Interpretation and enactment by teachers of the interrelatedness of Technology-Society-Environment and other themes of the Technology curriculum

by

Elliot Charles Ndlovu

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Supervisor: Prof M W H Braun

Co-supervisor: Dr W J Rauscher

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ABSTRACT

Interpretation and enactment by teachers of the interrelatedness of Technology-Society-Environment and other themes of the Technology curriculum

This descriptive case study focuses on how Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment (TSE) theme with the Technological Process and Skills (TPS) and Technological Knowledge and Understanding (TKU) curriculum themes of the South African school subject, Technology. Science and technology have influenced society in the twentieth and twenty-first Century to a considerable extent. A critical study of this group of related influences is termed Science-Technology-Society and addresses socially relevant topics that encourage critical and high level thinking skills, problem-solving and decision making capacity. These issues are included in the Technology curriculum as the TSE theme. Using the TSE theme in teaching would have the potential to make the curriculum more relevant and learning more meaningful as it provides scope for teachers to engage learners to construct knowledge at a critical level in different real life contexts.

This study investigated the relationship between teachers' understanding of the interrelationship of TSE with Technological Process and Skills (TPS) and Technological Knowledge and Understanding (TKU) themes and the extent to which the unique features and scope for teaching Technology are met. The study was set in Bohlabela district of the province of Mpumalanga, in South Africa and implemented between August 2011 and April 2012. Four teachers of different schools and circuits were interviewed, three were observed during teaching, their lessons, work schedules and learners' workbooks and project portfolios were analysed. A novel combination of an adaptation of the Ben-Peretz scheme of curriculum document analysis and Rogan and Grayson construct of implementation frame was used in the analysis of the information obtained through documents and observations.

The study established that only in exceptional cases teachers use learner centred approaches that allow the integration of the TSE theme with the process (TPS) and knowledge (TKU) themes. Evidence was found that while teachers planned such integration, learners themselves do not show any examples of such integration in their workbooks. Teachers have difficulties with specific knowledge areas of the Technology curriculum, in spite of formal adequate basic training in the subject. Teachers ascribe these difficulties to resource limitations, the absence of specific technology training and inadequate support by teacher support personnel.

It is recommended that teacher support groups be established, and that the Department of Education develop specific curriculum materials and train teachers in the interpretation and enactment of the documents.

Key words: technology; technology curriculum; science and technology; science-technology-society-environment; technology-society-environment; interrelationship; interpret; enact; planning; design process.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACE	Advanced Certificate in Education
CAPS	Curriculum, Assessment Policy Statement
C2005	Curriculum 2005
DoE	Department of Education
FDE	Further Diploma in Education
FET	Further Education and Training
GET	General Education and Training
IDMEC	Investigate, Design, Make, Evaluate and Communicate
IKS	Indigenous Knowledge systems
JPTD	Junior Primary Teachers' Diploma
LO	Learning Outcome
MEd	Master of Education
NCS R-12	National Curriculum Statements Grade R - 12
NCS 10-12	National Curriculum Statements Grade 10-12
NGO	Non-Governmental Organisation
OBE	Outcomes Based Education
RNCS R-9	Revised National Curriculum Statements Grade R-9
SAASTE	South African Association of Science and Technology Education
SPTD	Senior Primary Teachers' Diploma
SSE	Science-Society-Environment
STD	Secondary Teachers Diploma
STS	Science-Technology-Society
STSE	Science, Technology, Society and Environment
TKU	Technological Knowledge and Understanding
TPS	Technological Knowledge and Skills
TSE	Technology-Society-Environment

CHAPTER 1

INTRODUCTION AND OUTLINE OF THE RESEARCH

1.0 Introduction and background

This study is a descriptive case study focusing on how Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment (TSE) theme with the Technological Process and Skills (TPS); and Technological Knowledge and Understanding (TKU) curriculum learning themes.

Technology Education emerged as a subject in its own right in many countries in the past three decades (Jones, Buntting and de Vries, 2011). Technology is a relatively new subject in the South African curriculum and was not catered for in the general schooling system prior 1998. Even though Technology was introduced in schools, there were no teachers to teach the subject, as teachers did not have formal training in Technology Education. The Department of Education (DoE) relied on pilot programmes run by non-governmental organisations (NGO) to capacitate teachers. The subject itself has concepts that were new to teachers and difficult to conceptualise, as it needed a background of Mathematics, Science and vocational subjects. Most teachers did not have the background of all of these subjects. This led to some schools not giving much priority or value to Technology compared to Mathematics and Science (Williams, 2011).

In Africa, Science and Technology feature as central subjects in the school curricula in developing countries of sub-Saharan Africa (Hattingh, 2004). Science and Technology have influenced the twenty-first century society to a considerable extent (Cheek, 1992). A critical study of this group of subjects with related influences is known as Science-Technology-Society (STS). STS addresses socially relevant topics that encourage critical and high level thinking skills, problem solving and decision-making capacity (Zoller, Donn, Wild and Beckett 1991, in McGinnis and Simmons, 1999:180). The decision-making capacity contributed towards the shift from socio-economic issues to include and focus on moral-ethical issues relating to the environment. The shift has seen STS expanding to Science-

Technology-Society-Environment (STSE) (Jones et al., 2011). Environmental issues became a global concern during late 20th century and have continued into the 21st century.

In South Africa STS forms part of the Technology curriculum as specified in the Revised National Curriculum Statements (RNCS) of 2002 (DoE, 2002b), as well as in the most-recently gazetted National Curriculum Statements (NCS) of 2011 (Department of Basic Education, 2011).

In the Science and Technology learning areas, specific sections address the Science-Technology-Society-Environment which relate to Learning Outcome 3 in Technology, for example Technology-Society-Environment (TSE) (DoE, 2002b). Technology Education shares elements of knowledge, skills, capability and competencies, attitudes and values with the Outcomes Based Education (OBE) philosophy of the national curriculum (Reddy, Ankiewicz, De Swardt and Gross, 2003:27).

The national curriculum has changed since 1994. The first curriculum that introduced Technology as a "learning area" (or broader subject) was Curriculum-2005 (C2005). C2005 was replaced by the Revised National Curriculum Statement (RNCS) Grades R-9 (DoE, 2002b) and National Curriculum Statements (NCS) Grades 10-12 (DoE, 2004). In 2009 the ministry of the Department of Basic Education (DBE) appointed a task team to review the RNCS of 2002 and NCS of 2004 (DBE, 2009). The task team recommended the streamlining and strengthening of the curriculum that resulted in the introduction of the Curriculum Assessment Policy Statements (CAPS). However, the RNCS Grades R-9 remains valid until 31 December 2012 for Grades 4-6 and 31 December 2013 for Grades 7-9 (DBE, 2011).

The National Curriculum Statements (NCS) represents a policy that comprises inter alia, the Curriculum Assessment Policy Statement (CAPS) for all approved subjects. The individual curriculum documents of the 2011 form of NCS are still referred to as the Curriculum Assessment Policy Statement for each subject, the use of "CAPS" when referring to the curriculum document of an individual school subject should cause no confusion. Table 1.1 outlines the similarities of the RNCS and CAPS.

Table 1.1 shows that CAPS retains the theme of TSE as a focus area with aspects of indigenous technology, and with the impact of technology and bias in technology as defined in Learning Outcome 3 of the RNCS. The introduction of CAPS brings some minor changes to terminology and structure where, for example, "learning outcomes" (LO) are now called specific aims. The integrated theme of Technology-Society-Environment (TSE) was initially part of Learning Outcome 3 (LO3) in the RNCS. TSE is viewed in the literature as science and technology education embedded in all relevant social contexts and explicitly links the contribution of science and technology to social justice, society, the environment and economic development (DoE, 2002b; Naidoo, 2010).

Table 1.1. An outline of the similarities of RNCS and CAPS
(*Adapted from DoE (2002a) and Department of Basic Education (2011)*)

RNCS		CAPS
Learning Outcomes (LO)	**Broad descriptions of learning outcomes**	**Topics and Core Content Areas**
LO1: Technological processes and skills (TPS)	Learners are able to apply technological processes and skills through investigating, designing, making, evaluating and communicating	The design process skills: 1. Investigation 2. Design 3. Make 4. Evaluation 5. Communication
LO2: Technological Knowledge and Understanding (TKU)	Learners are able to understand and apply relevant technological knowledge ethically and responsibly in structures, processing and systems and control	Structures Processing of materials Mechanical systems and control Electrical systems and control
LO3: Technology, Society and the Environment (TSE)	Learners are able to demonstrate an understanding of the interrelationships between science, technology, society and the environment to ensure that learners are aware of indigenous technology and culture, impacts of technology and biases created by technology	Technology, Society and the Environment. 1. Indigenous technology 2. Impact of technology 3. Bias in technology

1.1 Rationale and purpose of enquiry

The Technology curriculum (as applicable to Grades 7-9, the General Education and Training or GET band) is based on three broad themes: Technological Process and Skills, Technological Knowledge and Understanding, and Technology, Society and Environment (hereafter, identified as Technology-Society-Environment in this study) since the Revised National Curriculum Statements (RNCS) was introduced (DoE, 2002a). These themes form the knowledge base for the subject Technology as they reflect the purpose, unique features and scope for the Technology curriculum (DoE, 2002b). Teachers are expected to interpret

and develop the meaning of these themes in an interrelated manner, to plan for teaching and learning activities (Magano, 2009; DoE, 2002b).

The Technology-Society-Environment (TSE) theme sets the context for teaching Technology in the classroom (DoE, 2002b). Teaching using the TSE theme has the potential to make the curriculum more relevant and learning more meaningful as it provides scope for teachers to engage learners with different real life contexts in constructing knowledge (Naidoo, 2010).

According to Potgieter (2004), some teachers are familiar with the concepts, processes, contents and methods associated with Technology Education. Several studies concerning approaches and methodologies for teaching Technology Education have been conducted. These include Ankiewicz, De Swardt and Stark (2000); Mettas and Constantinou (2007); Reddy, Ankiewicz and De Swardt (2005); and Van Loggerenberg (2000). However little is known about how teachers actually conform to the requirement of the RNCS or take advantage of the opportunity to employ an integrative approach as part of their teaching strategy of the themes. There is a need for a study on the relationship between teachers' understanding of the interrelationship of TSE with Technological Process and Skills (TPS) and Technological Knowledge and Understanding (TKU) themes and the extent to which the unique features and scope for teaching Technology are met.

The aim of this study was to establish how teachers interpret and enact the interrelatedness of Technology themes from the TSE perspective.

1.2 Statement of the problem

From the afore-going, it is clear that Technology teachers should be teaching Technology using an integrative approach to realise the interrelationship of the themes from the TSE perspective. However, teachers seem not adequately trained to realise this in their approach. This study attempts to investigate this problem.

1.3 Aim and Objectives

The aim is to determine how teachers of Technology interpret curriculum documents and enact their planning and teaching of the Technology curriculum themes with a particular focus on the Technology-Society-Environment theme in an interrelated manner.

The study intends to achieve the following objectives.

1. To determine how teachers interpret Technology Education within the context of TSE, which may identify the kind of influence it has in their teaching practice.
2. To investigate the manner in which Technology teachers enact the interrelationship of TSE with the other Technology themes, so as to establish their view of the importance of teaching Technology Education within the broader context of technology.
3. To identify the types of methods Technology teachers use when teaching Technology themes.
4. To establish the successes and/or failures that Technology teachers experience in interrelating TSE with other Technology themes.
5. To establish the barriers that Technology teachers may experience in interrelating the Technology themes.

1.4 Research questions

1.4.1 Main research question

How do Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment (TSE) theme with the other learning themes in the Technology curriculum?

1.4.2 Sub-questions

1. How do Technology teachers interpret TSE in the Technology curriculum?
2. How do Technology teachers link TSE to the other themes in Technology?
3. How do Technology teachers approach the themes from a pedagogical perspective?
4. What are successes and failures in interrelating the TSE theme with the TPS and TKU themes?

5. What barriers do teachers identify in their intentions and attempts to teach the relationship between TSE and other themes?

1.5 Significance of the study

The study may assist in providing information that teacher trainers and support specialists in Technology can use to help teachers identify and articulate the interrelationship of the Technology themes through their planning of learning activities and during teaching.

1.6 Limitations

The study is limited to qualitative methods and case study design. The study focuses on four cases, which involved two novice (grade 7 and 9) teachers and two experienced (Grade 7) teachers from four different schools in Mpumalanga Province. The findings of this study cannot be generalised, but could assist to frame future research questions similar to the ones in this study.

