be formulated with a structure and a language that reflects a shared understanding between those who are communicating".

This research argues for the importance of developing teacher understanding of the purpose and processes of relevant assessment practices and its role in nurturing technologically literate citizenship. The study, therefore, explored existing assessment practices and examined the extent to which teachers promote the development of technological literacy through their assessment practices.

2.5 CONCLUSION

This chapter presented bricolage as the theoretical framework that underpinned the study. The researcher's choice of bricolage was motivated by a discussion of the origins and characteristics of the theoretical framework, in response to the research problem statement, aim and objectives. This motivation was pursued further by the illustration of the formats of bricolage that are relevant to the study, the objectives of bricolage and the role of the researcher.

The researcher then defined the key operational concepts of the study, to provide the reader with a better understanding of concepts that were discussed further in the literature review. The literature was reviewed with regard to assessment practices relating to Technology, as presented in the objectives. The researcher discussed the major themes covered by the literature that may influence the enhancement of technological literacy. The next chapter discusses the research methodology that was used for data collection and analysis in respect of the research aim and objectives. Chapter 3 also discusses the ethical considerations, value of the research and the limitations applicable to this study.

CHAPTER 3:
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study sought to investigate the assessment practices Technology teachers employ in their classes. As a novice researcher, the researcher did not possess sufficient teacher knowledge and skills to enhance technological literacy in teaching and learning activities in the senior phase; and the researcher did not have sufficient and direct knowledge about the challenges faced in the teaching and learning processes. It was, therefore, imperative to ensure that participants were directly involved in the teaching and learning processes of Technology, as they are better equipped to respond to day-to-day challenges. As qualitative research methodology was used to generate rich data, based on the experiences of participating teachers, this study used embedded single-case design (see pg. 60) as a research methodology to gain additional, useful and appropriate data that enriched the study. This chapter serves to validate the use of case study research as a methodology.

3.2 QUALITATIVE RESEARCH METHODOLOGIES

A qualitative research methodology was used by this study to understand and describe the assessment activities employed by senior phase Technology teachers. According to Merriam (1998:xiii), qualitative research is an “intensive, holistic description and analysis of a bounded phenomenon”. Ritchie and Lewis (2003:3) describe it as a “naturalistic, interpretative approach concerned with understanding the meanings which people attach to phenomena (actions, decisions, beliefs, values etc.) within their social worlds”. Qualitative research, for the purpose of this study, is therefore described as:

> *A holistic, interpretive and descriptive analysis of a social phenomenon experienced.*

Observations, interviews, discussions, open-ended questionnaires and recordings (Ritchie and Lewis, 2003:3) are among the means used to obtain relevant empirical data from experienced Technology teachers. According to Rose, Spinks and Canhoto (2015:9), “one of the greatest strengths of case study design is its adaptability to

different types of research questions and to different research settings". Furthermore, the use of open-ended questionnaires are used as it "provides a much more diverse set of answers" and "allow the respondent to express an opinion without being influenced by the researcher" (Reja, Manfreda, Hlebec, & Vehovar, 2003:159, 161). For the purpose of this study, observations, open-ended questionnaires and interviews were used to generate data while the researcher investigated the teaching practices of two senior phase Technology teachers and twenty three (23) teachers of the Motheo school district of the Free State.

3.2.1 Research participants and data collection instruments

In this study, participants were chosen according to the following criteria: (1) Technology teachers (2) in the senior phase (3) within the Motheo school district. Therefore, the cases were determined by the availability of these participants and their willingness to engage in the study. Rose *et al.* (2015:1) state that, although a case study focuses on a small number of participants/cases, it provides an in-depth understanding of the research problem under investigation in the study. Shuttleworth (2008:online) emphasises that, although case studies can be very reliable, they should not be used to generalise an entire population, as the number of participants is small. In the case of this research, the researcher focused on two senior phase teachers in the Motheo school district, whose classes were observed and later, were interviewed; and twenty three (23) other teachers who completed open-ended questionnaires and with whom the researcher conducted follow-up discussions to clarify their responses.

3.2.2 Case study research as a research approach

Case studies are used by researchers in a wide variety of fields. Gustafsson (2017: online) gives three explanations as to why a researcher could choose case study as a research methodology: to test theories, to render a description, or to develop a theory about several topics. The researcher in this study chose the case study as a research methodology to render a description of the assessment practices employed by senior phase Technology teachers in the Motheo school district, in order to gain a better understanding of the assessment practices that are carried out. Technology Education is a subject that was introduced in schools only recently. According to Heymans (2007:37), no formal Technology Education subject was known in schools until

Curriculum 2005 in 1998; it is, therefore, necessary to identify best assessment practices in South African schools, in this case, in the Free State province Motheo school district. Gustafsson (2017: online) identifies the purpose of case study research as being “to produce background material to a discussion”, and that case studies are “open ended”.

According to Rose *et al*. (2015:1), the central feature of a case study is the word “case”, which suggests “an instance of something”. A case study can, therefore, suggest “something concrete such as an organization, a group or an individual”, or it can suggest “something more abstract such as an event, a management decision or a change programme”. However, according to Baxter and Jack (2008:544), there is “often misunderstanding about what a case study is and how it, as a form of qualitative research, can inform professional practice”. At the end of this study, the researcher makes recommendations (see Chapter 5) as a means of influencing professional practices and professional development.

Furthermore, case study, according to Cohen *et al*. (2011:289), is a “specific instance used to illustrate a more general principle”. Case studies, therefore, illustrate how principles can be used in a more practical sense, instead of burdening the reader with complex and abstract information. In other words, case studies illustrate how the theory or principle can be linked to practice. By understanding assessment practices employed by teachers, the case study enables the researcher to understand the alignment of theory and practical information and the assessment practices employed; as well as the rationale behind such alignments. Shuttleworth (2008:online) highlights certain steps of case studies – initially, before the case study is conducted, the researcher needs to identify and deliberately isolate a small group or an individual. The first step is to identify the main aim and to select the focus group/individual. The main aim of this study was to explore how teachers integrate assessment practices to enhance technological literacy in senior phase Technology classes; therefore, the intended group that the researcher isolated comprised of Technology teachers in the senior phase. The next step is to determine how to go about collecting the information, thus, planning and design is of the utmost importance. Shuttleworth (2008:online) advises that the researcher should make a checklist to ensure that all the information needed is collected along the way; otherwise, a gap might appear in the study as a

result of insufficient information. Case studies tend to be more opinion-based than quantitative, it is, thus, important to ensure that data is manageable and that the researcher is able to “construct narratives around it” (Shuttleworth, 2008:online). The researcher listed the study objectives in Section 1.5.3 – these objectives assisted the researcher to answer the main question. Supplementary questions were derived too, whereby the empirical data is discussed in Section 4.3, to assist the researcher to answer the research questions without deviating from the objective whilst conducting interviews.

Rose *et al.* (2015:4) cites Walsham, who proposes how existing theory can be used in case study research; his proposal states that case study can be used as an initial guide for the theoretical framework “which takes account of existing knowledge in the area". Gustafsson (2017: online) agrees, and states that findings should be “compared to facts in published literature and existing data” – the theoretical framework of this study is given in Chapter 2. Furthermore, theory forms part of “an iterative process of data collection and analysis, with theoretical understandings being modified in the light of findings from the data” (see Chapters 4 and 5) and “as a final product of the research” (see Chapter 3, as a research methodology that underlies the study). Plowright (2011:27) explains that, in a case study, the researcher has limited control over the case study allocation.

Cohen *et al.* (2011:289) state that case studies “penetrate situations in ways that are not always susceptible to numerical analysis”. Although quantitative and qualitative methods of research can be used together, for the purpose of this study, the researcher primarily used qualitative research methods to obtain data. Qualitative research methods ensure that the researcher gains rich narrative data. Another advantage of the case study is that it makes practical analysis possible, and provides reasons for why the study is successful, or why it has failed.

A disadvantage of the case study is that it could represent a very narrow approach to a hypothesis. The researcher can discover the strengths and weaknesses of the assessment practices and, therefore, the assessment instruments that Technology teachers employ. Rose *et al.* (2015:1) state that case studies are “naturally occurring (cases) in a sense that they are not manipulated”. The researcher does not intend to manipulate teaching and learning processes, or intervene in any way – the ethical

considerations to this approach is discussed in Section 3.3. The researcher observed and discussed the teaching and learning practices of two Technology teachers; and later analysed the data.

Furthermore, a case study is not done in isolation (Tellis, 1997:10) – it is carried out in a real, dynamic context, rather than in an artificial setting, although it is possible to set boundaries around the study. Case studies do not only involve the researcher observing; data production can be enriched further by conducting interviews and discussions – that is, case studies are both objective and subjective in nature. Geertz, cited by Cohen *et al.* (2011:290), describes a case study as being able to "portray what it is like to be in a particular situation", and Zainal (2007:1) states that "case study methods enable the researcher to closely examine the data within a specific context". The researcher interviewed two Technology teachers and observed their teaching and learning practices in order to experience a real and dynamic classroom setting. Furthermore, an additional twenty three (23) teachers were involved in answering open-ended questionnaires and clarifying answers through discussions; thereby providing additional data that further supported the discoveries of the initial collaboration with the two teachers and provided the researcher with new discoveries.

Cohen *et al.* (2011:290) warn, however, that, on completion of the case study, it is important to avoid (i) only emphasising selected material, as this can distort the aim of the case study (i.e. journalism), (ii) misinterpreting the results and selecting data that "fits in" with the conclusion (i.e. selective reporting), (iii) overemphasising data in such a manner that it is detrimental to the point of the study (i.e. an anecdotal style), (iv) using low levels of data to make profound conclusions (i.e. pomposity), and (v) being too bland. The researcher, therefore, used these warnings as a guideline when collecting data for the study.

Cohen *et al.* (2011), Gustafsson (2017), and Rose *et al.* (2015) describe how case studies can be either single case studies or multiple case studies. Cohen *et al.* (2011:219) quote Yin, who identifies with these two main case study designs, but identifies an additional two types, which are a single-case design (focusing on a critical case), an embedded, single-case design (in which a case study has sub-units), a multiple-case design (which studies multiple cases) and the embedded, multiple-case design (in which multiple cases have different subunits).

Gustafsson defined single case design as a study of a single case in a single context (2017:online). The author explains that, in multiple case study designs, the researcher can discuss either conflicting results or similar results, based on a comparison of cases. In this study, the researcher identified instances of best practices of twenty five (25) senior phase teachers of Technology and therefore makes use of embedded single-case design. As a multiple case study design is implemented, the researcher can "provide the literature with an important influence from the contrasts and similarities" of multiple cases (Gustafsson, 2017: online). Embedded single-case design however observes a single case (assessment practices used to enhance technological literacy) of two groups. This study generated data from (i.) two Technology teachers whose teaching and learning practices were observed and who were interviewed and (ii) twenty-three (23) Technology teachers who answered open-ended questionnaires and provided clarifications through discussions). Gustafsson (2017: online) also claims that the best way to report on a case study is to deliver a "story". This approach was adopted by this study, and is evident from the way the data is presented in Chapter 4.

3.3 ETHICAL CONSIDERATIONS

According to Resnik (2012:329), ethics can generally be defined as "guidelines and codes of conduct adopted by professional associations [that] are usually framed in terms of rules, duties, or responsibilities". Resnik emphasises the importance of ethical clearance, as people recognise ethical norms but interpreting these principles and, therefore, the application, can vary amongst individuals (2012:332). The researcher aimed to ensure that data collection processes were clear and unambiguous. Questions asked during interviews, discussions and open-ended questionnaires were derived from the aim of the study as well as from literature. Additionally, the researcher ensured adherence to ethical considerations, such gaining permission from the schools to observe classes and record educational practices, from participants and from the Free State Department of Basic Education. Ethical considerations included letters of consent from the various parties. Consent forms were attached to the letters, which were signed and returned. The researcher indicated the nature of the procedure and intention of the study clearly, and assured participants that their identities would be safeguarded, and that they were free to terminate their participation at any point.

According to MacDonald (2012:45), the ethical principles that underlie methodologies include allowing participants who do not wish to continue with the research, to withdraw. Participants were informed that all findings would be open to the public, though all participants' identities would remain confidential. This study made use of pseudo-names for the two teachers involved in observations and interviews, where as participants who engaged in open-ended questionnaires and follow-up discussions were randomly grouped (see Section 4.2.3). Under no circumstance was the intention to deceive participants. Participants were also informed about the benefits of the research. During visits to schools, the researcher guaranteed that teaching and learning activities would not be interrupted. On any recordings that were made, identities were blurred and/or the camera did not focus on a particular participant. These recordings were secured with passwords, of which access is limited to the researcher. When assistance was needed, the assistant signed a form stating that he/she would remain impartial and safeguard the identities of all the participants involved – no assistance was however needed for the duration of this study. The recordings would be deleted upon completion of the study. Additionally, within the study the researcher made use of codes to protect the identity such as QD for Questionnaire and Discussion. The researcher further divided the participants in 3 groups, namely A, B and C; and identified a number (i.e. 1, 2, 3, etc.) to each, represented with an x.