1.7 Explanation of key terms

This study rests on the following concepts:

- *Interpret*

In Booyse and Du Plessis (2008:51), the word interpret is associated with the word "interpreter" which originates from the Latin word "interpretari*"* which means "the ability to make sense of, explain, clarify, spell out, simplify, paraphrase, decode translate, unravel and decipher". The term in this study refers to the ability teachers have to make sense of the Technology themes during planning and teaching.

- *Interrelatedness*

According to Collins dictionary the concept "interrelatedness" emanates from the concept interrelate which means there is a connection between them and they have an effect on each other (Collins, 2006). The concept interrelatedness is synonymous to the concept

interrelationship, which means having mutual or reciprocal relationship interconnectedness. The reality in this case is that teachers are expected to realise the importance of interrelating the Technology themes during planning and teaching.

- *Science, technology and society (STS)*

Science, Technology and Society is defined as teaching and learning science in the context of human experience, which is an appropriate way of teaching as it provides an effective learning environment (Lee and Erdogan, 2007:1316).

- *Technology*

There are a number of definitions of technology found locally and internationally (Reddy, 1995:14). This study utilises the definition given by DoE (2002b:4) in which Technology is defined as "the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems taking social and environmental factors into consideration". This definition was chosen because of its relevancy to the study.

- *Technology Education*

Technology Education is defined as "an activity which involves investigating peoples' needs in the contexts of the home, school, community and larger environment. When identifying, designing, making and evaluation of their ideas, children need to consider the economic, moral, social and environmental consequences of their ideas and innovations", (Reddy, 1995:14). It also concerns technological knowledge and skills, processes and understanding the impact of technology on the individual and society (DoE, 1996:12)

- *Technology as a subject*

The Technology subject, or the subject of Technology, or the Technology curriculum, refers to the explicit curriculum taught in a school or other educational institution and seeks to develop knowledge, skills, values and attitudes associated with the body of knowledge and activities of Technology. The term technology used with capital letter **T** in the study defines technology as a subject or subject of technology or the technology curriculum. The term technology used with small letter **t** in the study defines the general application of technology in society.

1.8 Conclusion and structure of the dissertation

Chapter 1 outlines the status of the Technology as a subject in the school curriculum and how Technology relates to science and technology to address Science-Technology-Society issues. The chapter presents the rationale and purpose of enquiry into the teachers of the Technology-Society-Environment theme in teaching. The chapter highlights the challenges that teachers could face in integrating the Technology themes during planning and teaching. The chapter presents the objectives that translate into research questions, and the significance of the study.

Chapter 2 presents a review of the literature that is directly relevant to the study. This chapter sets the foundation for the conceptual and analytical frameworks that were used to produce a report on how Technology teachers understand and enact the interrelatedness of Technology themes from a Technology-Society-Environment perspective.

Chapter 3 outlines the research design, the sampling methods, data collection methods and instruments and data analysis strategies used in this study.

Chapter 4 outlines and presents the data and its analysis. The chapter bases its analysis on the strategies outlined in Chapter 3. This chapter engaged in the research questions in Chapter 1 to cluster the responses that helped in coding, categorising and formulating the themes that provide the frame for interpreting the data in this study. The chapter presents discussions on the findings.

Chapter 5 provides the summary of the major findings and the overall conclusion of the study as linked to the research questions. The chapter reflects on the study and discusses its limitations. It provides suggestions and recommendations for further investigations based on the findings and limitations.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The chapter discusses the literature to elucidate the nature of technology, its philosophy, its relationship with science, the role it plays in STS and in curriculum implementation. This chapter draws on literature to help build on the framework of the study. The literature helps to identify the related schemes and theories that are used to understand how teachers interpret and enact the interrelatedness of the theme Technology-Society-Environment with the other themes in Technology during planning and teaching.

2.1 Technology and the philosophy of technology

The philosophy associated with any discipline and its realisation as a teaching subject is important. Technology is a relatively new subject in the South African curriculum and was not taught in our general schooling system before 1998. Technology has emerged as a school subject in many countries as recently as the past two or three decades (Williams, 2011; Jones et al., 2011). This is attested to by an analysis of the Technology Education curriculum in the six developed countries Australia, England, France, the Netherlands, Sweden and the United States (Rasinen, 2003). The subject's philosophy compared with other discipline is relatively young and its emergence comes from the background of technological practice and engineering (Jones et al., 2011).

Four modes are identified as main modes of interest in the philosophy of technology. They are technology as artefact, technology as knowledge, technology as activities and technology as part of being human (Mitcham, 1994; de Vries, 2007). The modes blend or interlink to enrich Technology Education activities. This study will utilise all four modes for the inquiry as they are embedded in TPS, TKU and TSE themes in Technology. The following section presents the relationship between science and technology.

2.2 Technology education and the relationship between science and technology

Vocational programmes as in science, technology, engineering and mathematics education (STEM) are associated with Engineering education and Technology Education as a component of general education (Williams, 2011). Technology has its roots in education through these vocational and craft programmes (Stevens, 2009). Since then a strong link has developed between science and technology (Jones et al., 2011:7). Ankiewicz, De Swardt and De Vries (2006:119) point out that an epistemological relationship exists in the nature of technological knowledge and knowledge of the natural sciences. Technology brings context into science knowledge when science knowledge is simplified through the process of contextualisation and decontextualisation into a real life situation. These processes help in articulating practical technology tasks (Sidawi, 2009). According to Layton (1993), the partnership between science and technology provides a missing link through the process of recontextualisation.

Science and technology have their differences. The laws of science help to understand the universe, whereas the rule of technology provides the bases for design (Layton, 1974). The fundamental difference between science and technology is reflected in the "values, knowing and doing" that relate to the purpose of each discipline (Layton, 1974:40; and France, Compton and Gilbert, 2011:383). France et al. (2011) emphasised that this difference has implications in the practice of science and technology disciplines. Sjoberg (2003:2) argues that even though science and technology are different they relate as "forms of knowledge" and as "forms of activities" which describe their status as disciplines. Van Loggerenberg (2000:172) indicates that the disciplines of science and technology are often combined in the phrase "science and technology" as though they connote a single entity, yet they are disciplines in their own right and their components take shape independently. Williams and Williams (1996:42) note that the relationship between science and technology is "a useful one but not a dependent one" unless societal issues are taken into account. Taking the social implications into account the study of the science and technology relationship extends to the field of science, technology and society (Ankiewicz et al., 2006:83).

The section that follows emphasises the link between Science-Technology-Society in relation to the environment.

2.3 Links between Science-Technology-Society in relation to the environment

Science-Technology-Society (STS) is viewed in the literature as the study of how social, political and cultural values affect scientific research and technological innovation, and how in turn they affect society, politics, economy and culture (Cheek, 1992; Pedretti, 2005; Sjoberg, 2003; Jones et al., 2011). However, here the interest in STS lies more on the variety of problems and their relationships to scientific and technological innovations (Sjoberg, 2003:2). The scientific and technological innovations assist in realising existence of the socio-technological relationships between technical objects, the natural environment and social practice as centred in STS (Ropohl, 1997:70). Although Zeidler, Sadler, Simmons and Howes (2005) argue that while STS emphasises the impact of scientific and technological development on society, its focus on the moral and ethical issues is not explicitly embedded in decision-making. In the past four decades, the STS approach has expanded to Science, Technology, Society and the Environment (STSE) to emphasize the environmental aspects (Predretti, 2003; Jones et al., 2011). The STSE programs can be developed to interpret science and technology as socially embedded enterprises and to promote the development of a technologically literate citizenry who are capable to understand STSE issues (Predretti, 2003).

The literature reveals that there are few studies conducted on conceptualisation of environmental principles in the technology classroom (Elshof, 2009). However, there are two basic approaches to consider (identified in Elshof, 2009:249) in environmental education.

> 1) The traditional behaviour modification approach, that aims at prescribing certain of the pupils' behavioural patterns, and that we believe will contribute to solving current environmental problems.
> 2) The action competence approach, that relates to developing a critical, reflective and participatory approach, which the developing adult can cope with in future environmental problems.

In view of these approaches, Elshof (2009) suggests that when considering the environment in Technology education most Technology teachers are aligned with the behaviour

modification approach. The behaviour modification is concerned with teaching learners to use materials, to design products and to avoid creating more waste products Elshof (2009).

In the South African RNCS, STSE is addressed in learning outcome 3 in the Natural Sciences and Technology curricula. In the Natural Sciences curriculum STS is referred to as Science, Society and Environment (SSE) and in the Technology curriculum STS is referred to as Technology-Society-Environment (TSE) (DoE, 2002b). This study focuses on the "Interpretation and enactment by teachers of the interrelatedness of the theme Technology-Society-Environment (TSE) with the themes Technological Processes and Skills (TPS) and Technological Knowledge and Understanding (TKU)". These were investigated under the auspices of TSE. The section that follows focuses on the societal aspects that evolve human kind.

2.4 Technology education and human kind

The assumption that STS has an interdisciplinary approach to science education with a seamless integration of economic, ethical, social and political aspects of scientific and technological developments implies that it is centred on "human kind". According to Hattingh (2004:194), "human kind" has needs, since the existence of technology people used a combination of knowledge, skills and available resources to develop solutions to address their needs. Technology and its development changes continually as new needs develop as the result of the interaction of societal development and technological development (Ankiewicz and De Swardt, 2006).

If Technology teachers could understand the societal and technological developments within the context of TSE of RNCS, and could interpret and bring them into the interrelated activities during lesson planning and teaching, then the aims of the curriculum could be met with success. This idea is supported by the view that technology as a characteristic of humanity reflects the values that are related to design. These values are central components to its products and its processes as they represent the embodiment of culture (Jones et al., 2011; Gauteng Department of Education, 2005). These values in design are important for Technology education because it informs how technology is shaped by, but also shapes,

humans, human culture and society (Jones et al., 2011). The section that follows focuses on the values that are embedded on TSE context.

2.5 Technology education and value judgement within the context of TSE

Dakers (2006:209) discussed the various categories of value judgements extensively, and this should be considered when designing products. These value judgements are identified as technical, economical, aesthetical, environmental, moral, spiritual/religious, intellectual and social (Dakers, 2006 and Reiss, 2009). Dakers (2006:209) further classified these values into two categories: (1) technical, economical, aesthetical and environmental values as part of the design process and (2) moral, spiritual/religious and social as forming part of the society. The categories of values are also distinguished from virtues which are personal qualities and attitudes which are acquired tendencies to make judgements (Reiss, 2009).

In the South African RNCS, these value judgements can be realised in three aspects identified in the TSE theme of the Technology curriculum, namely indigenous technology and culture, impacts of technology and biases created by technology. The paragraphs that follow expand on each of these aspects.

2.5.1 Indigenous technology and culture

This aspect has crucial implications for Technology curriculum as it links with modern technology to enhance understanding of technology (Maluleka, Wilkinson and Gumbo, 2006). Indigenous technology forms part of the concept of "technology as a characteristic of humanity" as it exposes "how technology is shaped by humans, culture and society" (Jones et al., 2011). De Vries (2005) pointed out that different philosophical traditions have developed their own perspective on the interactions between humanity and technology. In the light of this, the designers in technology need to take into consideration issues of indigenous technology as part of the indigenous knowledge systems (IKS). According to Onwu and Mosimege (2004) indigenous knowledge supports a combination of traditional knowledge and other knowledge systems like technology, social, economic and philosophical learning or educational legal and governance systems. Onwu and Mosimege (2004:2) noted that this inclusive knowledge is essential for existence, survival and adaptation in different

environments. Odora Hoppers (2002) emphasised indigenous knowledge (IK) within the arts. For instance, it is not just about woven baskets and handcraft for tourists or traditional dances per sé – Rather, it is about identifying and discovering the technologies behind the practices and artefacts. Layton (1996:39) accentuated the integration of knowledge of previous technological achievements with the cultural variety of technological responses to problems-which is reflective of technology in the real world. Consequently teachers of Technology should be encouraged to include indigenous technology during planning and teaching to harness the "inclusive curriculum principles" (Maluleka, Wilkinson and Gumbo, 2006:510).

2.5.2 Impacts of technology

This aspect is very important to address the values in technology to reveal the impact the products produced have on the way people live and behave in the society (Dakers, 2006). According to the DoE (2002b:9) values, beliefs and traditions shape the way people view and accept technology, and this may have major influence on the use of technological products. According to Williams and Williams (1996:31), the problems that technology brings do not arise from technology itself but rather from conflicts that arise when the technology is put into use.

When products in technology are developed, learners should know what the product's potential impacts could have in society, so Technology teachers should foster the interrelation of themes in their teaching and planning.