As stated by Resnik (2012:331), the purpose of clarifying ethical considerations is to promote the aims of research, promote the values that are essential to collaborative work, ensure that researchers can be held accountable to the public, help to build public support for research, and to promote a variety of other important moral and social values; all of which the researcher intended to do. Participants were also made aware that, at any point in the process up to the completion of the study, they could withdraw without consequences. Data generation primarily focused on observation, interviews, open-ended questionnaires and follow up discussions that were captured on audio recording, and video recordings, if necessary.

3.4 VALUE OF THE RESEARCH

As the dynamics of society changes, the dynamics of the education system change in parallel. The study anticipated contributing to the Department of Education's

endeavours to improve technological literacy amongst teachers and learners, in order to produce competent individuals who are able to make valuable contributions to society. The study focused on assessment practices in Technology and related elements that have an impact on enhancing technological literacy, and elements that may discourage the development of technological literacy. As an alternative, it was envisaged that the study would contribute to teacher knowledge frameworks, and would empower teachers to take responsibility for their own teaching practices, and develop assessment instruments that will enhance technological literacy. The study also sought to contribute to existing literature on ways to improve the assessment of technological literacy, and to provide suggestions for schools, teachers, learners and the Free State Department of Basic Education on how to enhance technological literacy to enrich professional development for in-service teachers.

3.5 LIMITATIONS OF THE STUDY

This study was focused on the assessment practices employed by Technology teachers in their attempts to enhance technological literacy in learners. The researcher presumed a liberal educator's perspective on Technology Education. According to Salemi (2010:99), a liberal education/educator "seeks to develop free human beings who know how to use their minds and are able to think for themselves". Bailey states that, although liberal educators confer that there should be "efficient and appropriate… training" (2014:148),

> *the criticism made is not against vocational training as such, only against the idea that such training is properly located in schools of general education, or that such training should dictate the curriculum context and methodologies of schools in the general education* (2014:149).

As Technology teachers are required to "keep up with constant changing technologies and approaches to teaching" (Teis, 2014:18), the study is limited, as it does not focus on subject content knowledge, but rather on how this subject content is conveyed and assessed. This study focused on how assessment practices are employed by senior phase Technology teachers, in an attempt to enhance technological literacy. It was anticipated that teachers may be unwilling to cooperate, which may have impacted the study negatively.

3.6 CONCLUSION

This chapter provided an overview of the research methodology used in this study. Qualitative research methodology, more specifically, case study research methodology, was used to collect and analyse the empirical data. The aim of this study was to explore how teachers in senior phase Technology classes integrate discipline-specific assessment practices in their classes. The data collection processes involved observations of teaching and assessment practices, and interviews with two Technology teachers, open-ended questionnaires and discussions based on the questionnaires with twenty-three (23) Technology teachers. All teachers involved in this study were willing participants. Chapter 4 presents findings based on the data that was collected to determine the reality of the assessment practices employed by Technology teachers in senior phase classes at schools in the Motheo school district.

CHAPTER 4:
FINDINGS OF THE STUDY

4.1 INTRODUCTION

This research dissertation set out to understand the extent to which technological literacy is enhanced through assessment practices. The study used bricolage as the underlying theoretical framework for the study (see Chapter 2), and case study research as a methodology to provide a description of the assessment practices employed by senior phase Technology teachers, in order to gain a better understanding of assessment practices that are carried out (see Chapter 3). In using case study as a methodology, the researcher observed the teaching and learning practices, and interviewed two Technology teachers, and generated additional supporting data by administering open-ended questionnaires to twenty-three (23) Technology teachers of the senior phase of which follow up discussions were held. Participants in this study were Technology teachers of the senior phase who were willing to engage in the study.

In this chapter, the researcher reports the findings to the reader. The researcher provides a biographical data of the participants involved in the study, and discuss how assessment instruments were designed, with reference to the sources of inspiration. The researcher discusses the challenges teachers identified in relation to engaging in teaching and learning practices and the assessment instruments used to assess learners; and how assessment practices are used to enhance technological literacy. Furthermore, the researcher reports how assessment activities are carried out by learners (individually or in groups) and identifies the benefits of each; finally, the researcher discusses methods of feedback identified by the data analysis.

4.2 BIOGRAPHICAL DATA OF PARTICIPANTS

In this section, the researcher presents the profiles of the participants who participated in the study. The participants were chosen at random; having only the following in common: all participants were senior phase Technology teachers at schools in the Motheo school district, Free State. The researcher employed an

embedded single-case design of case study methods, as discussed in Chapter 3, to gather empirical data for the study; this data is presented in Section 4.3.

To maintain the anonymity of the participants, their unique individual profiles (i.e. names, genders) were altered. The two participants whose classes had been observed and who have participated in interviews on their teaching and learning practices are referred to as Ms Wahida and Ms Athnan in this dissertation. Their biographical data are as follows:

4.2.1 B**iographical data of Ms Wahida**

Ms Wahida is the mother of a 3-year-old boy. At the time of the research, she resided in Bloemfontein and lived with her partner. Ms Wahida dedicated her afternoons and weekends to her family and stated that she preferred to complete assessment before leaving school. Ms Wahida had been teaching Technology at a local high school for the past five years. At the time of the interviews, she was teaching all the Grade 8 Technology classes, with periods lasting 45 minutes, twice or thrice a week, depending on the schedule set by the school. She noted that she found Technology “easy”, as she was able to grasp the subject-specific concepts easily.

When she was a school learner, Ms Wahida had enjoyed Technology, and it was one of her strong subjects. She stated that, when she entered the Further Education and Training (FET) phase (i.e. Grade 10), she no longer took Technology as a subject. Ms Wahida attended an all-girls high school; and stated that she was not given the chance to continue with Technology or to be exposed to it, as boys at an all-boys school would have been.

At university, Ms Wahida majored in Technology, Psychology and English during her B.Ed. senior phase degree. She initially took Mathematics, as a first choice in the first year, but dropped it in the second semester and continued with Technology. Ms Wahida said she “took Technology because she enjoyed the technical aspects of it, such as the drawing part”. She said that she really enjoyed Technology at university, because it offered much more in-depth knowledge, compared to that offered at school. She also stated that she found Technology more interesting at university than at school.

4.2.2 Biographical data of Ms Athnan

At the time of the research, Ms Athnan resided in Bloemfontein, where she lived with her spouse. She had been teaching Technology Education for the past 10 years and has a rich Technology background. Ms Athnan was teaching Grade 9 learners for three periods of 45 minutes each per week.

Ms Athnan began learning about Technology in 1982 at the secondary level – she stated that it had been called "Basic Hand Crafts" back then, and that it had been a combination of woodwork, metalwork and technical drawing. She then proceeded to teach at a high school, where she focused technical drawing and woodwork (now Civil Technology) in the “Technology” class. Ms Athnan enrolled at a technical college in QwaQwa, in a department for Civil Technology, woodwork and technical drawings, and completed her N4 in structural survey and building administration. Later, she joined the National Teacher Training College and specialised in wood sciences, metal sciences and technical drawings, up to diploma level. Later, she enrolled at the University of the Free State and completed a B.Ed. (FET) with Technology as one of her subjects. Ms Athnan had graduated in 2007, and began teaching Technology in the senior phase and, later, also taught in the FET phase.

“Technology creates the future,” Ms Athnan stated, “creativity is the way to go and that is what I enjoy teaching”. She also stated that she enjoyed using available resources (human and physical) to solve daily problems.

4.2.3 Biographical data of questionnaire participants

An additional twenty three (23) participants were given open-ended questionnaires to complete, and certain answers were clarified through discussion after the questionnaire had been completed. The participants were divided into three groups of no specific structure; dividing participants into three groups assisted the researcher to analyse the data. The grouping was named QD, which refers to “Questionnaire and Discuss”, and then subgroups were called A, B and C, and, furthermore, each individual was allocated a number or a letter. The biographical data of these participants are as follows:

4.2.3.1 Group QD *x*A

QD 1A

Participant QD A1 had been teaching Technology Education for five years. QD A1 was teaching Grades 7, 8 and 9 for 30 minutes each, four times a week.

QD A1 states that she had studied education at Central University of Technology and had majored in Technology. She stated that she had always loved Technology and that is why she chose to teach the subject. This participant, furthermore, stated that "everything is technology and technology is everywhere" and that, "technology can help solve any problems".

QD 2A

Participant QD 2A had been teaching Technology Education for two years. QD 2A was teaching Grade 9 learners for 60 minutes, twice a week.

QD 2A had enrolled to study Computer Aided Technology (CAT) and Information Technology (IT) during her tertiary education, but soon realised that there would be no opportunity to teach CAT and IT at school level. She then decided to do Technology, as she was "good at drawing" and she was eager to learn about technology. QD 2A reported she especially enjoys Technology when doing the mini PAT – "I enjoy seeing different models of the learners". She further stated that, "I always encourage learners to design different models".

QD 3A

Participant QD 3A had been teaching Technology for nine years. QD 3A was teaching Grades 8 and 9 for 60 minutes, twice a week.

QD 3A studied B.Sc. (Botany) and then did a Postgraduate Certificate in Education (PGCE). She was appointed to teach Technology along with Natural Sciences and Physical Sciences. QD 3A stated that she "did not want to teach Technology, but rather was appointed as a Technology teacher", and, therefore, she had to teach the subject. When asked about her Technology background, QD 3A stated that, "my technological experiences include the ability to use a projector (OHP) and computer". QD 3A stated that she likes Technology Education, as the subject is related to real-life situations and that "basic topics relates to physical sciences". Furthermore, QD 3A stated that "the

learning area is too broad", though she enjoyed the following: term 1 - structures, term 2 - hydraulics and pneumatics, term 3 - gears and pulley systems and term 4 - electrical systems and components.

QD 4A

Participant QD 4A had been teaching Technology Education for six months. QD 4A was teaching Grade 9 learners for 30 minutes, four days a week.

QD 4A stated that she did not have any background in Technology and did not investigate any field of Technology when she was studying. QD 4A stated that she was given the subject to teach at school, and did not have any experience, other then what she was teaching at the time. QD 4A did, however, state that she was attending workshops. She stated: "I enjoy it. I even started to love it." QD 4A elaborated that such workshops, "teaches me how to draw different models and objects". She stated that she enjoyed improving her drawings skills and being able to teach "learners about the different models and giving learner's knowledge of different objects".

QD 5A

Participant QD 5A had been teaching Technology Education for 10 years, but lacked confidence. QD 5A was teaching Grades 7, 8 and 9 for 30 minutes, 3 times a week.

QD 5A had graduated with an ACE from North West University, and did Technology as one of the modules. She stated that she had been "allocated to teach Technology ten years ago". QD 5A confessed that "some concepts within the teaching context are not easy to teach, like graphical communication", and explained that the problem was the result of lacking background in technical drawings. QD 5A stated that her favourite part of Technology was "the teaching of some concepts, like mechanical systems and control".

QD 6A

Participant QD 6A had been teaching Technology Education for 17 years. QD 6A was teaching Grades 7, 8 and 9 learners for 30 minutes, three periods a week.

QD 6A had studied at the University of the Free State, and had majored in Technology. Prior to that, QD 6A had studied at a college. She stated that she became a Technology teacher in 2000 when Technology was introduced. "Technology is an

interesting subject whereby learners have to identify a problem and have a solution", QD 6A said. She further said that she particularly enjoyed teaching technology, because "it opens up learners' minds and gives them a chance to apply their ideas", and that she is given the chance, along with the learners, to share different ideas. She elaborated by stating that, "it gives me the chance to know my learners and understand them".

QD 7A

Participant QD 7A had been teaching Technology for two years. QD 7A was teaching Grade 8 and 9 learners for 30 minutes, 3 times a week.

QD 7A had studied Technology at North West University in 2016. She stated that she had decided to become a Technology teacher when she saw that learners did not have technology backgrounds; so, in order to help them understand Natural Sciences better and to help them when they reach the FET phase; she assisted them to apply what they had learnt in her class in Engineering Graphics and Design (EGD) and woodwork. She also stated that, by being a Technology teacher, her learners "can now specialise in the field of Science Technology". QD 7A enjoyed the electrical engineering part, and has also developed a liking for graphical communication. QD 7A stated that the "subject encourages someone to be creative and hands on" and that is what she liked the most.

4.2.3.2 Group QD B*x*

QD B1

Participant QD B1 had been teaching Technology for 12 years. QD B1 was teaching Grades 7, 8 and 9 for 30 minutes, 3 times week.

QD B1 had studied Technology at KwaZulu-Natal University, where she had completed an ACE in Technology. QD B1 had been teaching Technology since 2005; she stated that she "was not really interested in Technology until a former colleague influenced me to study Technology" and, since then, she has particularly enjoyed graphical communication.

QD B2

Participant QD B2 had been teaching Technology for two years. QD B2 was teaching Grades 7 and 9 for 30 minutes, 3 periods a week.

QD B2 had studied at Central University of Technology, where she did a B.Ed. (FET), specialising in Technology. She said that she initially wanted to do engineering after matric, but could not fulfil this dream. QD B2 said that, when teaching Technology, she enjoyed graphical communication, making models, mechanical systems, hydraulics, electrical components and structures.

QD B3

Participant QD B3 had been teaching Technology for three years. QD B3 was teaching Grade 9 for 45 minutes, three times a week.