2.5.3 Biases created by technology

The aspect of biases created by technology concerns the influences of technology on values, attitudes and behaviours. The aspect of biases addresses the value systems in technology. Every society is governed by its culture, beliefs and norms, these have an impact on choosing technology products-which might be able to answer societal questions like, "is the product appealing to all or restricted to just one sex or to the able-bodied?" (Dakers, 2006:210). Therefore, the costs and benefits of the choice must be taken into account. Designers need to be aware that societies share cultures and norms, and to compromise accordingly to avoid escalation of biases in designs. Williams and Williams (1996:32) suggested that tolerance of the range of values and determination to make creative use of the tensions between human

need values and technological advancement values, would represent the path to the resolution of conflict.

In light of this suggestion, when products in Technology are developed in the classroom, teachers should integrate appropriate activities during planning to ensure that learners consider their biases in society and observe this aspect of TSE. This aim can be realised if teachers have the knowledge and are prepared to incorporate TSE in their planning Hodson, (2009).

There are however, challenges that might exist in the implementing these aspects of Technology that cannot be overlooked, as implementation would depend on how the aspects of TSE are interpreted and enacted during planning and teaching. In addition, Technology teachers could accomplish this by exploring various methods and approaches in their teaching. Hodson (2009:272) feared though that some teachers might remain uncommitted to the approach as they could perceive it as a diversion from the content. The subsequent section explores some of these implementation challenges.

2.6 Technology education implementation and its challenges

Implementing Technology nationally and internationally poses various challenges, which affects its teaching (Wicklein, 1993:60; Potgieter, 2004; Rauscher, 2009). Some of the challenges such as curriculum development approaches, the knowledge base of Technology Education and interdisciplinary approaches to teaching Technology are discussed in the sub-sections that follow.

2.6.1 Curriculum development approaches for Technology Education

The view of curriculum development as a wide-ranging phenomenon sees the overall character of national curricula varying among countries in their specificity and binding nature (Booyse and Du Plessis, 2008; Turja, EndepohIs-Ulpe and Chatoney, 2009:3). According to Turja et al., (2009:3) these national curricula, serve as general frameworks for local curricula and it gives educational latitude for teachers. The general frameworks are realised on the five levels of curriculum development highlighted by Van den Akker and Thijs (2009) as supra, macro, meso, micro and nano (Table 2.1).

Table 2.1. Descriptions of curriculum levels (adopted from Van den Akker and Thijs, 2009)

Levels		Description	Examples
1.	SUPRA	International	Common European Framework of Reference for Languages
2.	MACRO	System, national	Core objectives, attainment levels
			Examination programmes
3.	MESO	School, institute	School programme
			Educational programme
4.	MICRO	Classroom, teacher	Teaching plan, instructional materials
			Module, course
			Textbooks
5.	NANO	Pupil, individual	Personal plan for learning
			Individual course of learning

These levels are based on the four curriculum types, which are the official, intended, implemented and experienced curriculum (Van den Akker and Thijs, 2009; Brown, 2009). Brown (2009:10) defines the relationships between the intended, the actualised, the experienced curricula and the official curriculum as the factor in the relationship between the curriculum that exists in the classroom and the one that exist in the teacher's mind.

Brown (2009:11) defines each curriculum type as follows.

1. The official curriculum [comprises the] national, state and district level standards and frameworks for the study of Technology Education. Intended curriculum is the curriculum that is written into the teacher's plan.
2. The implemented curriculum is what teachers actually do in their subjects in the classroom.
3. The experienced curriculum consists of those things that a learner chooses to emphasise, elaborate on, ignore, or omit during learning.

This study focuses on the micro level of curriculum development based on official, intended and implemented curricula within the context of South African Technology Education curriculum as specified within the RNCS, grade R-9. The South African Technology curriculum in the General education and training (GET) band for learners Grade R – 9 was pioneered with the likes of Design and Technology curriculum of the United Kingdom (England and Wales) and those of Commonwealth countries such as Australia and New Zealand (Stevens, 2009). However, in spite of South African Technology curriculum drawing extensively on the countries' curricula mentioned above, it is not easy to identify its position

within the de Vries categories (Stevens, 2009:131). Stevens (2009:131) suggests that the intended curriculum may be that of the design approach (design process) but being implemented as more of the craft-oriented approach with aspects of the STS approach crafted on.

Technology teachers at micro level interact with curriculum frameworks to develop instructional materials such as lesson plans, worksheets, work schedules and learning programmes for enactment in the classroom. The following paragraphs outline the South African Technology curriculum framework

2.6.1.1 The official curriculum at National, Provincial and District Level

The Technology curriculum learning area statement outlines the scope of Technology in three major themes that form the base of the three learning outcomes as described in subsequent paragraphs.

Technological processes and skills

DoE (2003, 2006) regard the technological process and skills as the backbone of the Technology learning area. The theme is associated with a problem solving approach. During technology activities, a learner engages in investigating, designing, making, evaluating and communicating solutions (IDMEC). When used together these activities are known as the "design process" (DoE, 2002b). The IDMEC activities give rise to specific assessment standards for the theme.

Technological knowledge and understanding

This theme is addressed in learning outcome 2, of which the three major content areas described in this theme are:

1. Structures - teaching and learning activities focuses on practical solutions that involve supporting loads and ways of making products that are stiff, stable and strong when forces are applied to them;
2. Processing - teaching and learning activities focuses on practical ways in which materials may be processed or manufactured to improve their properties to make them more suitable for their intended use.
3. Systems and Control - this content area is divided into mechanical systems (including hydraulic and pneumatic systems) and electrical and electronics

> systems. The teaching and learning activities focus on producing movement in some way, and examine how energy sources can be used to power products to produce movement, and the practical use of electrical energy in circuits to satisfy specific needs (DoE, 2002b:8).

The three major content areas in this theme are also regarded as the means of defining the assessment standards on each of the topics.

The interrelationship between, society and the environment

This theme is described in Learning Outcome 3, and is regarded as the context of the technology learning area. The aspects addressed in this theme are:

1. Indigenous technology and culture-changes in technology over time, indigenous solutions to problems.
2. Impacts of technology-how technology has benefited or been detrimental to society and the environment.
3. Biases created by technology – influences of technology on values, attitudes and behaviours (DoE 2002b:9).

This theme embraces all technological developments taking place in an "economic, political, social and environmental context" (DoE, 2002b:9).

2.6.1.2 Intended curriculum-choices that teachers make

According to DoE (2003:1),

> Curriculum and teacher development theories and practices in recent times have focused on the role of teachers and specialists in the development and implementation of effective teaching, learning and assessment practices and materials.

This statement suggests that it is the responsibility of the teacher to interpret the official curriculum and plan for the next phase of implementation of the curriculum (Booyse and Du Plessis, 2008). According to Werner (1993), interpreting the curriculum material is a skill that teachers need to cultivate and learn to adapt the curriculum materials to suit the given context. Fox-Turbull (2006) added that teachers need to design activities that are purposeful within a social framework or context. However for teachers to plan and implement lessons that are based in an authentic context they must demonstrate a good understanding of the Technology curriculum. Killen (2000) and Van Niekerk, Ankiewicz and De Swardt (2010) identified four principles that inform planning as the outcomes, the content and the process

teachers employ to achieve the outcomes. These principles are very important for curriculum planning and implementation.

2.6.1.3 The implemented curriculum

This type of curriculum is more visible than the official and intended curricula (Brown, 2009). The teacher applies different approaches to execute the intended curriculum in the classroom.

2.6.2 The knowledge base for Technology Education

Knowledge in any subject matter is fundamental, as it is regarded as an integrated body of information in a subject (Maluleka, Wilkinson and Gumbo, 2006; Mishra and Koehler, 2006). Technology Education has its own knowledge base (Williams and Williams, 1996:11; Jones and Moreland, 2004:123). This includes knowledge of the nature and content of technology itself (content knowledge), pedagogical knowledge of approaches and practices to teach Technology or Technology subjects, and pedagogical content knowledge (Gudmundsdottir and Shulman, 1987).

Mitcham (1994) identifies technology as ‘knowledge’ and the mode in which technology is manifest as the subject of analytical investigations in the epistemology or theory of knowledge. Vincenti (1984) categorised technological knowledge into descriptive, prescriptive and tacit - descriptive knowledge describes things as they are, prescriptive knowledge what is to be done to achieve desired results and tacit knowledge is contained in activity. The categorised technology knowledge also has an impact on understanding the technological knowledge levels and types. Technology as knowledge can be differentiated according to various levels and types of knowledge. Pavlova (2005:135) identifies knowledge levels as artisan skills, technical maxims, descriptive laws and scientific theory structured from little to more conceptual knowledge. McCormick (1997:143; 2004:24) describes the knowledge types as, conceptual knowledge (knowing that) and procedural knowledge (knowing how to). McCormick (2004) outlines procedural knowledge as associated with aspects such as design, problem solving, planning systems, analysis (or systems approach), optimisation, modelling, strategic thinking and conceptual knowledge as concerned with the relationships amongst items of knowledge, such as systems concepts. The knowledge levels and types described by Pavlova (2005) and McCormick (2004) suggest that these knowledge

levels and types are crucial for Technology teachers to master in their planning and teaching by showing the interrelationships that exist.

The understanding of these levels and types of knowledge by Technology teachers may be or not seen through the teachers' operation in various knowledge dimensions. They are knowledge about technology, knowledge within technology and general technological pedagogical knowledge (Moreland and Jones, 2000; Mishra and Koehler, 2006; Pavlova, 2005). Mishra and Koehler (2006:1028) simplified these knowledge dimensions in Table 2.2 below.

Table 2.2. The knowledge dimensions of Technology Education.
(*Adapted from Mishra and Koehler, 2006:1026*)

Knowledge dimension	Description of the dimension
1. Content knowledge	Knowledge about the actual subject matter that is to be taught Teachers must also know and understand the central facts, concepts, theories and procedures within the given field
2. Pedagogical knowledge	Knowledge about processes and practices of teaching and learning. It is involved in all issues of students learning, classroom management, lesson plan development and implementation, and learner evaluation
3. Pedagogical content Knowledge	Knowledge of pedagogy that is applicable to the teaching of specific content It is the skill of teaching a specific content in context

2.6.3 Interdisciplinary approaches to teaching Technology

Technology and its nature is cross-curricular and interdisciplinary in approach, it offers an opportunity for connections with other subjects in a school curriculum (Ankiewicz, De Swardt and Stark, 2000; Erekson and Shumway, 2006; Van Loggerenberg, 2000; Potgieter, 2004). In addition, Technology Education is hands-on and minds-on and allows theories and abstract concepts taught in other subjects to be put into practice (Ankiewicz et al., 2000:35). The methods of teaching play an important role in drawing material from across the curriculum to support learners' attempts to solve real life problems. The section that follows presents the approaches that constitute the teaching of Technology.

2.7 Teaching approaches in Technology Education

Jones (2003:93) views the nature of technology as the technological activity that necessitates a technological practice. Given the nature of technology, teachers of the Technology subject are required to use a variety of different pedagogical approaches and instructional strategies to complement the unique requirements of the curriculum (DoE, 2003; Mawson, 2003; Reddy et al., 2005; Rohaan, Taconis and Jochems, 2010; Mapotse, 2012). Boser, Palmer, and Daugherty, 1998, (in Rohaan et al., 2010:20) classify some of the typical approaches used in Technology Education into four categories:

1. The industrial arts approach, focusing on understanding of industrial technology and the use of tools, machines and materials
2. The integrated approach, incorporating other disciplines such as science and social sciences
3. The modular approach, consisting of individualised, action-based units of instruction
4. The problem solving approach, in which critical thinking and creative thinking are emphasised.

The problem solving approach featuring project-based learning form part of the teaching strategies in the teaching of Technology in the South African context which emanate from the overall goals of the Technology Learning Area activities in the GET band (DoE, 2002b:4).

Technology activities are project-based by nature. The project-based approach is the recommended approach for teaching Technology in South Africa (DoE, 2003:26). More emphasis in this study is placed on the problem-solving approach, which embraces project-based learning, and is aimed at engaging learners with real life problems to enhance learning (Mettas and Constantinou, 2007; Hattingh and Killen, 2003; Middleton, 2009). Project-based learning is a comprehensive approach to classroom teaching that is designed to engage learners in investigating authentic problems (Blumenfeld, Soloway, Marx, Krajicik, Guzdial and Palnicsar, 1991). Mettas and Constantinou (2007) view project-based learning as a means for learners to have an opportunity to define the purpose for creating a product.

In Technology Education, the design process or the technological process is regarded as the backbone of teaching Technology (Middleton, 2009; DoE, 2002a:6). The design process is seen as a creative and interactive approach used to develop solutions for the identified problems or human needs (DoE, 2002b:6).

The section that follows outlines the conceptual framework emanated from the literature discussed so far.