QD B3 stated that she did not have a degree or diploma in Technology, and struggles, particularly with drawings. She stated that she struggled to visualise the pictures, to draw oblique drawings, and one- and two-point perspective drawings; furthermore, she struggles to build three-dimensional models. In spite of these difficulties, QD B3 stated that she enjoyed teaching and making learners aware of how technology keeps improving. She also stated that electricity was her favourite part of the Technology content.

QD B4

Participant QD B4 had been teaching Technology for nine years. QD B4 was teaching Grades 7 and 9 for 60 minute periods, twice a week.

QD B4 studied Technology for six months at Tshiya College of Education. She said that Technology is “an interesting subject to learn”, but confessed that she did not draw very well, as she had not been introduced to graphical communication. QD B4 enjoyed that Technology is a hands-on subject, and said that she “enjoy[ed] the practical part” and that “learners are able to identify problems in their daily lives and come up with solutions”. She also said that Technology enables learners to become responsible citizens.

QD B5

Participant QD B5 had been teaching Technology for six months. QD B5 was teaching Grades 8 and 9 for 60 minutes, twice a week.

QD B5 had completed a B.Ed. specialising in Technology at Central University of Technology. She had decided to become a Technology teacher when she was still at school, because she had always loved anything related to technology. QD B5 stated that she particularly enjoyed hydraulics and pneumatics, and graphical communication.

QD B6

Participant QD B6 had been teaching Technology for four years. QD B6 was teaching Grades 7 and 8 learners for 30 minutes, four times a week.

QD B6 did not have a Technology background and had not studied Technology after school. She stated that she had gained skills and information from workshops that she had attended. QD B6 had been compelled by the situation at school to become a Technology teacher – she did not elaborate on what “the situation” was. QD B6 enjoyed exposing learners to real-life problems that are encountered on a daily basis, and that are solved with technology. She stated that, “this adds value to Technology as it is practical. It also helps learners realise that our lives are improved and made easier by technology”.

QD B7

Participant QD B7 had been teaching Technology Education for seven years. QD B7 was teaching Grades 7, 8 and 9 for 60 minutes, twice a week.

QD B7 stated that she did not have a Technology background. She was teaching Technology because the school did not have a Technology teacher and, because she taught mathematics, the school “gave it to me because it includes calculations”. QD B7 stated that she had gained experience through workshops and that she enjoyed drawings, because “it is one of the things I never had a background in”.

QD B8

Participant QD B8 had been teaching Technology for one-and-a-half years. QD B8 was teaching Grade 9 learners for 30 minutes, and has two double periods.

QD B8 had studied at the University of the Free State, where she had majored in Natural Sciences. She was teaching Technology as a result of a shortage of teachers at the school. QD B8 enjoyed Technology, because it is a hands-on subject and learners enjoy it, because they are able to apply what they learn in textbooks. Furthermore, QD B8 stated that she enjoyed practical activities, because "[when we do] practicals it easier for them to understand theory and it challenges their thinking skills".

4.2.3.3 Group QD Cx

QD C1

QD C1 had been teaching Technology for a year. QD C1 was teaching Grades 8 and 9 for 35 to 45 minutes, depending on the day they were scheduled, 3 times a week.

QD C1 had studied education at Central University of Technology and had majored in Technology and engineering graphics and design (EGD). She had a passion for Technology that had started when she was at school, and she stated that she "enjoyed it so much that I wanted to become a teacher within those fields". QD C1 enjoyed graphical communication the most, but also enjoyed the practical parts, where the class gets to build their own models.

QD C1 stated that "technology changes constantly and so I learn more and more daily". She said that she liked the way she could work with the children one-on-one and inspire them.

QD C2

QD C2 had been teaching Technology for eight years. QD C2 was teaching Grade 8 learners for 120 minutes, twice a week.

QD C2 had studied at Bonamelo College of Education, where she did a Primary Teachers' Diploma. She had also furthered her studies by studying for an Adult Basic Education and Training (ABET) higher certificate at University of South Africa. QD C2

had become a Technology teacher because there had been a need at the school, even though she had not studied Technology as a subject. QD C2 stated that, when teaching Technology, she enjoyed the mini PATs the most.

QD C3

QD C3 had been teaching Technology for 10 years. QD C3 was teaching Grades 7 and 9 learners for 30 minute periods, four times a week.

QD C3 was not studying Technology and had not studied Technology. She stated that she had learnt about Technology by following the technological process – "I experience how to solve the problems by following five technological design process skills" (IDMEC). QD C3 enjoyed teaching structures, processing, mechanical systems and control, electronics and electrical systems. She also enjoyed helping learners to become problem-solvers.

QD C4

QD C4 had been teaching Technology for 10 years. QD C4 was teaching Grade 9 learners for 35 minutes, three times a week.

QD C4 had studied education through Sefikeng College of Education, and had furthered her studies and obtained an Advanced Diploma in Education with Technology at KwaZulu-Natal University. QD C4 enjoyed doing practical activities and being able to improvise if there were no tools**.**

QD C5

QD C5 had been teaching Technology for seven years. QD C5 was teaching Grades 8 and 9 learners for 60 minutes, two days a week.

QD C5 had studied at Cape Peninsula University of Technology. She had chosen Technology because it is "everywhere you go and we are using the technology and it is a broad subject". She said that she "will be the best teacher because I applied what I know to my learner so that they can have a better understanding". She also stated that she had achieved the best academic results in Technology General Education and Training (GET) phase for Grade 8 learners on their performance; "by giving feedback to learners, they are able to trust you. Therefore you are creating a suitable

atmosphere". QD C5 reported she enjoyed "when you become a teacher in Technology, you have to think out of the boxes. You have to 'think broad'".

QD C5 stated that she did not teach with only one method, "I do not apply one method, I am strategic. A Technology teacher needs to use different resources". Furthermore, she stated that she did research before she entered the classroom, so that she was able to show learners how to tackle problems. She enjoys the mini PAT, as it gives learners the opportunity to apply their knowledge.

QD C6

QD C6 had been teaching Technology for eight years. QD C6 was teaching Grades 8 and 9 learners for 60 minutes, twice a week.

QD C6 had not obtained a qualification in the Technology field, but was planning to register to study Technology at North West University in 2018. She stated that "the subject was allocated to me to teach by the headmaster", and she had gradually developed an interest in and love for teaching Technology. QD C6 enjoyed teaching electricity, mechanical systems and control and processing.

QD C7

QD C7 had been teaching Technology for 15 years. QD C7 was teaching Grade 8 learners for 60 minutes, twice a week.

QD C7 had studied Technology at the University of the Free State, but has an Advanced Certificate in Education (ACE) – Technology. She stated that, "the workshops and training by learning facilitators also play an important role in order to master content". QD C7 also stated that, "in Technology, you always have to solve problems. We use knowledge and skills to meet human needs and wants".

QD C7 emphasised the importance of the technological process for teaching Technology, as "Technology is very practical; you must always follow the technological process". She enjoyed the practical part of the subject the most, as learners are able to solve technology problems. She stated, furthermore, that the content is simple and understandable and that, by attending workshops and training programmes, she had gained confidence in teaching, especially graphical communication. QD C7 also enjoyed the PAT, where learners apply different skills to determine if they understand

the problem, as well as teaching about mechanical systems. QD C7 stated that “learners understand [mechanical systems] more quickly, since most of them are accessible”.

QD C8

QD C8 had been teaching Technology for two years. QD C8 was teaching Grades 8 and 9 learners for 45 minutes, four times a week.

QD C8 had studied B.Ed. at Central University of Technology, but only did the “introduction to Technology“ which, when asked to clarify, was only the first year of Technology in the B.Ed. programme. She explained that she had found Technology hard to teach, at first, but had learned with the help of a mentor, who had assisted her to develop activities and showed her how to deliver content. QD C8 enjoyed electrical systems and control the most, because “we work with the reality of things”.

4.3 RESULTS FROM THE EMPIRICAL STUDY

The 21st century requires learners and teachers to be technologically literate, so that they can be functioning members of society. Because technology is developing at a rapid rate, it is essential for education to keep up with these developments. In this section, the researcher discusses the analysis of the observational data, the assessment instrument designer and sources of inspiration, the challenges that were identified, the assessment instruments that are used, the assessment practices used to enhance technological literacy, the benefits of individual and group work, and the methods of giving feedback to learners.

4.3.1 Observational data analysis

This section reports on the analysis and interpretation of the teaching practices of Ms Athnan and Ms Wahida. The teaching and learning activities of these two teachers were observed with the intention of gaining an understanding of their assessment practices; and the effect of these practices on technological literacy. Three of Ms Athnan’s classes was observed, and four of Ms Wahida’s classes were observed during sessions depending on their availability agreed upon beforehand. This enabled the researcher to observe the natural teaching environment that the teachers had designed to impact on learner development in their field of specialisation. It was noted

that both teachers conducted their teaching in their own classes; that is, learners moved from class to class while the teacher remained put.

4.3.1.1 Ms Athnan

In Ms Athnan's classes that the researcher observed, learners developed and presented their task to her. The task covered the topic of electrical systems and control, and learners were required to apply their creativity to design and develop a project that incorporated either a buzzer or a light bulb, and electricity (i.e. a circuit), and switch mechanisms. Learners designed two types of projects – one was a robot, and the other was a wire loop game – these learners had the choice of completing either project. When the learners developed their projects, it was noted that the learners had brought the equipment needed from home (wire, batteries, light bulbs, wires, etc.). Ms Athnan's role was to assist the learners when needed; she also constantly walked around in the classes and would ask learners if they needed assistance or to praise the learner for their efforts. When learners presented their projects, their excitement was visible, which could be an indication of their liking for the task. Ms Athnan would reciprocate their excitement; and if the learners' project would fail to work, such as when a wire was not connected properly, the battery died, or the light did not flicker / light up, Ms Athnan would assist the learners if she could. When an error was identified, such as a fused bulb, she would ask the learner to identify the problem before she identified it for them.

In a discussion that the researcher had with Ms Athnan, she stated that,

> *You just have to put something out of you to make them interesting for the learners. They should know that this is what I am expecting and this is what I want to see.*

Ms Athnan expressed her frustration about the availability of resources. She stated that, although learners' parents were very accommodating, in the sense that learners were permitted to use the requirements available at home, some requirements are expensive and learners cannot disassemble products to use the parts for their projects. Another issue that the researcher identified was that learners, as bricoleurs, had made use of what was available to them, but the parts they used were old and did not always work when they had to present the task. Ms Athnan stated,

furthermore, that she made use of her own resources to create her examples for the class. She also stated that learners were given the chance to present their work to the rest of the school and to old-age homes and orphanages. Additionally, some of the learners' projects were given to the orphanages.

When she was asked about her method of feedback, she referred to the occasion when learners did their presentations. She stated that,

> *The way that we are doing it is not… on paper, because the way it is supposed to be done is that you do it on an error analyses basis, where you show learners what it is that they're supposed to be doing.*

This means that Ms Athnan identified errors in their projects with learners. Furthermore, Ms Athnan stated that she does corrections with learners after they have completed an activity, to prepare them for a test; and once a test is handed back to learners and corrections are done, parents need to sign the learners' tests. This encouraged parents' participation.

4.3.1.2 Ms Wahida

In the first observation, learners had made corrections with Ms Wahida. The activity was a homework activity from the textbook that learners had had to complete. The topic was calculating gear ratios – the calculations were done on the board and learners were asked to answer the question if they knew the answer. Furthermore, learners were asked to raise their hands if they had the answer correct. No other means of feedback was observed. It was noted that during this session, only corrections were done with the learners.

In the next observations, learners developed and handed in their practical tasks. Just as in Ms Athnan's class, learners in Ms Wahida's class had brought their own equipment to class. Learners then completed the task of building a functioning bucket system for a well (the focus for this activity was on the mechanisms used to lower and rise the bucket from the well); Ms Wahida occasionally walked around in the class; and would assist the learners with queries or problems. Furthermore, Ms Wahida explained that the simple task of handing in a project takes a lot of time, because the class was so large. Ms Wahida called out learners' names and a volunteer learner collected the task and placed it in the storeroom – the researcher observed that

learners who were not handing in their projects at the time were noisy and disruptive; furthermore, some learners' projects had been "lost" or "stolen", but were "discovered" later in the period. The Technology periods that the researcher attended was scheduled after the break period, and some learners arrived late for class, or claimed that they had left their equipment or projects outside. No feedback was provided in this class, nor did learners present their tasks. Whilst collecting the tasks, Ms Wahida completed a checklist to ensure that all learners had submitted their practical tasks and their portfolios.

The practical task that learners completed was from a textbook and included a rubric that served as a guiding tool. Ms Wahida explained that she provided feedback on the rubric itself, and does not discuss it, as "there is not enough time".

4.3.2 Assessment instrument design

Participants in the study were asked to elaborate on the design of assessment instruments that were used in their classes and, if they had designed the assessment instrument, what had inspired them. The data presented in Figure 4.1 was recorded.

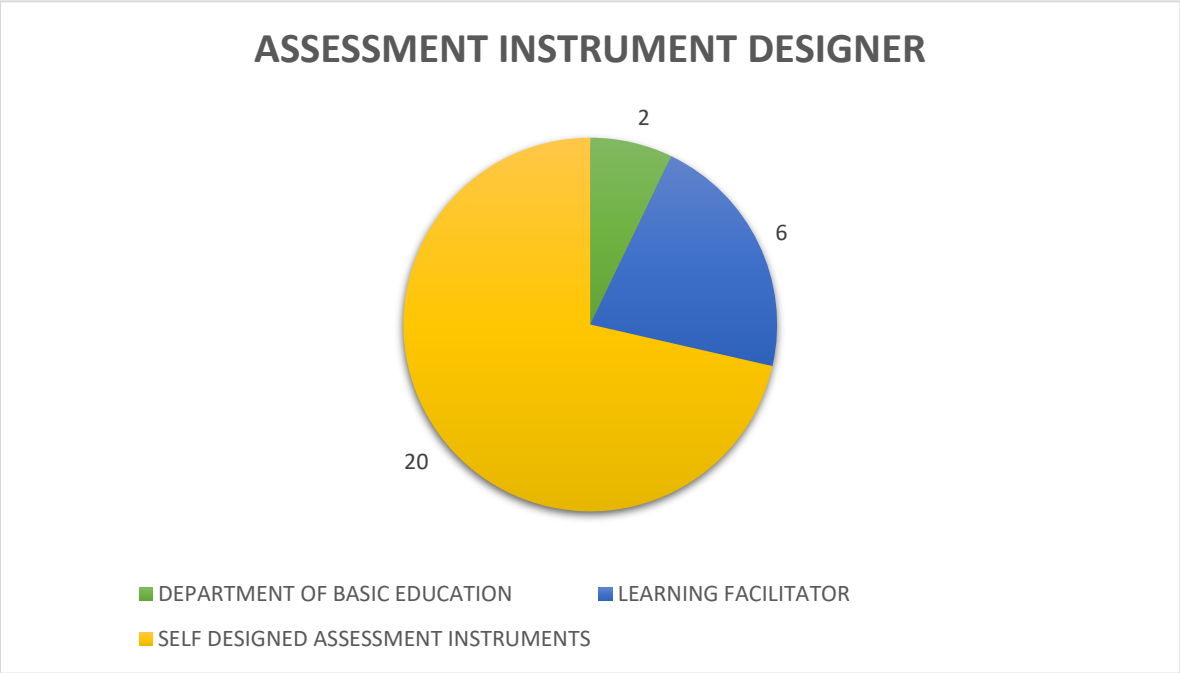

Figure 4.1: Assessment instrument designer

Figure 4.1 presents a pie chart that illustrates the three role players in the design of assessment activities. It should be noted that teachers stated that they

sometimes made use of assessment instruments of the learning facilitator, and sometimes instruments that they designed themselves. The data is therefore represented in a pie chart, to demonstrate clearly what assessment instrument designer is used most frequently.

From the data gathered, two teachers stated that they received assessment instruments from the Department of Basic Education, and six stated that they received assessment instruments from their learning facilitator. However, 20 teachers stated that they designed their own assessment instruments for their classes, for both formal and informal assessment tasks. The bar chart in Figure 4.2 indicates where Technology teachers acquired inspiration for designing assessment instruments.

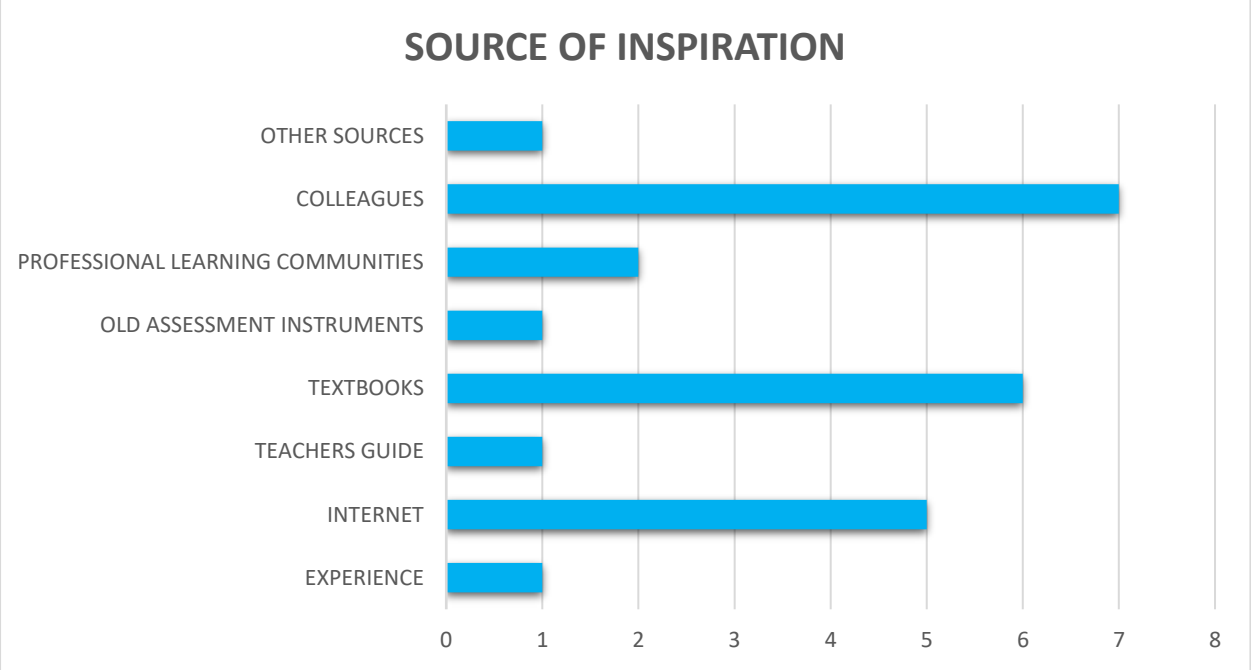

Figure 4.2: Sources of inspiration

Figure 4.2 lists the sources of inspiration in the form of a bar graph. It is clear that the majority of teachers gained inspiration from colleagues, thereafter from textbooks and the internet. The grouping “colleagues” refers to co-workers, former teachers, learning facilitators, mentors, former lecturers and other superiors. Six participants stated that their source of inspiration was textbooks - this raises concern because QD 2A had stated that her school lacks updated textbooks. Although she does not use textbooks as a source of inspiration, other Technology teachers may use the same outdated

textbooks to design assessment instruments for learners. Furthermore, five participants used the internet as a source of inspiration.

Participants also gained inspiration from professional learning community (PLC) groups – QD C6 describes a PLC group as “a group of Technology teachers from different schools”, whereas the Sooria, Hamza and Nadzir (2014) describe PLCs as “a collection of experts continuously researching on improving the teaching and learning process as it serves as the main platform for organic sharing of practice, workload and professional collaboration”. Furthermore, old assessment instruments, teachers’ guides, experience and “other sources” also served as inspiration. One participant mentioned “other sources”, which referred to a combination of various, non-specific resources.

QD C4 stated that her learning facilitator encouraged her to use various assessment instruments, which gave her confidence. This information emphasises that support from key role players has an impact on teaching and learning activities. QD B1 stated that, if she needs help, “Department officials are always a phone call away”. QD 3A experiences coincide with QD B1, when she stated that she received a lot of support from her superiors. QD C7 stated that she designs her assessment instruments herself, as it is easier to assess and more understandable in relation to what she expects from learners. Other participants acknowledged their learning facilitator, superiors, colleagues and head of Department as active, supportive role players that not only provide the necessary encouragement, but also assist in ensuring that assessment instruments that are designed by the teacher is, as stated by QD C5, “critical and adventurous”.

4.3.3 Challenges in relation to teaching and learning practices

Teachers were asked what challenges they face in teaching Technology. From the data, the following groups of challenges were identified, and are presented in Figure 4.3:

1. Challenge 1: The learners
2. Challenge 2: Lack of resources
3. Challenge 3: Graphical communication

4. Challenge 4: The teacher
5. Challenge 5: Management
6. Challenge 6: Transition to senior phase

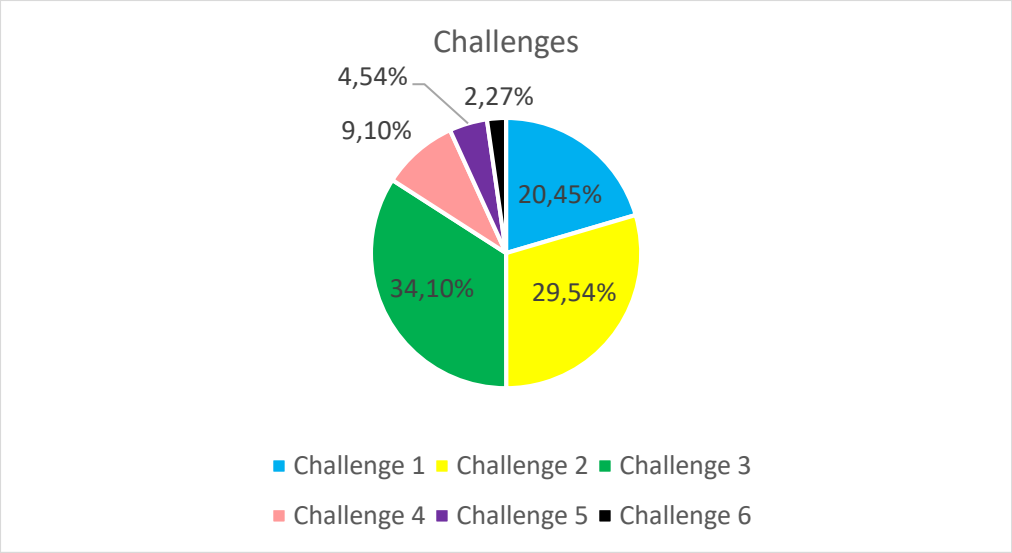

Figure 4.3: Challenges teachers face in relation to teaching and learning

Figure 4.3 presents a pie chart that lists the challenges teachers face in relation to Technology teaching and learning practices according to frequency. The chart indicates that 34.10% of the challenges faced by teachers relate to graphical communication, 29.54% to lack of resources and 20.45% to learners. Below, the researcher discusses these challenges in-depth.

4.3.3.1 Challenge 1: The learners

Participants in the study identified various issues such as lack of effort and motivation of learners in Technology classes, a lack of interest to engage in class discussions or class activities, such as homework activities and mini PATs, learners who struggle to understand Technology terms, as well as lack of interest in the subject, unsatisfactory attendance and lack of a Technology background of learners.

Ms Wahida mentioned that one of her biggest challenges is learners who do incomplete work, or who often leave their work at home. QD 1A and QD C3 also referred to these challenges by stating that learners do not do their homework activities and that learner's lack motivation to complete tasks. Ms Wahida reported that it becomes a problem for marking learners' activities, because "I prefer that, if I get work

today, I should mark it today, because as soon as I get behind then it gets difficult to catch up". Ms Wahida explained that Technology is her passion and to see a learner failing to perform well causes concern. She stated that, "I sometimes take that chance of giving them a zero if it's not on time, just to set an example to the rest of the class, especially if it's just one or two learners". Ms Wahida also stated that she avoids giving learners homework, because "I just feel it gets done when it was supposed to be done in class". However, Ms Wahida also stated that, because time is sometimes a factor that needs to be considered, she allows learners to continue and complete work that had not been completed in class, at home. Other challenges that were highlighted are that learners do not show an interest in Technology. This disinterest could be because learners "do not understand the importance of the subject", or as QD B7 stated, "learners are lazy, especially in Grade 7, because Technology is not done in the intermediate phase" (this opinion is discussed further under Challenge 6). However, QD C8 stated that learners in her class perform well in the theory. Ms Athnan reported that her main challenge with learners in her class is unsatisfactory attendance. In addition, Ms Athnan stated that she lacks resources in her class, and 13 other teachers identified that the same challenge faces their teaching and learning practices.

4.3.3.2 Challenge 2: Lack of resources

Participants in the study expressed their frustration regarding lack of resources in their classes, which results in an inability to complete assessment activities, primarily PAT. Shortages range from lack of equipment, tools and material for practical classes, to lack of appropriate Technology classrooms. Participants also mentioned that,

> *Learning and teaching support material is not available*
>
> *There is no material in class, such as textbooks, teaching materials, ….*
>
> *We do not have a big enough space to store previous models*

Ms Athnan indicated that she would like to have a space in her classroom that is dedicated to displaying learners' projects, so that they could feel pride in their accomplishments; unfortunately, the classroom is too small to accommodate this ideal. Ms Wahida has a storeroom, where she stores projects which proved helpful as she could ensure the safety of the projects; it also enabled her to mark more comfortably as "it does overcrowd the classroom by having their projects on their desks". Ms

Wahida also stated that “I am able to mark better because the learners leave their projects at school and I can mark it in the afternoons”. Participants also mentioned that lack of equipment, tools and materials affects teaching and learning practices; as a result, learners are required to take their projects home to complete. This is a problem, because “the parents tend to take over the learner’s project and do it for them instead of guiding them” (Ms Athnan). Ms Wahida indicated that conditions at learners’ homes influence the completion of assessment activities: “most of them live in one room so they don’t have space”.