2.8 Conceptual framework

Figure 2.1 is a conceptual framework developed out of Table 1.1 and the literature in Chapter 2. This conceptual framework shows the three important broad aspects of the Technology curriculum tied with Technology-Science-Environment (TSE) as a focus point in the middle to show the flow of ideas through the three aspects. These broad aspects are Technological Knowledge and Understanding (conceptual knowledge, TKU), Technology, Society and Environment (attitude and values, TSE) and Technological Process and Skills (procedural knowledge, TPS) and their components.

The three themes are conceptualised around the goals of the teaching Technology Learning Area for Grade R-9 (schools) of the RNCS. The realisation of the unique features and scope that form part of the official and intended curricula, need to be interpreted and enacted in an interrelated manner by the Technology teachers. The RNCS Technology curriculum framework lies with the intentions of the curriculum designers and the case to be measured.

The conceptual framework is intended to describe the Technology curriculum and its implementation with a particular focus on TSE rather than the Technology curriculum designers' intentions ─ which may be rather broader within the RNCS. A scheme by Ben-Peretz (1990:99) for analysing curriculum materials was adopted and adapted to incorporate the elements of the unique features and scope of the Technology subject along the sub-categories to analyse the planning documents within the conceptual framework. The reason for using the scheme is because it provides a pre-determined set of categories for analysis which yield examples of curriculum interpretation (Ben-Peretz, 1990). The scheme consists of four specific dimensions: the subject matter dimension, learner dimension, milieu dimension and the teacher dimension. Table 2.3 outline the dimensions, the categories and sub-categories. The sub-categories were used to formulate the rubric level descriptors, such as "not at all", "somewhat" and "to a great extent". These were used to analyse and describe the four document sources for each participant (Appendix B).

The study also adopted the theory of curriculum change of Rogan and Grayson (2003) to articulate the position of teachers' understanding about the interrelationship of TSE with TPS and TKU during planning and teaching. This theory was used to address the aspect of implementation of the conceptual framework. This theory is based on the three constructs for analysing school implementation: (1) profile of implementation, (2) capacity to support innovation, and (3) support from outside agencies. Rogan and Grayson (2003); Aldous and Rogan (2009) identified sub-constructs within each construct. This study focuses on construct (1) the profile of implementation under the sub-construct science in society but contextualised as technology in society, detailed in its four levels of complexity in Table 2.4.

Table 2.3. Scheme of analysing documents (*adopted and adapted from BEN-PERETZ'S (1990) scheme of analysing curriculum materials*)

Dimension	Category	Sub-categories
Subject matter	Information, Concepts, Principles	•The materials present specific information •The materials emphasize unifying concepts •The material emphasize general principles
	Approach to the nature of technology inquiry	•The materials imply the existence of a general mode of enquiry
	Relationship to everyday life	•Convey the meaning of subject matter knowledge for individuals •Express the meaning of subject matter knowledge for society
	Image of technology	•Involved in solving problems in a creative ways •Using authentic contexts that are rooted in real situations •Using and engaging with knowledge in a purposeful way •Integration within or with other subjects
Learner	Image of learner	•Involved in active learning that links abstract concepts to concrete understanding •Expected to acquire knowledge that is presented in the curriculum materials
	Opportunities for learner development	•The materials offer opportunities for cognitive development. •The materials offer opportunities for psychomotor development(use of technological skills)
	Intended focus of instruction	•The learner is perceived as an individual with particular needs and interests •The learner is perceived as a member of a group with shared interests and

Dimension	Category	Sub-categories
		needs
	Learning Style	•The learner is perceived as being able to function in a variety of learning environments, structured or unstructured. •The learner is perceived as requiring a highly structured learning environment
Milieu	Interaction between society and technology	•Influences of society on the development of technology are explicitly mentioned in the materials. •Influences of the development of technology on society are explicitly mentioned in the materials
	Interaction between society and process of curriculum development	•Curriculum materials reflect societal needs •Curriculum materials reflect ideological concerns.
Teacher	Communication of developers' considerations to teachers	•The curriculum materials relate developers' considerations regarding selection of subject matter •The curriculum materials explain the rationale of the developers regarding students •The curriculum materials deal explicitly with developers' consideration s regarding the setting context in which the curriculum is to be implemented •The curriculum materials discuss anticipated roles for teachers implementing the materials
	Degree of teacher autonomy	•Specific objectives are stated. •Teaching strategies are specified •Teachers are offered teaching alternatives. •Teachers are advised to develop their own units.
	Teachers role in instruction	•The materials suggest a central role for teachers as sources of subject matter knowledge •The materials suggest a supportive role for teachers who guide their students in independent learning
	Consideration of teachers' needs	•Developers manifest awareness for the need for special training to teach technology •Possible difficulties in teaching the materials are anticipated •The curriculum material(s) reflects consideration of opinions and attitudes

Table 2.4. Profile of implementation contextualised as technology in society.
(*Adapted from Rogan and Grayson, 2003*)

Level 1	Level 2	Level 3	Level 4
Teacher uses examples and applications from everyday life to illustrate technological concepts. Learners ask questions about technology in the context of everyday life	Teacher bases a lesson (or lessons) on a specific problem or issue faced by the local community Teacher assists learners to explore the explanations of technological phenomena by different cultural groups	Learners actively investigate the application of science and technology in their environment, mainly by means of data gathering methods such as surveys Examples here might include an audit of energy use or career opportunities that require a technological background	Learners actively undertake a project in their local community in which they apply technology to tackle a specific need. An example might be on investigating the problem/need to bring solution to the community Learners explore the long-term effects of community projects. For example, a project may have short-term benefit but resulting long-term detrimental effects

2.9 Synthesis

The contribution of the literature forms the base from which the context in which Technology Education is understood and implemented and the challenges that teachers in the field are facing. This chapter also highlights the approaches towards teaching the Technology as a subject. The literature presents the importance of addressing different curricula planning Levels and shows the location of the themes. The literature helped to develop a conceptual framework (Figure 2.1), that describes the curricular levels and how they relate to each other. This framework assisted in aligning the research aim and objectives in Chapter 1. Chapter 1 and the frame in Chapter 2 contributed to determining the research design, the type of sampling, the methods of collecting the data, and developing the data collection instruments as in Chapter 3.

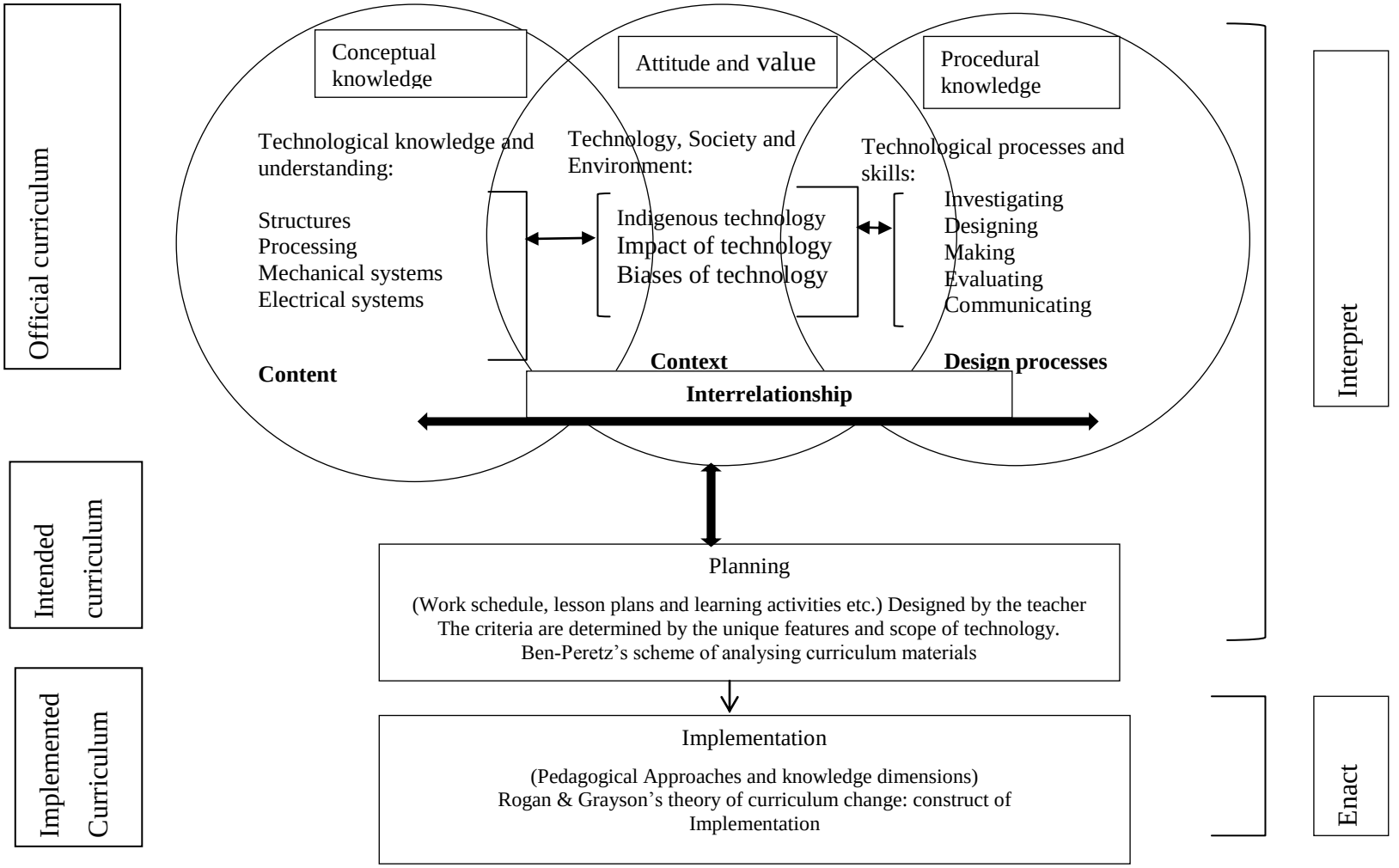


Figure 2.1. Conceptual framework

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This chapter discusses the methodology of the research process that informs this study. It focuses on the research design, research paradigm, sampling methods, data collection methods, data analysis strategies, methodological norms and ethical considerations. The research takes the form of a qualitative enquiry of multi case studies to establish the way Technology teachers interpret and enact the interrelatedness of TSE theme with the other themes in Technology curriculum.

3.1 Research design

The study comprises a case study design characterised by a qualitative research methodology in view of the nature of data to be collected. Case studies can be appropriate for both qualitative and quantitative methods (Naidoo, 2010; Yin, 2009). Creswell (2009:13) describe a case study as a strategy of enquiry in which the researcher explores in-depth a programme, event, activity, process, or one or more individuals in time bound and activity. Yin (2009) maintains that case study research includes single and multiple case studies. Yin (2009:19-20) further noted four applications where case studies can be used:

1. to explain the presumed causal links in real life interventions that are too complex for the survey or experimental strategies;
2. to describe an intervention and the real life context in which it occurred;
3. to illustrate certain topics within an evaluation, again in descriptive mode;
4. to enlighten those situations in which the intervention being evaluated has no clear, single set of outcomes.

Multiple-case studies (comparative) were applied in the study to obtain an in-depth analysis. Four teachers were investigated to describe an intervention in real life

contexts (classrooms) in which they teach. These multiple-cases were purposefully selected to find perspectives of teachers' interpretation and enactment of the interrelationship of TSE with other themes in Technology (Creswell, Hanson, Plato Clark and Morales, 2007)

Mason 2002, in Van Niekerk, (2009) describes qualitative research as having a capacity to constitute compelling arguments on how things work (context in particular) and is capable of producing cross-contextual generalities. Magano (2009) attested this by saying qualitative research describes and analyses people's individual and collective social actions, beliefs, thoughts and perceptions. The qualitative data in this study was collected through interaction with four Technology teachers in their setting, through interviews, observations and document analysis to describe the way teachers interpret and enact the interrelationship of TSE with TPS and TKU. The study investigated the teachers' explanations of how they teach, that could assist in identifying barriers to successful Technology teaching, and could form the foundation for future research beyond the descriptive level.

3.2 Research paradigm

The study followed an interpretive paradigm to describe the interpretation and enactment by teachers of the interrelationship of the Technology curriculum learning theme TSE with TPS and TKU themes in their planning and teaching. The interpretive approach helped to analyse and provide the insight and understanding of the situation in which the four teachers make sense of the inquiry (Niewenhuis, 2007). The interpretive paradigm is based on a subjective world view (Cronje, 2010). The interpretivist perspective views people as having a human life, a social life, a human mind, a human behaviour and a social world, not as sources of data (Niewenhuis, 2007; Mason, 2002). According to Van Niekerk (2009), qualitative research is grounded in the philosophical position that is broadly interpretive as it is concerned with the interpretation of the social world.