Another challenge that was highlighted is lack of money to complete PATs and graphical communication assessment activities. QD C5 stated that the school is in a “rural area” and learners have to supply their own materials and tools; however, there is no money for such activities. This shortage is unfair to parents, who have to make every cent count. Ms Athnan stated that learners are encouraged to use waste material; nevertheless, other participants indicated that lack of money is a problem.

4.3.3.3 Challenge 3: Graphical communication

Participants referred to challenges with regard to visualisation skills. QD C2 stated that she struggled to visualise the object and, therefore, has trouble drawing it. QD C6 stated that she lacks knowledge of graphical communication and has a problem delivering this skill to learners. QD B7 stated that she had “limited knowledge and skills in teaching some aspects; one being graphic design”. QD 7A expressed that,

> *Teachers do not teach learners about perspectives or any other topic that involves graphic communication... learners suffer as a result of not receiving appropriate graphic communication classes.*

Participants report that learners, too, experience problems conceptualising drawings. Learners struggle to visualise drawings from the various perspectives, and they struggle to make models. QD C4 pointed out that girls in her class did not like drawings, whilst Q D C1 stated that “some are not capable or made for drawing”. Participants also disclosed that learners do not bring the necessary stationery to class to complete the drawings, and the school does not supply the stationery. Learners are “not used to drawings” and they “do not understand the technological terminology”, which poses a further challenge to teachers.

4.3.3.4 Challenge 4: The teacher

QD 4A stated that, “[I] face many challenges when teaching Technology, because it is my first time”, and that “going to workshops helped me a lot to gain experience from the different topics”. QD B8 also stated that teacher training workshops had helped her a great deal. QD B4 stated that she lacked the skills as a teacher.

These challenges raise the issue of a need for in-service teacher training workshops. The participants expressed positive attitudes towards workshops, because they had little or no prior experience of or a background in Technology Education. The statement by QD C7 that, “the subject is more practical and I am not good at practicals”, indicates a need for in-service teacher training workshops related to practical tasks.

4.3.3.5 Challenge 5: Management

Participants expressed concern about management. QD C7 stated that she lacks support from the school management team, and receives minimal developmental help from the learning facilitator. Other participants also mentioned this challenge in relation to completing tasks and assessment activities within the scheduled time period in class –some classes (i) do not have double periods, or periods are too short, and (ii) it is difficult to complete activities because learners lose focus due to the pressure of what needs to be completed in the limited time frame. QD C8 stated that, “the time allocation is too short to focus in a drawing, as some learners do not finish the drawings”, and QD 3A stated that there is “a lack or no time for mini PAT on the timetable”. QD 5A expressed that,

> *Technology teaching needs money allocated to buy materials and tools that are to be used by learners in doing their activities, like pliers, hammers and others.*

Although lack of support by management and other role players is mentioned, the supporting role of these key role players in relation to the development of assessment instruments was underlined.

4.3.3.6 Challenge 6: Transition to senior phase

As stated under Challenge 2 (see Section 4.3.3.2), some participants were concerned about learners who were unable to grasp Technology concepts, when after they have entered the senior phase. QD C5 stated that, “the subject is only taught in the senior phase”; QD B7 mentioned a similar challenge. During the intermediate phase, Natural Sciences and Technology is combined into a single subject covering topics such as *Life and Living, Matter and Materials, Energy and Change,* and *Planet Earth and Beyond*. It is recommended that a study be done about Natural Sciences and Technology Education in the intermediate phase, to gain a deeper understanding of this challenge. Furthermore, QD 7A stated that, in her class, learners do not know the Technology terms, or fail to understand them. It was also suggested that learners do not gain enough exposure to Technology in the intermediate phase.

4.3.4 Assessment instruments used in teaching and learning practices

Participants in the study were asked which assessment instruments they frequently employed in their classrooms, and how often they used these assessment instruments. As discussed in Section 2.4.2, in this chapter, summative assessment refers to formal assessment practices, and formative assessment refers to informal assessment practices. The following instruments were employed frequently for formal assessment: a) Memorandums; and b) Rubrics.

Participants stated that they assessed learners with a controlled test/examination and a (mini-)PAT once a term. Memorandums were used to assess the controlled test and rubrics were used to assess the (mini) PATs, including presentations.

Participants were also asked what assessment instruments they used informally, and to discuss how often these assessment instruments were used. Participants used the following instruments informal assessment practices: a) Memorandums; b) Rubrics; and c) Question and answer techniques/quizzes. These instruments included the following activities:

- Class tests;
- Drawings;
- Activities in textbooks;
- Activities suggested by the learning facilitator;

- Assignments; and
- Homework.

The frequency of assessment varied from teacher to teacher: some participants stated that they assessed daily, others weekly or monthly, whilst some stated that they assessed learners once they had completed chapter. The assessor also varied; in some classes the teacher assessed, in others the learners assessed either themselves or a peer. When the Technology teacher assesses learners, memorandums are used for theoretical assessment and rubrics are used for drawings. QD C5 disclosed that her assessment instrument was based on the problem identified, and that “there is no point in finishing the syllabus if learners are left behind”. QD C6 confirmed and stated that her assessment instrument was based on “the kinds of concepts that are being dealt with”. Furthermore, QD C8 stated that informal assessment is necessary, as “it prepares learners for formal assessment”. It is clear that a wider variety of assessment instruments and activities are used in informal assessment practices, than in formal assessment.

4.3.5 Assessment practices used to enhance technological literacy

Participants were asked why they had selected the various assessment instruments (i.e. memos, rubrics, and question and answer techniques). This information assisted the researcher to understand the reasons for their choices, and to determine how these assessment instruments enhanced technological literacy.

4.3.5.1 Memorandums/Memos

A memorandum is defined as “a written reminder” (Merriam-Webster, 2017: online). In the context of this discussion, a memorandum or memo serves as a written answer sheet to a test, an exam or a theoretical assessment activity. It provides the reader with the mark allocation for each answer, and identifies specifics required in the answer. A memorandum also guides the reader as to how the question should be answered. Based on the analysis of the study, the researcher found that participants made use of memos for the following reasons:

> *Memos are easier for me as a teacher, and for the learners to see*

Memos are used because questions such as "true or false", "mark the column", "choose the correct word", and "provide a definition" are asked

Memos are fair and they allow general knowledge

Memos are used for assessing tests and classwork because it is the most straightforward tool

The memos are aligned with the CAPS

I use memos to guide and train learners on how to answer questions

From the above, the researcher deduced the following regarding the use of memorandums in a Technology assessment activity: Memorandums are used for theoretical assessment activities, where questions are open, even though a standardised answer (such as one-word answers or definition) is required. The memorandum allows learners to answer questions based on their general knowledge, which is essential in any assessment activity, because it allows a learner to provide an answer that is not limited to the classroom. The memorandum is also aligned to the CAPS Technology document, which ensures that, even though learners are given the freedom to express themselves, they do it within the context of the aims and objectives of the Department of Basic Education. Furthermore, the memorandum is not only available to teachers, but learners have access to it too, and can use it to guide their answers to questions in assessment activities.

4.3.5.2 Rubrics

According to the Collins English Dictionary (2017:online), a rubric can be described as "a set of rules of conduct or procedure". In the context of this study, a rubric is seen as a mark sheet, whereby learners are awarded marks against certain procedures or criteria. For example, when learners complete an activity requiring them to design a frame structure, learners will be assessed according to how they have applied their knowledge on triangulation. Learners can also be assessed on whether they were able to solve the scenario, and whether their models are functional. The following benefits of rubrics were identified by the researcher from participants' responses:

Rubrics, because it caters for each learner's ability, knowledge and skill

Rubrics are used as a guide for when learners design and make

A rubric allows learners to know how to achieve marks

Rubrics are used for drawings, so they need to follow the criteria

Rubrics are fair

Rubrics are used in drawings, so that learners can know what to expect before drawing

Rubrics help a lot because they determine the ability and understanding of a learner, whether they work in groups or individually

Rubrics are aligned with the CAPS

I use rubrics to guide and train learners on how to achieve maximum marks

Rubrics allow learner to be creative and proactive

Rubrics are used to test learners so that they focus on the technological process

Mini PATs allow learners to express themselves in their work [use of rubric]

The rubric enables me to monitor learners' progress weekly before submission

According to the responses, rubrics assist to enhance technological literacy, as it allows each learner to express themselves and to demonstrate their abilities. As PATs include a hands-on practical activity, rubrics guide learners to the completion of the activity, whilst providing room for creativity, as well as ensuring that learners are able to work individually and in groups. While learners complete graphical communication activities of the PAT, they know what is expected. Furthermore, rubrics allow teachers to monitor learner progress and, therefore, allows teachers to intervene positively and guide learners before they submit.

4.3.5.3 Question and answer techniques

Question and answer is a method whereby teachers and learners ask and answer questions from each other about related content or about a specific topic. The following statements were captured regarding question and answers techniques:

Question and answer, as it is easy to check whether learners understand the subject matter

Other learners are also allowed to ask questions when learners are presenting to make it more interesting and to ensure that learners are well prepared

Question and answer build confidence in the learners and makes them feel free in class

Question and answer techniques are used at the beginning of a lesson to test learners' pre-knowledge about the topic as well as at the end of the lesson to determine learners' level of understanding

I use question and answer techniques as guiding questions for learners, such as "why?", "what?" and "when?" so that they can formulate their sentences

Question and answer techniques creates fast-thinking learners

Questions differ from a low cognitive level to a high cognitive level

Question and answer techniques involve learners in the teaching and learning process

Question and answer techniques, as it allows you, as the teacher, to get to know them better in conjunction with their capabilities. It also allows you to classify your learners

Question and answer techniques in the form of an activity is the best method to teach them before they write a formal assessment task.

I use question and answer techniques to ensure that all learners fully participate during teaching

Question and answer techniques assist to enhance technological literacy, as it provides learners with a platform to ask questions about topics that they do not understand, and also allows teachers to formatively assess learners' development through questions. This technique assists the teacher to ensure that learners are up to date with the work that is being dealt with, and also provides a starting point for teachers, so that they can assess learners' prior knowledge and avoid wasting time focusing on information that learners are familiar with. As learners are also able to ask

questions to other learners, it ensures that learners think about their responses and, therefore, familiarise themselves with the content. Furthermore, teachers can guide learners' responses to ensure that they answer questions fully. Asking questions creates fast, critical thinkers. Question and answer techniques not only ensure that learners are actively engaged in class, but also provides them with an indication of what they can expect in assessment activities.

4.3.6 Benefits of individual and group work

Collaboration is a necessary part of Technology teaching and learning, and is essential in assessment practices employed by the Technology teacher, as is individual work. The researcher in this study questioned participants on whether learners in their classes worked individually or in groups, and the responses indicated that learners worked both individually and in groups, depending on the assessment activity that they were engaged in. The researcher identified the benefits of working individually and working in groups, and present the benefits in Sections 4.3.6.1 and 4.3.6.2.

4.3.6.1 Benefits of individual work

Participants in the study stated that learners work individually when they are engaged in controlled tests and exams, and when they are engaged in drawings. The following benefits were identified:

- Working individually helps learners to assess themselves and assists them in identifying where they can improve.
- Working individually allows the teacher to determine learners' progression and identify those learners who need assistance and those who are on track.
- Working individually teaches learners not to depend on someone else.

4.3.6.2 Benefits of group work

Participants stated that learners work together in groups when they are engaged in some parts of the (mini) PAT, and when they are engaged in certain assessment activities, such as discussions. The following benefits of group work were identified by the researcher:

- Group work helps learners to learn how to work together and to see things from someone else's perspective.

- Working together requires learners to share ideas/combine their ideas.
- Learners work in groups so that they can share the cost of material ("work in groups when they have to build a model because the parents cannot afford all the material themselves, we stay in a rural area" - QD C5).
- Working in groups helps learners to gain a better understanding of the work and of each other, as they are on the same level (w.r.t. schooling experiences and social experiences), which is sometimes better than understanding the teacher.
- Working together requires them to share information, especially when they brainstorm.
- Group work allows learners to help each other, where possible.
- Working in groups encourages learners to help one another and to do as well as the others in the group, and in the other groups.
- Group work provides a setting where collaboration and cooperation are valued.
- Group work teaches learners about the sharing of responsibilities.
- Working in groups saves time spent on marking.
- Group work encourages diversity when teachers divide learners into groups.

4.3.7 Ways of giving feedback

Participants in the study were asked how they provided feedback to their learners. Based on the answers received from the participants, there seems to be a misalignment amongst teachers about what feedback entails, as discussed in Section 2.4.4 and Section 2.4.5, providing feedback does not only include a discussion of the memo, but also providing learners with clear indications of where they have lost marks and where they can improve, and that "learners need to be involved in the feedback process rather than to simply be receivers" (Boud and Falchikov, 2006:402).

The researcher determined that teachers provide feedback using the following feedback techniques:

Technique 1: Asking learners questions about the work, to see if they have any problems

Technique 2: Doing revision/corrections and giving practical examples

Technique 3: Doing work again if a large portion of the learners did not do well in a certain area in the assessment activity

Technique 4: Discussing work that may be challenging to learners

Technique 5: Writing comments on scripts or other assessment instruments

Techniques 1 to 4 indicate that feedback is given when a teacher identifies a mistake, and provides the correct answers to learners. One teacher (QD C1) reported that she asks learners questions in class (Technique 1) to test their understanding and, based on their answers, she will explain the work again, if necessary. This indicates that the teacher provides feedback to learners whilst the topic is being dealt with, as suggested by Wiggens (cited by Bansilal *et al.,* 2010:155; see Section 2.4.5). QD C1 asked learners questions as a means of repeating; she stated that repetition ensured that learners understood what is being assessed and that "the learners learn better when you keep repeating".

The majority of the teachers stated that they prefer to do revision, and to make corrections (orally or in writing) with learners in class (Technique 2). This was also a way of involving the learners in the assessment process as learners were now made aware of how they were assessed and what could be anticipated in future assessment processes through the revision. The Merriam-Webster Online Dictionary (2017: online) defines revision as "study of information that was studied before", and correction as "the action or an instance of correcting: such as amendment or a bringing into a conformity with a standard". Both revision and correction refer to an activity that takes place after another activity has been completed. This refers to a process called "reflection-on-action" which takes place after the (assessment) activity has taken place (Lavoué, Molinari, Prié and Khezami, 2015:129). Schön created two key concepts, namely reflection-in-action and reflection-on-action (Lavoué *et al*., 2015:129; Munby, 1989:2). Munby (1989:2) describes "reflection-in-action" as "the active and non-propositional processes by which new knowing-in-action is developed". According to Lavoué *et al*. (2015:129) and Munby (1989:2), reflection-in-action refers to reflecting during practices; such as when a teacher hands out assessment activities to learners in the Technology class. The reflection can take place in multiple ways, such as observing learners during the course of the assessment, answering learners'

questions to identify gaps they face in achieving the expected Technology outcome, and gaps in the assessment task, asking learners questions, and so forth.

Just as reflection-in-action, reflection-on-action is “the act of thinking practically” (Munby, 1989:3). Munby (1989:3) states, furthermore, that reflection-on-action is the process of thinking before or after an action has been carried out. The action can be the reflection on (assessment) activities that should be designed, and on activities that had already taken place. Technology teachers can, therefore, reflect on learners’ answers and marks, their willingness to engage in the assessment activity; as well as learners’ responses to the assessment activity (i.e. learners may perform badly in a section in the assessment activity, and technology teachers can then improve on in their teaching and learning activities as a means to enhance technological literacy).

As stated in Section 2.4.5, this method of feedback “affords learners with the opportunity to identify errors and to rectify them”; however, aside from self-reflection, no participant has received feedback from learners regarding their teaching and learning practices in general – teachers only receive feedback during discussions (Technique 5), when learners have the opportunity to discuss “things that might be challenging” (QD B5). Another participant explains that she projects memos indicating where corrections were made in a “formal recording book where they paste their continuous test”. The frequency with which learners do revision/make corrections differs from teacher to teacher. Participants stated that they provide this method of feedback on the following occasions:

- **After a formal activity**, so that feedback is immediate. QD C6 stated that she marked the formal activity immediately after it had been completed by learners, and then she returns it to them to clarify what they do not understand. QD B3 stated that she does corrections on the board, so that learners can solve a problem “step-by-step”. She explained that she did corrections in detail, so that “learners can know the correct way of solving a problem”. QD B3 shared that she employed this method, because “learners will respond positively and remember the experience about what is being learnt in a positive manner”. QD 4A, however, stated that she does informal assessment activities that are assessed with the learners; doing so provides learners with the opportunity to engage in the activity after assessment.

- **After every informal activity**: Some participants stated that doing revision with learners is the most effective method of feedback, as it involves all the learners (QD C1) and because learners “need to identify their mistakes” and rectify them (QD C4, QD C7). Other participants stated that, by making corrections as a class, learners “understand that they are allowed to make mistakes as long as they identify what their mistakes were and correct it so that it is not repeated in a formal test” (QD C8); it also guides learners, back to the answers, when they prepare for formal activities (QD B4, QD B7, QD C8). QD 1A stated that she did corrections with learners so that “learners can see how many answers they got right”.

Participants also stated that, once they had completed marking, they reflected on the marks and went over work again if a large portion of the learners did poorly in a certain area of the assessment activity (Technique 3). As stated in Section 2.4.2, achievement in formative assessment practices is dependent on various factors, including “involving the teacher and learners in self-reflection” – reflection is critical in assessment practices. Morales (2016:159) notes that literature reveals that, in order for teachers to improve and develop their teaching and learning practices, they need to constantly reflect on what they are doing. Munby (1989:4) agrees and states that “reflection” in reflection-in-action may be misunderstood – reflection refers to a process that occurs after an action has been carried out, but in the context of reflection-in-action, it occurs throughout the process. Reflection-in-action should, therefore, be seen as a monitoring of oneself whilst carrying out an action, such as a participant reflecting on her assessment practices during the Technology teaching and learning process.

Techniques 4 and 5 were only identified by two of the twenty five (25) participants. These two stated that they discuss work with learners so that they, the teachers, could gain a better understanding of where learners face challenges. QD B5 stated that the discussions boosted learner confidence and QD B8 stated that, in addition to written comments on scripts, discussion has proven to be the most effective method of feedback for her class. As feedback is an essential part of learning, it is often taken for granted, resulting in ineffective methods of feedback being applied, where the intent is ensure that learners pass, rather than understand. In Section 4.3.4, the types

of assessment instruments used were discussed, such as rubrics, whereby teachers write comments on the assessment instrument to assist learners. Ms Athnan stated that she writes comments on the rubric with suggestions for ways learners can improve their task; however, Ms Wahida stated that, “with the PAT I don’t give feedback, because there really isn’t enough time -- I don’t see them enough. They get a rubric back with their mark and most of the time I try really hard to write a comment about the task”. This raises concern, as Ms Wahida separated “feedback” from “comments on the rubric”, which could imply that comments are not effective feedback methods. The researcher suggests that a study be conducted on the effectiveness of verbal feedback compared to written feedback. As stated in Chapter 2 (see Section 2.4.5), feedback is a more complex process than simply providing statements about work done. By discussing work done with learners, they are actively involved; furthermore, it affords learners and the teacher with the opportunity to develop as critical thinkers who are able to assess their own learning and teaching practices in Technology and in other subjects, and aspects of life. Another issue is also briefly raised in Section 4.3.3.5. about time allocation – as highlighted in the biographical data of each participant (see Section 4.2), there are various time allocations and contact periods that the learners have in Technology. The correlation between time allocations and contact periods; and technological literacy development was not explored in this study.

4.4 CONCLUSION

The analysis and interpretation of the findings made from the empirical data were presented in this chapter. Empirical data was generated from observations and interviews with two teachers, and open-ended questionnaires completed by twenty three (23) teachers of Technology Education senior phase. First, the biographical data of each of the participants was given, to inform the reader about diversity regarding aspects such as teaching experience, school dynamics and technology background. The researcher provided information about the assessment practices employed by participants, by referring to the assessment designer and the sources that inspired Technology teachers to create their assessment instruments. The interviews and discussions gave insight into the challenges that Technology teachers face in teaching Technology. Teachers’ assessment practices were found to be influenced by various factors, including their own teaching background; and their technology background.

The chapter discussed the assessment instruments participants used, and highlighted the assessment practices they used to enhance technological literacy. The following chapter presents a summary of the major findings of the study, and explore the correlation with the literature discussed in Chapter 2. The researcher offers recommendations and conclusions based on these findings.

CHAPTER 5:
SUMMARY OF THE FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter presents a summary of the findings in relation to the aims and objectives of the study. The researcher discusses the meaning of the findings presented in Chapter 4, and draws conclusions with reference to the literature reviewed in Chapter 2. Recommendations are made with regard to the findings on the enhancement of technological literacy through assessment practices in the senior phase, before concluding with recommendations for further research.

5.2 SUMMARY OF THE FINDINGS

From the analysis of the literature on Technology Education, technological literacy, and assessment practices, the researcher gathered information about the various assessment practices that underlie the teaching of Technology Education in the senior phase in schools in the Motheo school district, Free State province. As Technology is a relatively new subject in the South African school curriculum, the researcher intended to understand how Technology teachers enhance technological literacy through the assessment practices that they employ in their classes.

As stated in Section 2.4.8, teachers hold the general assumption that assessment “is an official event” (Bliem and Davinroy, 1997:19), therefore, the researcher distinguishes between formal and informal assessment practices. Formal assessment practices are seen as summative in nature, whereas informal practices can be both summative and formative in nature; however, formal assessment practices lead to the calculation of a learners’ final mark at the end of the term, and at the end of the year. Participants stated that they assessed learners formally on the basis of the CAPS: Technology; that is, one theory task (such as a test or an examination) and one PAT in the first three terms. In the fourth term, only a PAT, as a formal assessment practice, is employed. Furthermore, according to the CAPS: Technology, the final mark for the first three terms is calculated on the basis of 30% theory and 70% PAT. In the fourth term, 100% of the mark is for the PAT (DBE, 2011).

Participants indicated that they continuously, throughout each of the four terms, assessed learners informally using homework activities, group-work activities and question and answer techniques/discussions in class. Informal assessment activities serve to ensure that learners remain up to date regarding the intended outcome; and ensure that learners understand the task and are able to gain clarity about the task.

For this study, the researcher observed two senior phase Technology teachers teaching and learning practices in order to experience the real and dynamic classroom setting; and had interviews with each. Furthermore, an additional twenty three (23) Technology teachers completed open-ended questionnaires and participated in follow-up discussions, which provided additional data in support of the discoveries of the initial collaboration with the two teachers. The researcher focused on factors that were derived from the main research aim and the objectives, which assisted the researcher to answer the main research question: How do teachers in senior phase Technology classes integrate assessment practices to enhance technological literacy?

The open-ended questionnaire focused on factors such as Technology background, teaching experience, fulfilment and challenges Technology teachers experience, formal and informal assessment instruments and the frequency of their employment, the designer, the nature (i.e. individual vs group-work) and inspirational sources of the assessment instruments employed and methods of giving feedback. The following findings were recorded from the empirical data analysed, as detailed in Section 4.2.

Upon investigating the biographical data of the participants, it was evident that diverse circumstances had sculpted their teaching. Differences were noted regarding the number of years they had been teaching Technology, their reasons for teaching Technology, their training and professional teaching and technical (engineering) qualifications, as well as their experiences and challenges. Although these teachers exhibited diverse educational and teaching backgrounds, the researcher found that their teaching and learning practices, and thus their assessment practices, were related in terms of design – this finding became clear from the empirical data (see Section 4.3), which is viewed as the Technology teacher culture.

This finding highlights the technological culture that exists in relation to the significance of centralised planning; and highlights the need for in-service professional development and/or PLC groups, that could improve teaching instruments.

The literature suggests key factors that could influence technology teachers' assessment practices (see Section 2.4) - the research found that these factors included the teachers' subculture, understanding and employment of summative and formative assessment, judgements made in assessment, sustainable assessment practices, understanding of feedback and methods of execution, defining good assessment practices, collaboration, and other factors listed that could influence Technology assessment practices.

It was found that Technology teachers primarily designed their own assessment instruments. Technology teachers also employed assessment activities that were designed by the learning facilitator of their school district; or that were designed by the Department of Basic Education. The researcher, however, points out that most participants indicated a combination of these sources for designing assessment activities. These factors were evident in the empirical data generated from the research participants as demonstrated in Chapter 4 (see Section 4.3)

The inspiration for the design of assessment practices also varied. Primary sources of inspiration included colleagues, textbooks, the internet, and PLC groups. PLC groups were seen as important sources in this study. The researcher suggests that the absence of a shared subculture among technology teachers could influence teaching and learning practices, and the formation of and meeting by such groups can ensure that uniformity is established across the discipline. The literature suggests that, (i) Technology teachers do not align assessment practices with their teaching objectives, and (ii) Technology teachers do not demonstrate understanding of the importance of such alignments (see Section 2.2.1). The data of this study suggests that Technology teachers make use of textbooks, internet resources and PLC groups, and it is anticipated that these assessment activities, therefore, align with the intended technological literacy developmental outcomes, and national curriculum outlines. Participants in the study who participated in PLC meetings formed the groups with the intention of aligning assessment practices with teaching objectives, and to establish uniformity.

One of the important findings of this study is related to the challenges Technology teachers face in their teaching and learning practices. Participants reported facing challenges primarily with regard to graphical communication (34.10%), lack of resources (29.54%) and challenges relating to learners (20.45%). As stated in Section 2.2, teachers' theoretical and practical knowledge affects assessment practices. Their lack of skills and knowledge about graphical communication has proven to be a major challenge. Participants reported that *they* lacked visualisation skills and were, therefore, unable to transfer such skills and knowledge to their learners. Additionally, as a result of their lack of experience, participants expressed concern about the execution of graphical communication assessment tasks and PAT; they revealed that the resources they required to cultivate such graphical communication skills were unavailable. The participants also expressed concern about the lack of resources needed for both the execution and final products of other assessment tasks, such as PAT. Participants reported that their classrooms were not necessarily equipped to teach a subject such as Technology: the lack of tools and equipment along with the lack of space for physical tasks and to display projects discouraged learners and the Technology teacher.