My philosophical assumptions in this study are influenced by a constructivist-interpretivist paradigm. Table 3.1. below highlights the summary of what this

paradigm entails in terms of its ontological, epistemological and methodological assumptions by Ponterotto (2005) and Botha (2010) and its overview of the implications for the study.

Table 3.1. A Summary of an interpretive paradigm and its philosophical assumptions (Ponteretto, 2005:130-132 and Botha, 2010:33)

Paradigm	**Ontology**	**Epistemology**	**Methodology**
Interpretivism	• Multiple, constructed realities exist • Subjective experience influence by the context of the situation • Interactive communication between the researcher and individual participant	• Subjectivity • Interactive communication between the researcher and participant is key to capture and describe the lived actual experience	• Interaction • Interpretive • qualitative
Overview implications	Multiple realities are constructed and elaborated on through the subjective experiences of the participants in their real contexts through interaction	Interacted with all participants in their real context to capture their experiences through interviews and observations.	Semi-structured interviews, observations and document analysis were used in order to understand the teachers' realities they come across in class.

According to Krauss (2005:758), ontology involves the philosophy of reality. The study comprised of four cases (teacher participants) in their natural setting to determine how Technology teachers interpret and enact the interrelationship of the theme TSE with other Technology themes. To form my ontological assumptions in this study, the researcher chose multiple realities based on subjective experience (Botha, 2010). The researcher interviewed participants in different settings (in schools) and each of their transcripts. the researcher interacted with the data to construct themes that were acceptable to the internal reality of the participants.

Epistemology addresses how we come to know that reality (Krauss, 2005:758). Krauss further views epistemology as closely related to ontology and methodology. The researcher's epistemological assumptions were confirmed through subjective experiences. I interacted with participants in their school contexts to capture and describe their experiences through observations and interviews (Pontoretto, 2005). The researcher observed the manner in which the three teachers addressed and interacted in their reality during their lessons to gain deeper insight in their experiences in interpreting and enacting the integration of themes in an interrelated

manner. These observations and interviews conform to the idea that reality is socially constructed (Nieuwenhuis, 2007).

Methodology identifies the particular practices used to attain knowledge (Krauss, 2005:758). Same set of data collection instruments were used to collect data to identify the realities through subjective experiences. the researcher's methodological assumptions are that these realities were confirmed through interpreting the results from the data acquired through in-depth interviews, observations and document analysis to understand different contexts to form a single reality (Krauss, 2005, Pontoretto, 2005, Nieuwenhuis, 2007; Botha 2010).

3.3 Sample

Purposive sampling was chosen as a method of sampling to provide sufficient insight and understanding of the enquiry in this study (Ary, Jacobs and Sorensen, 2010). Creswell (2012) describes purposeful sampling as the manner in which researchers select individuals and sites to understand a central phenomenon. The phenomenon under study is the way Technology teachers interpret and enact the interrelatedness of the TSE theme with the other themes in the Technology curriculum. Maree and Pietersen (2007:178) describe purposive sampling as appropriate in "special situations where sampling is done with a specific purpose in mind which informed the identification of participants". The participants in this study were responsible for teaching Technology in the senior phase and were drawn from separate schools to ensure a better understanding of the study in question (Brown, 2009). The group of participants were chosen to give an indication of what was happening during planning and teaching in the sampled schools of Bohlabela district of the Mpumalanga province. Bohlabela district is mostly rural and semi-rural.

Four cases (initially two to which another two were added) of senior phase Technology teachers from four different schools were identified. The four schools in which the teachers are employed were selected on the basis of good governance and upholding a good culture of teaching and learning. These schools met the criteria set by the researcher of maintaining a good culture of planning, teaching and learning in

the Bohlabela district of the Mpumalanga Province. Ball 1994, in Cohen et al. (2007:115) posits that purposive sampling is used to access 'knowledgeable people' i.e. those who have in-depth knowledge about a particular subject. In this study, the specific knowledge refers to the knowledge of planning and teaching the Technology.

Two cases were initially studied in-depth, but in the process, two more cases were added (one case in each category) to observe the principle of saturation and redundancy of information. The saturation and redundancy of information refers to the point or level when no new information is forthcoming from the participants (Ary et al., 2010:429). The cases were assigned to two categories as follows:

> Category 1 (Cases 1 and 4, Table 3.2) comprised near-novice teachers who had experience of teaching Technology in the senior phase for at least two years and who had at least an undergraduate degree or an Advanced Certificate in Education with Technology as a major subject.
>
> Category 2 (Case 2 and 3, Table 3.2) comprised experienced teachers with eight or more years of teaching Technology in the senior phase and at least an Honours degree in Technology or Technology education.

The reason for categorising the above cases was to make the process of cross cases analysis easier.

The learners' work for analysis was selected with the consent of the parent or guardian, with the learners' willingness to participate and with work that was up-to-date with the teacher's plan. With the help of the participating teachers, the researcher, selected examples of their learners' work (workbooks and project portfolios) for content analysis. Limited, non-participatory whole classroom observation was performed at the request of three teachers (Ary et al., 2010). Consequently, three lessons were observed.

Table 3.2. Sampling details of participants and methods of data production

Category	Teacher participants (pseudonyms are used)	Number of years teaching technology	Gender	Subjects taught in senior phase	Type of schools and their location	Qualifications	interviews	Observations	Documents analysis
1	Nomvula –Case 1	3	Female	Natural Sciences Technology	Semi-rural	SPTD, ACE	√	√	√
2	Suzan – Case 2	13	Female	Technology	Rural	JPTD, ACE	√		√
2	Job –Case 3	13	Male	Technology Natural Sciences English	Semi-rural	SPTD, FDE, ACE BEd (Hons), S&T	√	√	√
1	Jane-Case 4	7	Female	Technology Mathematics literacy	Rural	STD, ACE	√	√	√

3.4 Data collection

The aim of this study is to establish the way teachers interpret and enact the interrelationship of Technology themes from a TSE perspective. The data were collected by means of semi-structured interviews, document analysis and limited non-participatory observations. Table 3.3 outlines the summarised details of these aspects in line with the research questions. The sections that follow look at each of these data collection instruments in some detail.

3.4.1 Interviews

The interview is one of the instruments used to gather qualitative data in a particular context for interpretation and to establish meaning (Van Niekerk, 2009:108; Ary et al., 2010:438). A qualitative interview is viewed by Babbie and Mouton (2001:283) as an "essential conversation in which the interviewer determines the direction for the conversation and pursues specific topics raised by respondent". Qualitative research offers different types of interviews, such as structured interviews, unstructured interviews, semi-structured interviews and focused group interviews (Nieuwenhuis, 2007; Ary et al., 2010). Semi-structured interviews were used in this study because the researcher could formulate the questions and modify them to suit the context as new information emerged during the interviewing process.

The interviews with the teachers were conducted with permission from the Bohlabela district authorities in the Mpumalanga Province. Semi-structured face-to-face interviews were conducted for approximately 30 minutes with all four participants in both categories. The aim of choosing the four teachers was to obtain an in-depth description of the context in which teachers operate. The focus of the interviews was based on the way teachers interpret and enact the interrelationship of the Technology curriculum themes. The researcher audio-recorded the interviews and transcribe it. The researcher used these transcriptions to provide evidence to answer the research questions. The researcher took notes as the process unfolded to capture important aspects that were observed during the interviews. The participants were asked the same questions which were modified through probing in the process to reduce the possibility of bias between interviews. All the interviews were conducted at the participants' schools (Appendix C for transcripts and field notes).

3.4.2 Observations

According to Cohen, Manion and Morrison (2002:305), observations afford the researcher the opportunity to gather live data from live situations than at second hand. In this study, the researcher embarked on limited, non-participatory classroom observations as requested by three of the participants. Two participants were from Category 1 (near novice) and one participant from Category 2 (experienced) as outlined in section 3.3. The participants seized the opportunity to be observed while teaching in their classes, as they hoped to get feedback that would assist to improve their teaching. Amongst the three participants requested to be observed, two of them were teaching Grade 7 Technology and one was teaching Grade 9 Technology. Specific permission to observe the classroom was obtained from the school and parents. Assent was obtained from the learners (Appendix A2). The observations were analysed utilising the Rogan and Grayson (2003) construct of profile of implementation scheme. The reason for adapting and utilising the Rogan-Grayson construct of profile of implementation is that its levels fit well within the context of the enquiry and qualitative context of the study.

The researcher visited the participating teachers a week prior to the observation sessions to become familiar with their environment and to interact with them. The researcher observed lessons lasting 45-60 minutes in the scheduled teaching times without disrupting the normal running of the school timetable. The observations contributed towards capturing and confirming some of the issues mentioned during the interviews. The observations contributed to the document analysis, and to the realisation of the aim of the study (Appendix B).

3.4.3 Document analysis

The researcher carried out a document analysis of the teachers' planning, which included work schedules, lesson preparation (worksheets and or activity sheets) and resources, to identify any evidence of addressing the TSE in the planned activities. The researcher also looked at the type of work produced by the learners in the Technology learning area, i.e. project portfolios and their workbooks to establish the interrelatedness of the themes in which the learners were engaged. The analysis of these document sources was done using Ben-Peretz (1990) scheme to analyse curriculum document materials (Table 2.3). The reason for adapting and utilising the Ben-Peretz's scheme was that its dimensions and categories fit well within the qualitative context of the study. The themes in this section were identified using

the dimensions and their categories. The dimensions were aligned with the research questions. The process of analysis took place in the schools during the data collection period (Appendix E for some of the learners' activities).

Table 3.3. Summary of data collection methods

Research Question	Data Source	Method(s) of collecting data	Expected information
How do Technology teachers interpret TSE in the Technology curriculum?	Teachers	Interviews, observations and documents analysis	The extent to which teachers are able to (or do): Describe what they understand about the concepts in the Technology curriculum Demonstrate an understanding of the interrelationship of themes in Technology Describe the role TSE plays in teaching Technology Articulate the nature of Technology activities
How do Technology teachers link TSE to the other themes in Technology?	Teachers Students' work	Interviews and documents analysis	Plan Technology activities so that it shows the interrelationship of the Technology themes. Design student activities so that it reflects the interrelationship of TSE and other themes. Determine the kind of activities or work given to students
How do Technology teachers approach the themes from a pedagogical perspective?	Teachers	Interviews and observations	Determine the approaches teachers' use to teach Technology Establish the approaches used to interrelate the themes during the facilitation of activities in class
What are the successes and failures of interrelating with the themes?	Teachers and Researcher	Interviews, documents analysis and observations	Establish the successes and failures in their approaches to planning and teaching Technology
What are barriers to successes and how should they be addressed?	Teachers	Interviews and reflections on interview and observations.	Explain the barriers encountered in interrelating the themes during planning and teaching Establish a base for future research

3.5 Data analysis

According to Gibbs (2007:4) the base of finding patterns and producing explanations in a qualitative data depends on qualitative analysis. There are two contrasting logic of explanations for analysis, which are deductive and inductive logic (White and Marsh 2006; Gibbs 2007). These logics of explanations are described as follows:

1. Induction logic as the generation and justification of a general explanation based on the accumulation of lots of particular but similar circumstances; and
2. Deduction explanation moves in the opposite direction in that a particular situation is explained about the circumstances (Gibbs, 2007:4).

White and Marsh (2006:35) associate inductive explanation with qualitative research and deductive explanation with quantitative research. Gibbs (2007:4) affirms that both inductive and deductive logics of explanation can be used in qualitative research. It is through this affirmation by Gibbs (2007) that, this study utilises the qualitative research approach and deductive logic to analyse data. The study uses a deductive approach because of the multiple cases that brought data from the different contexts of the cases.

Nieuwenhuis (2007) suggests that the researcher should follow a specific type of analysis to analyse texts and narratives guided by rigour and certain procedures. The study engaged a multi-case study approach. The interviews, document analysis and observations were used to collect the data which were analysed using cross-case analysis (Creswell, Hanson, Plano Clark and Morales, 2007; Miles and Huberman, 1994). Each of the instruments used different analysis but they were aligned to the research questions in all three instruments as indicated in sections 3.4.1-3.4.2.

The researcher used a constant comparative analysis (Corbin and Strauss 2008) to scan the interview data to transcribe and categorise. The researcher studied the observation sheets and put together the points that were relevant to the topic at hand. The researcher collated the information by organising the data per respondent.

The researcher formulated descriptions that provided the in-depth analysis on the sequence of the way teachers handle the interrelationship of Technology themes in their planning and teaching. The intention was to foreground the nature of the relationship between the

technological knowledge and the technological activities within a particular set context outlined in TSE.