This information relates to a desire to touch further on the affective domain of learning: if learners' projects are displayed, it provides them with a sense of achievement and desire to progress. Doing so would also be beneficial for group-work activities, as it would encourage collaboration. Participants said they promoted group work when resources were lacking, as working together in a group could minimise costs for individual learners. Participants also reported inadequate resources for completing PAT, but they stated that they were able to make use of second-hand or recyclable materials to complete their tasks – in this regard they acknowledged the role played by parents and guardians who supported their endeavours. Resource shortages, however, cause further, sub-problems for teachers, who have to do additional planning and reorganising to achieve the outcomes and provide learners with meaningful teaching and learning practices. As stated in Section 2.2, participants, as bricoleurs, are encouraged to make use of all the resources that are available to them, both within the school and within the community. Participants reported about initiatives to involve the school by "showing-off" learner projects and participating in

local community groups, such as old-age homes and orphanages. Such participation could lead to the formation of relationships that could be mutually beneficial.

Learners in the class are also reported to pose challenges; teachers reported various problems that occur in their classes (see Section 4.3.3). It is not clear what the reason for learners' reluctance to collaborate could be.

The study also exposed managerial challenges and how they influence the technological environment. A Technology class should provide learners with opportunities to engage in both "cognitive, affective and psychomotor activities that foster critical thinking, decision making, and problem solving skills" (Brown and Brown, 2010:51). Lack of support by management can result in a teaching and learning environment that does not promote these opportunities regardless of subject-specific teacher competencies.

The empirical data (see Section 4.3.3) indicated that technology teachers primarily made use of memorandums, rubrics and question and answer techniques to assess learners in a variety of assessment activities. The reason for using memorandums was that they are easier to employ, ensured that learners were treated fairly, it was aligned with departmental goals and it served as an effective guide for learners. The assessor, however had varied from (i) the teacher to (ii) the learner him-/herself and to (iii) their peers. This indicates the importance of collaboration, and confirms the existence of "the more knowledgeable other", who provides a sense of autonomy and assists in the production of new knowledge (see Section 2.4.7). Rubrics were employed too, as they enabled learners to express themselves and provided them with the opportunity to demonstrate their abilities. Question and answer techniques were employed to establish a foundation in relation to what learners knew (prior knowledge), and to establish the extent to which learners were aligned with the topic that was being dealt with and the intended outcome.

Furthermore, the nature of the assessment task varied from individual to group work, depending on the outcome. Participants reported on the various benefits of individual and group-work assessment tasks (see Section 4.3.5) and reported that individual tasks were primarily applied when they wanted to test the learners' knowledge through assessment activities such as tests/examinations, homework and some classwork activities. Group work, on the other hand, was used in assessment activities such as

PAT, when learners needed to collaborate to complete a large task. In this way, time spent on the task was minimised, and thereby costs for individual learners were also minimised. Another motivation to use group work was because Technology teachers employed the CAPS: Technology, which specifies that PATs must be carried out as group tasks.

Methods of feedback also varied for different assessment tasks. As discussed in Section 4.3.6, various methods of feedback were employed at various stages. Participants reported that doing revision or making corrections with learners were the best methods of feedback they employed; though they also reported using other methods, such as asking questions, doing a theme over, discussing work and writing comments.

The researcher noted that the methods used to give feedback primarily involved the Technology teacher providing learners with alternative means to bridge the gap; however, it was found that learners provided feedback only when discussions took place, which indicated that learners were not fully involved in the feedback process, as encouraged by the literature in this study. Feedback to learners was, nevertheless, found to be frequent, as participants indicated that they provided feedback after every formal and informal assessment task, as a means to promote self-reflection and thus ensure that everyone (the Technology teacher and the learners) are headed towards the same outcome.

5.3 RECOMMENDATIONS

As any research intends to provide an incentive for future research endeavours, and to make recommendations based on the findings of the study; this section of the chapter provides recommendations for enhancing technological literacy from findings arising from the empirical data. These recommendations implicate various levels of the education system, including Technology teachers, Technology learning facilitators and policy makers. Additionally, recommendations for future researcher is made.

5.3.1 Recommendations for enhancing technological literacy

The empirical data indicated that technology teachers designed their own assessment instruments, however, they also made use of assessments provided by the learning

facilitator and the Department of Basic Education. The researcher of this study therefore recommends that Technology teachers to make use of sources available around them, and that learning facilitators should be available to assist teachers in need and to provide guidance. Learning facilitators have proven to hold considerably influence, not only because participants in this study reported that they are assessment designers, but also because they acted as inspirational and stimulating "go-to" people for the participants of this study. Furthermore, the participants stated that they found inspiration in their colleagues. The researcher, however, recommends that teachers are mindful when implementing the ideas of colleagues in their assessment practices, as the outcome of the activity may not be aligned with the technological intentions envisioned.

Participants reported that they strive to overcome challenges and associated sub-problems that confront them. This finding leads to concern that the reported lack of Technology knowledge, skills and resources may affect teaching and learning practices. In-service teacher-training workshops could be important recommendation for overcoming the discipline-specific challenges related to teacher competence. Furthermore, the need for effective pre-service training also needs to be evaluated. Assessment is seen as "planning beforehand, active learner involvement, feedback and the need to be related to both present and future learning needs" (see Section 2.3.5). Because funding is limited, the researcher, therefore, suggests that teachers continue to plan for PAT and graphical communication tasks beforehand, by anticipating what they need, and developing ways to minimise costs or finding alternative sources/resources, in an attempt to foresee problems and overcome them before the assignment is given.

Participants revealed the need for and benefits of graphical communication in-service teacher-training workshops. They also expressed a need for PAT-related in-service teacher-training workshops. The researcher, therefore, suggests that the possibility of implementing PAT-related in-service teacher training workshops be explored as a means to aid not only Technology teachers, but the learners and their parents/ guardians. These workshops, according to participants, have proven to be helpful for cultivating teacher knowledge competencies, providing a platform for

Technology teachers to discuss problems/concerns of a similar nature, and collaborating to find solutions to problems together.

The researcher recommends that learners be more involved in the assessment practices employed by Technology teachers. As stated in Section 2.4.1, learners are recipients of the “actions of others” (Boud and Falchikov, 2006:400), as learners are not involved in the assessment process. From this study, it is evident that learners are provided with feedback both verbally and in writing, however, the extent to which learners are able to provide feedback to teachers regarding assessment practices that are employed and teaching and learning processes, has not been established. The empirical data was found to correlate with literature, in that assessment tasks are time-consuming; this can be discouraging to both the teacher and the learners (see Section 2.4.8). The researcher recommends that Technology teachers express their concerns to learners and to devise methods of providing beneficial feedback to learners. Teachers should also raise concerns regarding time allocation for the subject and timetable organisation with management. It was observed that a single period is too short to achieve the intended lesson outcomes when other challenges arise, such as learners arriving in class late, and learners being rendered unproductive and unmotivated when they start an activity with time constraints. It is recommended that management reschedules the timetable, to allow for double periods for Technology.

One of the primary concerns of participants was the lack of resources, such as infrastructure, tools and equipment. It is recommended that, in addition to the teacher exploring alternative resources, instead of relying solely on management to provide resources, management itself raises additional funds for allocation to Technology. The researcher encourages management to prioritise Technology-specific classrooms.

The research found that the majority of participants designed their assessment activities themselves. By analysing the assessment activities employed by the participants whose teaching and learning practices were observed in this study, the researcher found that these assessment activities were based on or taken from the CAPS document, or from a textbook.

Considering that the researcher found that the sources of inspiration were primarily colleagues, the validity of the assessment activity should be assessed, as these colleagues’ outcomes may not be aligned with Technology outcomes. The

memorandums, rubrics and question and answer techniques that were employed by Technology teachers are regarded by the researcher to be discipline-specific assessment instruments that can be used to enhance technological literacy. This study found that graphical communication workshops are deemed to be beneficial to Technology teachers, however, it was also found that there is a need for PAT-related in-service teacher training. It is, therefore, recommended that management identify areas within Technology teaching and learning practices that exhibit gaps, and communicate such needs, so that additional in-service teacher-training workshops can be offered in conjunction with pre-service teacher-training workshops. Furthermore, the researcher recommends that Technology teachers and management develop and maintain PLC groups in order to create an "assessment community" (see Section 2.4.3).

5.3.2 Recommendations for further research

This study identified learners as posing a challenge to Technology teachers, as the learners are reluctant to participate in class. The researcher, therefore, recommends that a study be conducted into the unwillingness of learners to engage in Technology in the senior phase; and, if needed, in the intermediate phase, where Technology is taught along with natural sciences, to investigate the challenge identified.

Furthermore, the researcher suggests further research to analyse the tools, equipment and facilities that are needed for effective Technology teaching and learning practices to take place. As suggested in Section 2.4.2, conventional methods of assessment do not assess the learners' motivation, commitment and participation; and factors, such as other social and personal outcomes, need to be assessed "in order for the learner to benefit from schooling" (Stears and Gopal, 2010:594). The researcher found that Technology teachers design assessment tasks to promote motivation, commitment and participation; and recommends that further research is done about the learners' point of view, to determine the extent to which learners judge whether the assessment task assesses these factors. The researcher recommends that a deeper study be conducted to evaluate the extent to which these activities are aligned with departmental initiatives. Additionally, the researcher recommends that a study be conducted to evaluate the effect that time allocation and contact periods have on the learners' technological literacy development.

5.4 CONCLUSION OF THE STUDY

In Section 2.4, the researcher stated that the Department of Basic Education prescribes Technology goals with the intention of developing, and therefore enhancing, technological literacy. The researcher of this study found that these goals are being realised, and are in the process of being pursued by senior phase Technology teachers in the Motheo school district, Free State. The researcher uncovered Technology teacher knowledge competencies relating to the assessment practices that are employed. It was found that Technology teachers employ assessment instruments designed by Technology teachers themselves, by learning facilitators, and by the Department of Basic Education. The assessment instruments that were employed was found to be designed by the Technology teacher, it was found that their sources of inspiration were colleagues, textbooks, the internet, PLC groups, old assessment instruments, teachers' guides, and experience.

Regarding the execution of the assessment activities, Technology teachers referred to various challenges that they face; these challenge include the learners, the lack of resources, graphical communication challenges, the teacher and management, plus additional challenges, such as difficulty grasping technology concepts as a result of inadequate prior learning. The assessment activities that were given to learners were varied in relation to topic as well as outcome. Assessment activities were either for the individual or for the group; and memorandums, rubrics and question and answer techniques were primarily used as assessment instruments. It was also found that, although learners were provided with feedback after every formal and informal activity; methods of giving feedback varied and were linked to specific intentions, not only providing learners with "the right answer".

This study, therefore, reports that senior phase Technology teachers in the Free State Motheo school district use uniform Technology assessment practices in the initiative to enhance technological literacy.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE LETTER

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
EDUCATION
OPVOEDKUNDE

Faculty of Education

04-Apr-2018

Dear **Zaynab Mobara**

Ethics Clearance: **Enhancing Technology Literacy through Assessment Practices in the Senior Phase**

Principal Investigator: **Zaynab Mobara**

Department: **School of Education Studies (Bloemfontein Campus)**

APPLICATION APPROVED

With reference to you application for ethical clearance with the Faculty of Education, I am pleased to inform you on behalf of the Ethics Board of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2017/0231**

This ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours faithfully

Prof. MM Mokhele
Chairperson: Ethics Committee

Education Ethics Committee
Office of the Dean: Education
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APPENDIX B: INFORMED CONSENT LETTER FOR OBSERVATIONS AND INTERVIEWS

Researcher:
Z. Mobara

Faculty of Education
University of the Free State
BLOEMFONTEIN
9300
084 657 4454

Study Leaders:
Dr NJP Teis
Dr DJ Hlalele
Faculty of Education
University of the Free State
BLOEMFONTEIN
9300
051 401 2693 – Dr NJP Teis
058 718 5003 – Dr DJ Hlalele

Informed Consent: Technology Educator

The study intends to explore existing Technology Education assessment practices. The aim is to determine how assessment instruments are used to develop learner's technological literacy. We would like you to participate in this research because you are involved in the teaching of Technology in the senior phase.

The study examines the assessment practices used in your technology classroom for the enhancement of technological literacy and the cultivation of critical technology teacher competencies needed to effectively assess technological practices. These critical competencies, according to the B.Ed programme, implies that the Technology teachers should be able to demonstrate; (i) an ability to operate effectively within a technology teaching system and manage it effectively, (ii) an ability to apply, in a self-critical manner, discipline specific teaching strategies and assessment techniques which effectively are designed to address their own technological and on-going learning needs, and cultivate (iii) an ability to develop learners autonomy to take full responsibility for their technological work, decision-making skills and the use of resources (SAQA, 2008:5).

There are no risks involved in the participation in this study and your identity will remain anonymous throughout the publications and reports. Indeed, your contribution will add value to this field of teaching and help to deepen the understanding of assessment as an effective process in the development of Technological Literacy.

While your contribution is highly appreciated and your participation in this important study invaluable, you are under no obligation to partake in the study as your involvement is entirely voluntary. If you do choose to participate, and an issue arises that puts you in discomfort, you may at any time discontinue your involvement without any repercussions. Your participation may involve answering questions in interview sessions or group discussions. There may be a follow-up interview to clarify issues resulting from our discussions. Furthermore, I would need to observe your teaching of technology classes of no more than three (3) sessions. Both the interviews and the observations will be arranged for a time that best suits you.

If you experience any discomfort, unhappiness and/or unpleasantness with the way the research is being conducted, please feel free to contact me or my supervisors (indicated above) to discuss and resolve the matter immediately.

Yours sincerely

Ms Z Mobara

Dr NJP Teis (Supervisor)

Please fill in your details below and return via email at zaynabmobara@gmail.com OR return to the school secretary where it will be collected. The above page is to be kept for future reference.

Study:

Enhancing Technology Literacy through Assessment Practices in the Senior Phase

Researcher: Zaynab Mobara

- I hereby give free and informed consent to participate in the above mentioned study.
- I understand what the study is about, why I am participating and what the benefits and risks are.
- I give the researcher permission to make use of the data gathered from my participation, subject to the stipulations she/he has indicated in the above letter.

Name and surname: _____

Technology Education District: _____

Contact Number: _____

By signing this document, you accept that you are fully informed about the research study and give your permission that the information used by the researcher will not identify you as an individual in any manner.

Signature: _____

Date: ___/____/_____

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APPENDIX C: INFORMED CONSENT LETTER FOR QUESTIONNAIRE AND DISCUSSION

(Includes the questionnaire)

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV
EDUCATION
OPVOEDKUNDE

Researcher:
Z. Mobara

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University of the Free State
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Study Leaders:
Dr NJP Teis
Dr DJ Hlalele
Faculty of Education
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051 401 2693 – Dr NJP Teis
058 718 5003 – Dr DJ Hlalele

Informed Consent: Technology Educator

The study intends to explore existing Technology Education assessment practices. The aim is to determine how assessment instruments are used to develop learner's technological literacy. We would like you to participate in this research because you are involved in the teaching of Technology in the senior phase.

The study examines the assessment practices used in your technology classroom for the enhancement of technological literacy and the cultivation of critical technology teacher competencies needed to effectively assess technological practices. These critical competencies, according to the B.Ed programme, implies that the Technology teachers should be able to demonstrate; (i) an ability to operate effectively within a technology teaching system and manage it effectively, (ii) an ability to apply, in a self-critical manner, discipline specific teaching strategies and assessment techniques which effectively are designed to address their own technological and on-going learning needs, and cultivate (iii) an ability to develop learners autonomy to take full responsibility for their technological work, decision-making skills and the use of resources (SAQA, 2008:5).

There are no risks involved in the participation in this study and your identity will remain anonymous throughout the publications and reports. Indeed, your contribution will add value to this field of teaching and help to deepen the understanding of assessment as an effective process in the development of Technological Literacy.

While your contribution is highly appreciated and your participation in this important study invaluable, you are under no obligation to partake in the study as your involvement is entirely voluntary. If you do choose to participate, and an issue arises that puts you in discomfort, you may at any time discontinue your involvement without any repercussions. Your participation involves completing the attached questionnaire. There may be a follow-up discussion to clarify issues resulting from the questionnaire.

If you experience any discomfort, unhappiness and/or unpleasantness with the way the research is being conducted, please feel free to contact me or my supervisors (indicated above) to discuss and resolve the matter immediately.

Yours sincerely

Ms Z Mobara

Dr NJP Teis (Supervisor)

Please fill in your details below and return via email at zaynabmobara@gmail.com OR return to the school secretary where it will be collected. The above page is to be kept for future reference.

Study: **Enhancing Technology Literacy through Sustainable Assessment Practices.**

Researcher: Zaynab Mobara

- I hereby give free and informed consent to participate in the above mentioned study.
- I understand what the study is about, why I am participating and what the benefits and risks are.
- I give the researcher permission to make use of the data gathered from my participation, subject to the stipulations she/he has indicated in the above letter.

Name and surname: _____

Technology Education District: _____

Contact Number: _____

By signing this document, you accept that you are fully informed about the research study and give your permission that the information used by the researcher will not identify you as an individual in any manner.

Signature: _____

Date: ___/____/_____

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QUESTIONNAIRE

UNIVERSITY OF THE FREE STATE
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YUNIVESITHI YA FREISTATA
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1. Describe your Technological background

(Where did you study? When did you want to become a technology teacher? What are your technology experiences?)

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2. How many years of teaching experience do you have in Technology Education?

3. Which grades do you teach Technology to? How often do you see them? What are the time frames of these periods?

4. What do you enjoy the most about teaching Technology?

Please turn over

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5. Which assessment instruments do you employ most frequently in your theory class? Who designs the assessment instruments?

(Please describe the assessment instruments and state why you think it is the best assessment instruments for the activity)

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6. Who designs your assessment instruments? If you do, where do you get the inspiration from?

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7. What assessment instruments are used to assess learners formally? How often do you assess learners formally?

8. What assessment instruments are used to assess learners informally? How often do you assess learners informally?

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9. Describe the practical assessment tasks (PAT) you employ in your class to assess learners technological literacy.

10. Do learners work individually or in groups?

(When do learners work individually and when do they work in groups? Why?)

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South Africa/Suid-Afrika
www.ufs.ac.za

11. How do you give feedback to the learners?

School of Mathematics, Natural Sciences & Technology Education
Skool vir Wiskunde-, Natuurwetenskappe- en Tegnologie-Onderwys
T: +27(0)51 401 3443
E: swanepoell@ufs.ac.za

205 Nelson Mandela Drive/Rylaan
Park West/Parkwes
Bloemfontein 9301
South Africa/Suid-Afrika

PO Box/Posbus 339 (25)
Bloemfontein 9300
South Africa/Suid-Afrika
www.ufs.ac.za

12. What are some of the challenges faced when teaching Technology?

THANK YOU FOR YOUR COOPERATION!

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Natural Sciences & Technology Education
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UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

APPENDIX D: LETTER OF APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE

Enquiries: KK Motshumi
Ref: Research Permission: Z Mobara
Tel. 051 404 9283 / 9221 / 079 503 4943
Email: K.Motshumi@fseducation.gov.za

education
Department of Education
FREE STATE PROVINCE

Z MOBARA
[redacted]
BLOEMFONTEIN, 9301

Dear Miss Mobara

APPROVAL TO CONDUCT RESEARCH IN THE FREE STATE DEPARTMENT OF EDUCATION

1. This letter serves as an acknowledgement of receipt of your request to conduct research in the Free State Department of Education.

   Topic: Enhancing technology literacy through assessment practices in the senior phase

   List of schools involved: [redacted]

   Target Population: Grade 7 – 9 teachers teaching technology learning area

2. **Period of research**: From the date of signature of this letter until 30 September 2018. Please note the department does not allow any research to be conducted during the fourth term (quarter) of the academic year. Should you fall behind your schedule by three months to complete your research project in the approved period, you will need to apply for an extension.

3. The approval is subject to the following conditions:

   3.1 The collection of data should not interfere with the normal tuition time or teaching process.

   3.2 A bound copy of the research document or a CD, should be submitted to the Free State Department of Education, Room 319, 3rd Floor, Old CNA Building, Charlotte Maxeke Street, Bloemfontein.

   3.3 You will be expected, on completion of your research study to make a presentation to the relevant stakeholders in the Department.

   3.4 The attached ethics documents must be adhered to in the discourse of your study in our department.

4. Please note that costs relating to all the conditions mentioned above are your own responsibility.

Yours sincerely

DR JEM SEKOLANYANE
CHIEF FINANCIAL OFFICER

DATE: 19/02/2018

APPENDIX E: LETTER TO SCHOOLS

APPENDIX E: Letter to Schools

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV EDUCATION OPVOEDKUNDE

[redacted]

[redacted]
Bloemfontein
9306
.../.../.....

The Principal

Dear Sir/ Madam

APPLICATION FOR CONDUCTING RESEARCH AT YOUR SCHOOL

I am an M.Ed student at the University of the Free State, doing research on the topic: **Enhancing Technology Literacy through Assessment Practices in the Senior Phase**. This study intends to explore the assessment practices in your Technology class to examine to what extent teachers promote the development of technological literacy through their assessment practices.

I hereby apply for permission to conduct research at your school. The aim of the study is to explore technology teachers' assessment practices in technology teachings. The study will focus on teachers' perceptions and intentions on assessment in Technology classes. These observations will make a meaningful contribution to the literature on Technology teacher assessment practices. The results of the research will be shared with the school.

I further request permission to observe no more than three (3) Technology lessons and conduct interviews with Technology teachers.

These interviews will not interrupt the normal school program. Informed consent will be requested from the teachers concerned.

Thank you for your kind cooperation. Your favourable response will be highly appreciated.

Kind regards

.....

Zaynab Mobara

M.Ed Candidate
University of the Free State
084 657 4454
zaynabmobara@gmail.com

APPENDIX F: INTERVIEW AND OBSERVATION DESIGN

Ms Wahida

Session Number	Interview and Observation Objectives
Initial introduction	Initially, the first contact session was a short briefing between the participant, the principal and the researcher. Thereafter, a session was requested whereby the participant and the researcher could interact on a one-on-one basis and observe a class. The researcher also requested details of the lesson that will be presented in the class that will be observed.
Session 1	Interview session - Discussion of the aims and objectives of the study in more detail. - Discussion on willingness of the participant which includes ethical considerations, what participation entails, the option to withdraw, and so forth. - Background of the participant must be obtained. - Background of the classes (grades, times, periods, etc.) - The researcher must also arrange for another session regarding activities and assessment processes. - The researcher also must request to see previous activities of the learners. Observation of teaching and learning practices (The researcher will observe a class where corrections are done) - Who marks the activity? Who provides the answers? How are correct answers given to the learners? How are learners provided with feedback? How do learners participate in the

	assessment activity? What happens if a learner does not do the activity?
Session 2	Observation of teaching and learning practices (The researcher will observe a class where learners develop their functioning bucket system for a well (grade 8)) - What is the teachers' role when learners are engaged in the development of the project? Who provides the resources? Where do learners work? Interview session - The researcher must discuss the methods of assessment, forms of assessment used and understanding thereof, themes and activities. - The researcher must gain clarity regarding the observed lesson. This included the materials used, feedback and responses. •
Session 3	Observation of teaching and learning practices (The researcher will observe a class where learners develop their functioning bucket system for a well (grade 8)) - Have learners brought additional materials? Where projects built at home? Have the learners adjusted their initial projects? Have their projects maintained their initial shape after they have been stored? Are learners willing to participate? How does the teacher assist the learners? Interview session - The researcher must discuss feedback methods, rubrics, memos, and the use of these assessment instruments - What are the teachers' sources of inspiration for assessment tasks? What are the challenges in completing assessment tasks? What are the teachers' views of the task?

	•
Session 4	Observation of teaching and learning practices (The researcher will observe a class where the learners submit their functioning bucket system for a well (grade 8)). - How are the projects collected? How long does it take? How is the class managed? Interview session - The researcher basis her discussion on the collection of the learners' activities, the marking process must be discussed (including comments and feedback), storage, time allocations to marking. - The participant must be asked about any contributions she would like to make regarding the observations, interviews, general comments or about the research and additional inputs. - The participant is also thanked for their contribution. •

Ms Athnan

Session Number	Interview and Observation Objectives
Initial introduction	Initially, the first contact session was a short briefing between the participant, the principal and the researcher. Thereafter, a session was requested whereby the participant and the researcher could interact on a one-on-one basis and observe a class. The researcher also requested details of the lesson that will be presented in the class that will be observed.
Session 1	Interview session

	- Discuss the aims and objectives of the study in more detail. - Discuss the willingness of the participant to contribute to the study. Include ethical considerations, what participation entails, the option to withdraw, and so forth. The researcher must also arranged for further timeframes regarding activities and assessment processes. - Background of the participant must be discussed. - Class observation and displaying of previous projects must be requested. Observation of teaching and learning practices - How are the learners divided into their respective groups? What are the requirements for their project (i.e. the robot or the wire loop game)? Did the learners bring their materials and tools to schools? Had the learners already begun working on their projects?
Session 2	Observation of teaching and learning practices - The researcher must observe the role of the teacher in the class; how she provides assistance, if learners ask for assistance, have they changed their projects? What is creative about the projects? Interview session - The researcher must discuss the methods of assessment, forms of assessment used and understanding thereof, themes and activities, etc. - Clarity must be given regarding the observed lesson. This included the materials used, feedback and responses.

	- Classroom management must be discussed from previous observation. •
Session 3	Observation of teaching and learning practices - The learners in their respective groups will present their projects to Ms Wahida (the robot or wire loop game). - The researcher must observe feedback methods, assessment methods and the overall enthusiasm of the class and the teacher. Interview session - The researcher must discuss the feedback methods and assessment methods with the participant. (Frustrations, such as the displaying of projects in the class, could arise). - The participant must be asked about any contributions she would like to make regarding the observations, interviews, general comments or about the research and additional inputs. - The participant must be thanked for her contribution and willingness to participate. •

Participants engaged in open-ended questionnaires

- After participants had returned the questionnaire to the researcher, the researcher analyzed the data. The researcher then called participants and/or arranged follow-up meetings to clarify any data.