The researcher compared and categorised the responses and identified the patterns of teachers' responses to each question by using qualitative data analysis. The replication approach to multiple case studies analysis was used. Yin (2009) describes the replication approach to multiple-case studies in three stages. In Stage 1, the researcher defines and designs cases; in Stage 2, the researcher prepares instruments and schedules to collect data for analysis and in Stage 3, the researcher analyses data and then draws conclusions. The researcher followed a replication approach through which each case was studied, analysed and reported on. Based on the analysis of each case, the researcher made a cross case comparison to answer the research questions and evaluated the realisation of the study objectives.

3.6 Methodological norms

This study engaged the multiple data collection methods of interviews, observation and document analysis to enhance its trustworthiness (Cohen et al., 2002; Babbie and Mouton, 2001; Nieuwenhuis, 2007). The difficulty that exists in qualitative research is that it eliminates the human element, and the influences that emanate from the side of the observer could alter the data (Magano, 2009).

3.6.1Credibility and trustworthiness

In view of Magano's statement (2009) above, the following procedures were followed to ensure that the data which was collected meant what it was thought to mean by observing the four standards of rigour in qualitative research to ensure credibility and trustworthiness. The standards of rigour are dependability, credibility, transferability and confirmability. These standards of rigour are briefly discussed in the subsequent sections.

3.6.1.1 Dependability

Dependability is compared to reliability as it refers to the same results when using same instruments (Cohen, Manion and Morrison, 2007). The study employs audit trail which

enable readers to understand the context of the research which influenced the conclusion that was drawn from the study. The raw data through audio recordings, the field notes obtained from interviews, and the document analysis and observations can be retrieved for viewing and verification. The research results and findings are presented to establish the trustworthiness of the study. Multiple case studies were used during interviews and document analysis and observations for triangulation purposes to establish dependability of the study findings.

3.6.1.2 Credibility

Credibility is compared to internal validity as it refers to the situation where the phenomenon is clearly identified and all research factors are reflected in the data collected (Botha, 2010; White and Marsh, 2006). The researcher ensured that the process of the study and data collection and analysis were credible and trustworthy in that the researcher talked to the participants about the field of research under study and piloted the instruments. Four cases were studied using multiple data sources in the form of interviews, document analysis and observations and themes were identified and coded. The raw data from interviews transcripts and field notes was discussed with the participants to check (member check) whether it represented what they know and they even signed. The same data collection instruments protocols were applied to all participants to avoid element of bias which would affect the data interpretation.

3.6.1.3 Transferability

Babbie and Mouton (2001) and White and Marsh (2006:38) compare transferability with external validity refers to as generalizability or “the applicability of findings from different context”. This study provided detailed descriptions of the context to enable readers to make judgements of the similarities and differences obtained from the cases studied. Comprehensive descriptions were provided through transcripts from audio tapes during interviews, document analysis and observations.

3.6.1.4 Confirmability

Confirmability is compared to internal validity or objectivity refers to bias free procedures and interpretation of results (Botha, 2010; Ary, Jacobs and Sorensen, 2010). Member

checking was applied to confirm the findings of the study. Participants were given a chance to verify the accuracy of the verbatim transcripts extracted from interviews and commented on the field notes taken during observations. The codes were used for data presentations. The next sub-sections discuss in detail the processes followed to fulfil these four standards of rigour.

3.6.2 Piloting instruments and schedules

The piloting process was done with three (3) teachers and a curriculum implementer for Technology before the actual fieldwork. This helped the researcher to eliminate sections of the interview schedule that were not clear, to reinforce the ones that were clear and further adjust the observation protocol instrument. The participants who took part in the pilot study were not part of the actual research sample. The researcher also compared the interview questions with other interview questions that were used in other studies in an attempt to standardise them.

3.6.3 Actual data collection

The respondents were all asked the same questions with probing in 20–30 minutes and the responses were audio recorded and transcribed. The researcher scheduled follow-up interviews to assess the merit of the interpretations the researcher made against the intentions of the participant to improve the reliability and validity of the interpretations.

The participants were asked to comment on the transcripts of the interviews immediately after transcribing, to validate the results of the transcripts. The researcher negotiated the right of veto as participants had a right to comment on the interpretations of the transcript but were not able to change what was said on the recordings. Field notes were discussed with the participants directly after the observation. The four participating teachers could comment on the field notes and transcripts to confirm their accuracy. They confirmed the field notes and transcripts as correct or provided explanations and the corrections (Sentences written in italics on transcripts in Appendix C).

3.7 Ethical considerations

Creswell (2008:639) describes ethical issues as the process through which the researcher informs participants of the purpose of the study, refrains from deceptive practices, shares information with participants including the role of the researcher, shows respect for the research site, reciprocity, uses ethical interview practices, maintains confidentiality, and collaborates with participants. This description fits well with the process the researcher followed in the study.

In this study, certain ethical considerations were upheld. Firstly, the researcher submitted the protocols schedules and instruments to the ethics committee of the Faculty of Education of the University of Pretoria and acquired a letter of permission for my research before collecting the data. The researcher obtained letters of permission from the Mpumalanga Department of Education and the school authorities to conduct my research in their schools. Based on the demographics of the context where the research took place, the researcher requested translators to translate the letters of consent into two vernacular languages, i.e. Sepedi and Xitsonga for parents who do not understand English. The participating teachers consented to the interviews, the parents or guardians and learners consented to the class observations and to the classroom teaching (Appendix A1).

Secondly, the researcher visited the schools to brief them on the objectives of the study, to seek permission to analyse learners' written work, and asked the intended participants for consent to record the interview proceedings.

Power relations did not come into play, as the researcher did not work with the participants at a level of authority. The researcher had an academic appointment and had no function or authority in the education department or in the districts in which the schools are located. However, consent from the participants was sought in the absence of power relations, and all the consent letters and forms recognise the researcher as a MEd student at the University of Pretoria.

The purpose of the research was briefly described in all the letters of permission to the authorities and the participants for them to be aware of what the research aimed to achieve.

Participants were informed of their right to withdraw at any time. Confidentiality and anonymity were preserved by protecting participants' privacy and anonymity to maintain trust in the research relationship. This was done by keeping the data the researcher collected from the participants only for research (Ferguson, Yonge and Myrick, 2008:61). To ensure the anonymity of the participants the interviews were recorded, but the names, designators and schools were replaced by coded references and pseudonyms in the transcripts. The privacy of the participants was respected and care was taken to prevent any possible harmful effects, such as transgressing cultural values during the study.

The letters of permission contained a short description of the aim of the study and the following points were mentioned (Appendix A1):

1. Participating in the research project was voluntary and the information of the participants was kept confidential.
2. The participant's information was secured and anonymity was preserved.
3. The participants could decide to withdraw at any stage of the research project.
4. There were no monetary incentives for participating in the research project.

Table 3.4 outlines the summary of the ethics relating to each research question and how these were addressed, the methods of collecting the data and the analysis of data.

3.8 Synthesis

This chapter presented a detailed qualitative enquiry and outlined strategies used for case study design involving multiple cases. The chapter discussed the interviews, observations and document analysis methods that were used to collect and analyse the data. In this chapter, the research design, research paradigm, sampling, data collection methods, data analysis strategies and ethical issues were discussed in detail. The chapter justifies the choices the researcher made for the research design, and the samples and data collection methods. The chapter addressed the issues of credibility and trustworthiness based on the standards of rigour.

The subsequent chapter addresses the data presentation and analysis.

Table 3.4. Summary of ethics consideration in addressing each research question

Research Question (s)	Method(s) of collecting data	Ethics for each question	Analysis of data.
How do Technology teachers interpret TSE in the Technology curriculum?	Interviews	Obtain consent from the participants The right to participate or not to Participants have a say in how their statements are interpreted (after transcribing) Have a right to know what the interview will be all about before The researcher uses the pseudonyms to protect the anonymity of participants	Transcribing and coding the participants' responses of interviews Categorise to formulate the themes
How do Technology teachers link TSE to the other themes in Technology?	Interviews and Documents analysis	Permission to review documents that the participants use to teach and learners work Participants need to be assured the information is not going to be disclosed to any person except between the participant and the researcher	Transcribe and code the responses and analyse the data collected through analysing participants' and learners' documents
How do Technology teachers approach the themes from a pedagogical perspective?	Interviews and Observations	Permission is important before the observation take place Participants are assured about the information collected is specifically for research purposes not any other thing than that Discuss the observation schedule with the participants beforehand	Check the accuracy of the data collected with the participants through observing their teaching The analyses are to be done within the case study design

What are the successes and failures that may lead to improvement of the rate of successes?	Reflect on observations and interviews.	Uphold the anonymity stance of the participants by protecting participants' privacy and anonymity so to maintain trust in the research relationship	Reflecting on the interviews, observations and document analysis to establish the successes and failures on the approaches used by Technology teachers so as to improve the rate of successes and to inform future research
What are the barriers to successes that could be addressed?	Identify barriers to successes through interviews and observations.	Uphold the anonymity stance of the participants by protecting participants' privacy and anonymity so to maintain trust in the research relationship	Document the barriers to success to give recommendations and to identify aspects for future research

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.0 Introduction

This chapter outlines the case studies of four senior phase Technology teachers with the aim of understanding how Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment (TSE) theme with the other Technology curriculum themes. The themes are Technological, Processes and Skills (TPS) and Technological, Knowledge and Understanding (TKU).

The chapter commences with the description of the biographical information and institutional context of the participating teachers as shown in Table 4.1. The presentation of the data, and the results and analysis are in two stages. Stage 1 presents data derived from the document analysis. Stage 2 presents the narratives from the semi-structured interviews and lesson observations. This data representation was interpreted based on the Ben-Peretz's scheme of curriculum document analysis and Rogan and Grayson's construct of implementation to address the research questions (Section 1.4.2, Chapter 1).

Lastly, a summary discussion of the findings in the chapter is presented, where patterns, similarities and differences are discussed to answer the research questions.

4.1 Biographical information of participants and institutional contexts

In this section, pseudonyms are used and only broad biographical characteristics are provided. This is to protect the confidentiality of participants (Appendix E). Table 4.1 below describes the participants' profiles, their teaching experiences, their understanding of what inspired them to follow the teaching profession, the participants' extra-curricular activities, and the context in which they teach to understand their demographic status. Two of the participants teach in semi-rural schools and two in rural schools. The participants do not live close to the schools where they teach, but travel daily in a radius of about 50 km. Three of

these participants reside in townships, and one stays in a rural village different from the village at which she teaches.

4.2 Analysis of documents utilising the Ben-Peretz's scheme of analysing curriculum materials

The researcher analysed four types of source documents using the Ben-Peretz's scheme of analysing curriculum materials (Table 2.3). The documents that were analysed are work schedules, lesson plans, project portfolios and learners' exercise books. Two types of work schedules for Grades 7 and 9 in this study were analysed in different cases. The documents were analysed to establish an interpretation and enactment of the interrelationship of Technology themes. This exercise contributed to data triangulation.

Of the four document types, the work schedule and lesson plans were planning documents used by the teacher, and the learners' work came from their project portfolios and exercise books. The four document types are outlined and briefly characterised in Table 4.2 below. The Ben-Peretz (1990) scheme of analysing curriculum materials was used to analyse the four document types in the next section, 4.3.

Table 4.2. A description of the four types of source documents were analysed (DoE, 2003)

Work schedule	Lesson plan	Project portfolio	Learners' exercise books
A work schedule is a plan for a year that shows how teaching, learning and assessment would be sequenced and paced in a grade. This type of planning is produced by an individual teacher for a particular Grade (DoE, 2003)	A lesson plan is drawn from the work schedule and could range from one or a single activity to a term of teaching. Lesson plans describe the details of teaching and the learning and assessment activities. The components of a lesson plan comprise aspects of teaching methodology, style and approaches that need to be managed in the classroom	This is a document completed by the learners. It shows all the stages of the Technology process or design process as outlined in the technological processes and skills theme (TPS). This type of document forms part of the learner's final product	These are books in which learners write their classwork, homework, tasks and tests. The reason for having these books is that they contain written work on a day-to-day basis. The researcher consulted the exercise books to establish whether the written work is in line with what is stated in the lesson plan and to what extent the standard of learners' written work shows integration

Table 4.1. Biographical information and institutional contexts of participants.

Category	Nomvula	Suzan	Job	Jane
Profile	Nomvula is a female teacher in her mid-thirties from School A. She is identified in the study as a novice Technology teacher with a natural sciences background. She holds a three year Senior Primary Teachers Diploma (SPTD) in Education, Senior Phase. She majored in Mathematics, General Sciences & didactics in Technology. She furthered her studies to obtain an Advanced Certificate in Education (ACE Technology Education)	Suzan is female teacher in her late forties from School B. She is identified in the study as an experienced Technology teacher with a mathematics and natural sciences background. She holds a three year Junior Primary Teachers Diploma (JPTD) in Education and an Advanced Certificate in Education (ACE) in Technology Education	Job is a male teacher in his late forties from school C. He is identified in the study as an experienced Technology teacher with a background in natural sciences and English. He holds a three year Senior Primary Teachers Diploma (SPTD) in Education, Senior Phase and majored in Mathematics and Sciences at the college. He furthered his studies at a University to obtain the Advanced Certificate in Education (ACE) in Technology Education. A Further Diploma in Education (FDE) in education management followed, then a BEd (Hons) in Science and Technology Education. He is a head of department	Jane is a female teacher in her late thirties from School D. She is identified in the study as a novice Technology teacher with a natural sciences background. She holds a three year Secondary Teachers' Diploma (STD) in Education. She furthered her studies to obtain the Advanced Certificate in Education (ACE Technology Education)
Teaching experience	She started teaching in 2004 where she taught mathematics in Grade 6 and natural sciences in Grade 7 to date. Nomvula taught Grade 7 in the Technology learning area for 3 years, from 2009 until the time of this study. Teaching Technology came after she obtained a scholarship from the Mpumalanga Department of Education to further her studies and did the ACE. She teaches Technology to two Grade 7 classes (A & B) with 64 and, 32 learners in the classes	She started teaching in 1990, and taught Grade 1, Grade 3 and Grade 6. Suzan received training as part of C2005 Technology pilot programme in 1998. According to her, this programme was initiated by the National and Provincial Departments of Education for the implementation of Technology C2005. She has been teaching Grade 7 Technology since 1998 up to the time of this study, which marked 13 years	Job started teaching in 1992 where he taught natural sciences and English in Grade 6 and Grade 7. He has been teaching Technology to Grade 7 learners for 13 years. Teaching Technology for Job came after he participated in the C2005 Technology pilot project and had an opportunity to obtain a scholarship from the Mpumalanga Department of Education to further his studies in the ACE Technology Education. Job is teaching Technology in two Grade 7 classes with 96 and 48 learners in the classes	She started teaching in 2004 where she taught mathematics literacy Grade 12 and Technology Grades 8 and 9. She had been teaching in the Technology learning area in Grade 8 and 9 since 2004 until the time of this study (8yrs). Teaching Technology came after she obtained a scholarship from the Mpumalanga Department of Education to further her studies in the ACE Technology Education
Inspiration to be a teacher	Her teaching career was inspired by her love for children and she would like to be instrumental in improving the standard of education. About her teaching, Nomvula acknowledged that teaching as a career needs perseverance as it involves being a teacher, a parent, a nurse and a social worker. This is because of the challenges that learners have in the class and in	Suzan described herself as a person who was not keen on teaching but due to circumstances, she had to enrol with the college of education. Even though she did not like teaching at first, she realised that she has become a good teacher and enjoys her job. Suzan's biggest challenge in her teaching is learners who cannot read	Job became a teacher after being inspired by his high school biology teacher. He said that he was motivated by the teacher's style of teaching and character traits. Challenges about his experiences in his teaching career he precisely highlighted the frequent changes in curriculum.	According to Jane, her poor family background led her into teaching

	their homes			
Other responsibilities besides teaching	Besides teaching, Nomvula is engaged in the school-feeding scheme as the secretary and coaches netball. As a secretary in the feeding scheme, she keeps all the records of the scheme	Besides teaching, Suzan is also responsible for extra mural activities	Besides teaching, Job is engaged in a number of activities such as planner for extra and curricular activities and being a subject mentor. He is also a head of examination, and involved in music and cultural sub-committees	Jane is engaged in school extra-curricular activities such as athletics and netball. She is a SASTE branch secretary
School context	The school at which Nomvula teaches is situated in a semi-rural area of Bohlabela district in Mpumalanga province. The school started in 1966, and has an enrolment of 881 at the time of the study. The school has 20 classrooms, an administration block, a computer lab and a school library. It has 36 staff members (including support staff). The school starts at 07h30-13h50 on weekdays including Fridays	The school at which Suzan teaches is situated in a semi-rural area of Bohlabela district in Mpumalanga province. The school started in 1985, and has an enrolment of 927 at the time of the study. The school has 27 classrooms, an administration block, a computer centre and a school library. It has 46 staff members and operates 5 days a week, from 07h15 to 14h00, including Fridays. The school has a school garden where they plant vegetables used for a feeding scheme and for fundraising	The school at which Job teaches is situated in a semi-rural area of Bohlabela district in Mpumalanga Province with an enrolment of 954 at the time this research was conducted. The school was established in 1970.The school has 36 staff members and 20 classrooms, an administration block, computer lab and a school library. The school operates 5 days a week and it starts at 07h20 to 14h20.	The school at which Jane is teaching is situated in a deep-rural area of Bohlabela district in Mpumalanga province with an enrolment of 599 at the time of this study. The school was established in 1990. It has 27staff members and has 14 classrooms. The school starts at 07h20 and ends at 14h30 during weekdays including Fridays

4.3 Document analysis using the Ben-Peretz's scheme

This section presents detailed analysis of the four document types using the dimensions of the Ben-Peretz scheme in Table 2.4. The dimensions are presented in each sub-section with its categories and sub-categories. The sub-categories include in them the unique features and scope of Technology. The document types shown in Table 4.2 were analysed per case. The analyses are presented through the description of sub-categories. At the end of each sub-section a syntheses is presented.

4.3.1 Subject matter dimension

The subject matter dimension consists of four categories and each category has 2 to 4 sub-categories as shown in Table 2.3. The subject matter dimension is useful to address research sub-question 1 in sub-section 1.4.2. This sub-section concludes with the synthesis of the four cases in relation to the subject matter dimension.

4.3.1.1 Nomvula

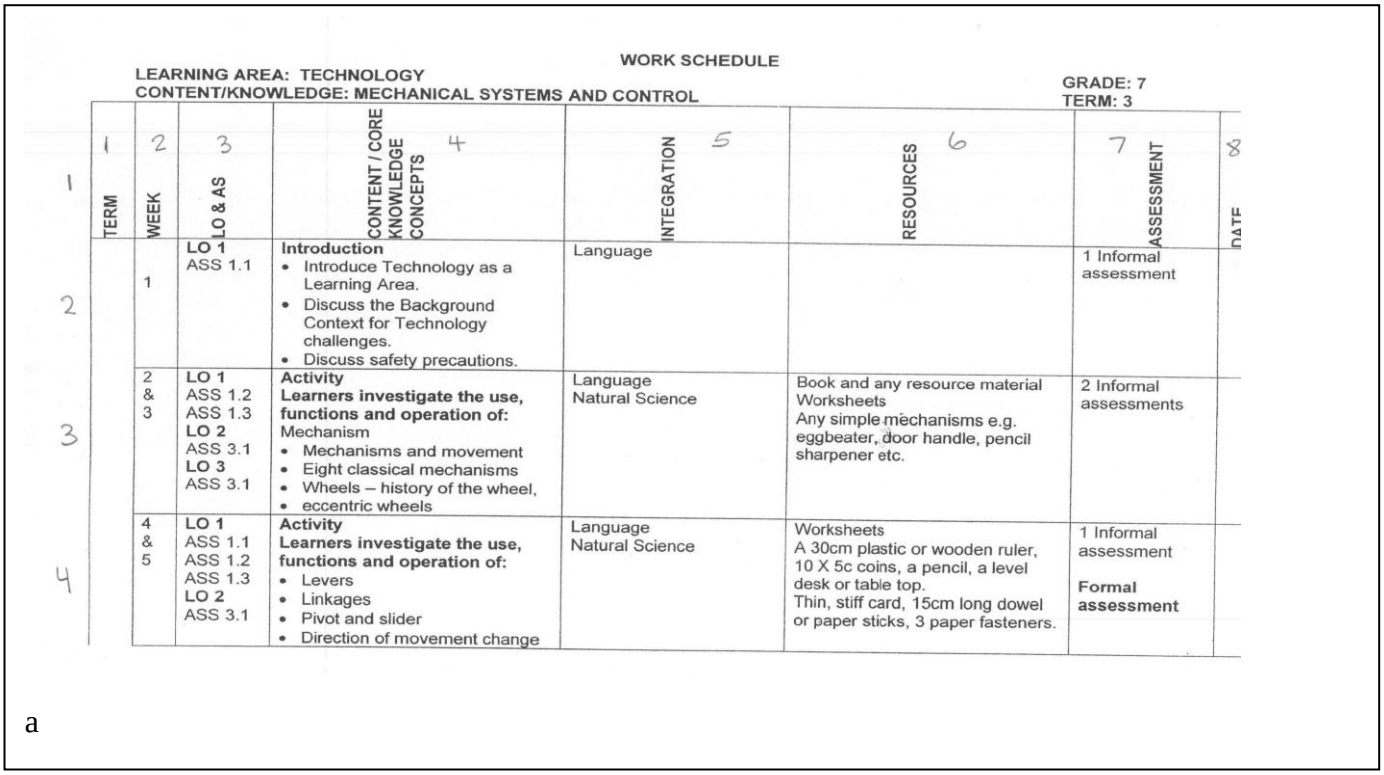
In Nomvula's case, the researcher analysed the work schedule for Grade 7, the lesson plans, the learners' written work, and the project portfolios. The Grade 7 work schedule was supplied to Nomvula by the Department of Education (Appendix D). The lesson plans were supplied by the service provider of an in-service schools project for which the school is the feeder (Appendix D). The project portfolios and the learners' workbooks belong to the learners who participated in the study. Table 4.3 below outlines the results of the analysis of Nomvula's documents analysed on the subject matter dimension in its four categories.

Table 4.3. Overall results of Nomvula's documents on the subject matter dimension

Categories	Not at all	Somewhat	To a great extent
1. Information, concepts, principles		Lesson plans, learners' workbooks, project portfolio	Work schedule
2. Approach to the nature of technology inquiry		Lesson plans, learners' workbooks, project portfolio	Work schedule
3. Relationship to everyday life		Lesson plans, learners' workbooks, project portfolio	Work schedule
4. Image of technology		Lesson plans, learners' workbooks, project portfolio	Work schedule

Document origins: Work Schedules – *Department of Education*; Lesson Plans - *In-service project*

The results show that Nomvula's work schedule is classified under "to a great extent" in all the four categories. This is an indication that the work schedule contains substantive evidence of each of these categories as shown in the work schedule exemplar below (Figure 4.3.1). The column numbers and row numbers are marked by hand on the work schedule exemplar. (Figure 4.3.1a columns 3 and 4 address categories 1 and 2; and Fig 4.3.1a-b column 3 row 7 addresses categories 3 and 4 in Table 4.3)



WORK SCHEDULE

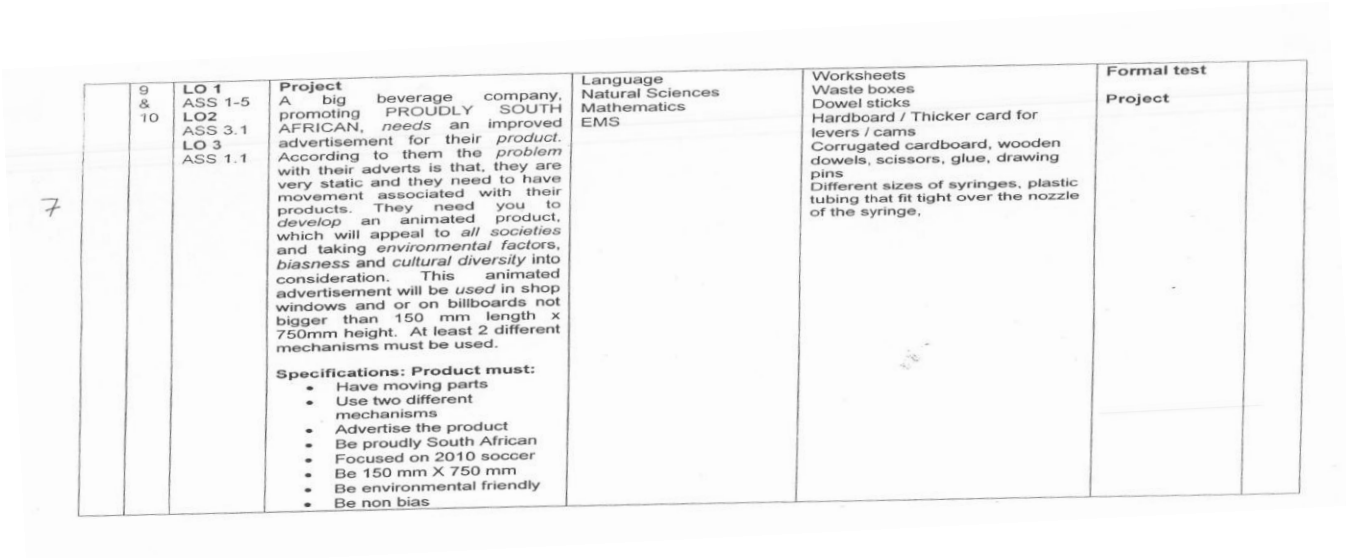
LEARNING AREA: TECHNOLOGY
CONTENT/KNOWLEDGE: MECHANICAL SYSTEMS AND CONTROL

GRADE: 7
TERM: 3

1 TERM	2 WEEK	3 LO & AS	4 CONTENT / CORE KNOWLEDGE CONCEPTS	5 INTEGRATION	6 RESOURCES	7 ASSESSMENT	8 DATE
1	1	**LO 1** ASS 1.1	**Introduction** • Introduce Technology as a Learning Area. • Discuss the Background Context for Technology challenges. • Discuss safety precautions.	Language		1 Informal assessment	
2	2 & 3	**LO 1** ASS 1.2 ASS 1.3 **LO 2** ASS 3.1 **LO 3** ASS 3.1	**Activity** **Learners investigate the use, functions and operation of:** Mechanism • Mechanisms and movement • Eight classical mechanisms • Wheels – history of the wheel, • eccentric wheels	Language Natural Science	Book and any resource material Worksheets Any simple mechanisms e.g. eggbeater, door handle, pencil sharpener etc.	2 Informal assessments	
3	4 & 5	**LO 1** ASS 1.1 ASS 1.2 ASS 1.3 **LO 2** ASS 3.1	**Activity** **Learners investigate the use, functions and operation of:** • Levers • Linkages • Pivot and slider • Direction of movement change	Language Natural Science	Worksheets A 30cm plastic or wooden ruler, 10 X 5c coins, a pencil, a level desk or table top. Thin, stiff card, 15cm long dowel or paper sticks, 3 paper fasteners.	1 Informal assessment **Formal assessment**	
4							

a

b



7	9 & 10	**LO 1** ASS 1-5 **LO2** ASS 3.1 **LO 3** ASS 1.1	**Project** A big beverage company, promoting PROUDLY SOUTH AFRICAN, *needs* an improved advertisement for their *product*. According to them the *problem* with their adverts is that, they are very static and they need to have movement associated with their products. They need you to *develop* an animated product, which will appeal to *all societies* and taking *environmental factors*, *biasness* and *cultural diversity* into consideration. This animated advertisement will be *used* in shop windows and or on billboards not bigger than 150 mm length x 750mm height. At least 2 different mechanisms must be used. **Specifications: Product must:** • Have moving parts • Use two different mechanisms • Advertise the product • Be proudly South African • Focused on 2010 soccer • Be 150 mm X 750 mm • Be environmental friendly • Be non bias	Language Natural Sciences Mathematics EMS	Worksheets Waste boxes Dowel sticks Hardboard / Thicker card for levers / cams Corrugated cardboard, wooden dowels, scissors, glue, drawing pins Different sizes of syringes, plastic tubing that fit tight over the nozzle of the syringe,	**Formal test** **Project**	

The results show that lesson plans, the learners' exercise books and their project portfolios are classified under "somewhat". This is an indication that of the documents containing (at least) some evidence of each of the categories as shown in the extract of the lesson plan, and the learners' workbook exemplars in Figure 4.3.2. The information in lesson plans presents some Technology information and concepts in relation to Technological Processes and Skills (TPS); and Technological Knowledge and Understanding (TKU), but none on TSE as shown in the extract below (Figure 4.3.2). The aspects of TKU are dominant in both lesson plan and learners' workbooks.

Educator and Tagging Information

Learning Area: Technology
Resource Name: Technology
Assessment Exemplar Number: TECHN7.65
Item/s: 1
Phase: Senior Phase
Grade: 7
Tags: Technology, processing, denim, questionnaire, survey, Formative Assessment
Assessment Type: Formative
Assessment Form/s: Survey, questionnaire
Copyright for included material: N/A
Duration: 60 min
Learning Outcome(s) and Assessment Standard(s): **Learning Outcome 1: Technological Processes and Skills** The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology. **Assessment Standards** We know this when the learner 1 **Investigates** 1.4 During investigations, plans a strategy for collecting data and information that includes: • Identifying technologies and methods; • Considering the source, resources and copyright laws; • Uses search techniques; • Extracts relevant data for specific purposes; • Produces meaningful summaries. **Learning Outcome 2: Technological Knowledge and Understanding** The learner will be able to understand and apply relevant technological knowledge ethically and responsibly. **Assessment Standards** We know this when the learner 2 **Processing** 2.1 Demonstrate knowledge and understanding of how materials can be processed to change or improve properties (e.g. strength, fire resistance, waterproofing, taste, volume, texture).
Learning Space: Assessment
Hyperlinks: To be completed later.
Rating:
Number of questions for exemplar: 3
Easy questions: Question 2 Question 3
Medium questions: Question 1

Figure 4.3.2. Lesson plan exemplar extracts Grade 7

Nomvula did not have a record of lesson plans that she had created herself but had pre-planned lessons she received from an in-service school project in which her school participates. The exemplar extract in Figure 4.3.2 is taken from one of those lessons.

The work schedule emphasizes the content in context that shows the influence of society on the development of technology and the development of the effect technology has on society. The context in the work schedule relates to the influence of the Technology-Society-Environment (TSE) theme as shown in columns 3 and 4 rows 3 and 7 of Figure 4.3.1a and b. This is not the case of the lesson plans, the learners' exercise books and their project portfolios. However, based on the evidence drawn from the exemplar in Figure 4.3.2, the lesson plans contains skills and knowledge classes that are unrelated to a specific context that has an influence of TSE. Figure 4.3.3 below is an example of the activities that learners were involved when producing a project portfolio.

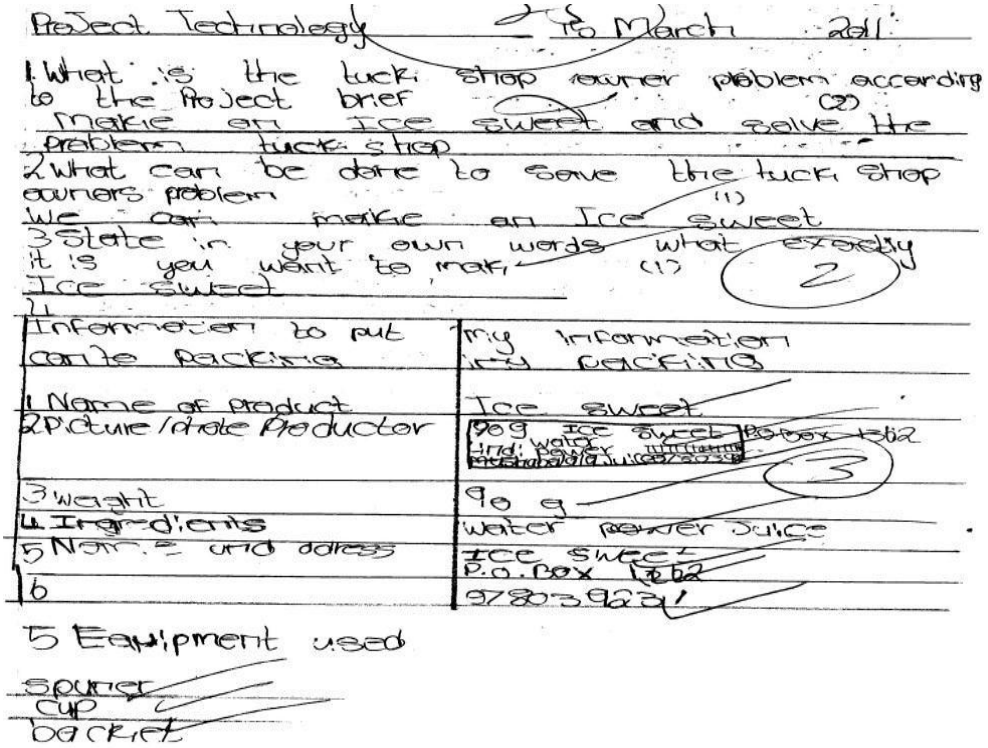
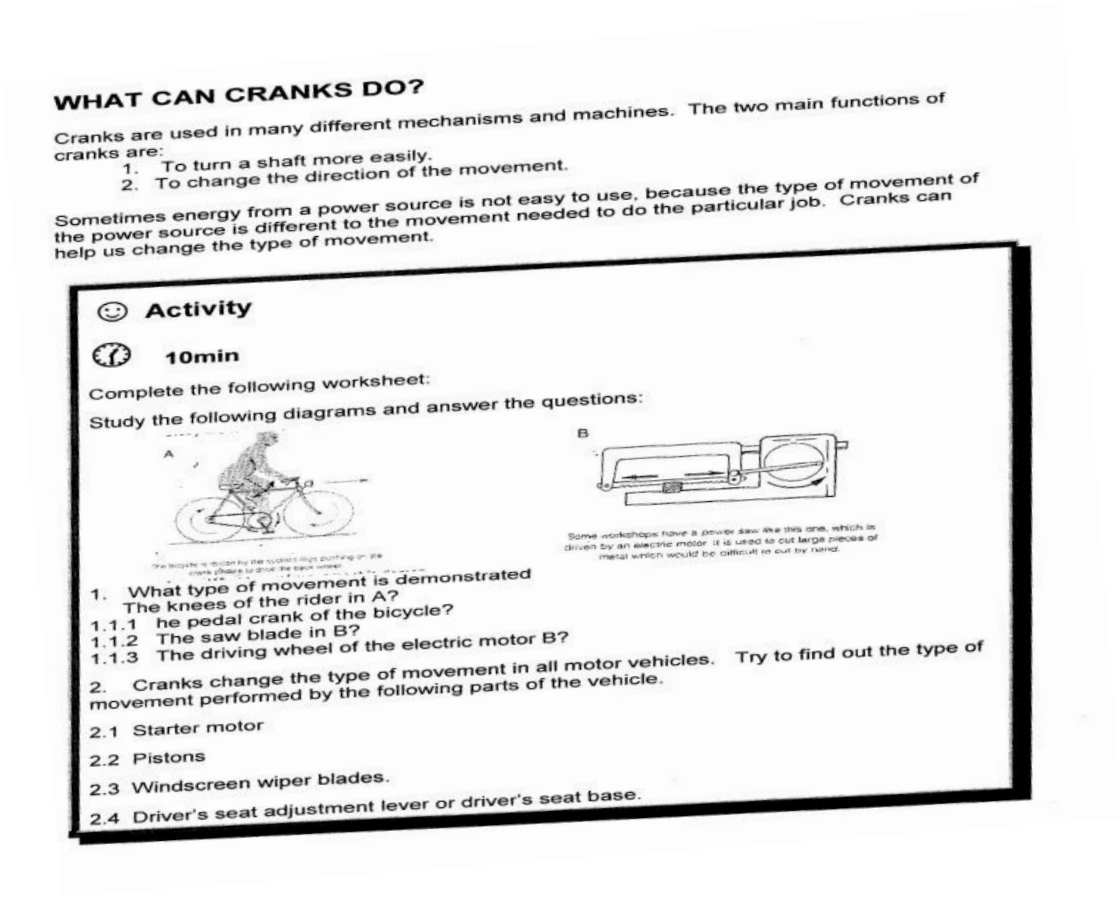


Figure 4.3.3. Exemplar of a learner's project portfolio



WHAT CAN CRANKS DO?

Cranks are used in many different mechanisms and machines. The two main functions of cranks are:

1. To turn a shaft more easily.
2. To change the direction of the movement.

Sometimes energy from a power source is not easy to use, because the type of movement of the power source is different to the movement needed to do the particular job. Cranks can help us change the type of movement.

Activity

10min

Complete the following worksheet:

Study the following diagrams and answer the questions:

A

B

Some workshops have a power saw like this one, which is driven by an electric motor. It is used to cut large pieces of metal which would be difficult to cut by hand.

1. What type of movement is demonstrated
   The knees of the rider in A?
   1.1.1 he pedal crank of the bicycle?
   1.1.2 The saw blade in B?
   1.1.3 The driving wheel of the electric motor B?
2. Cranks change the type of movement in all motor vehicles. Try to find out the type of movement performed by the following parts of the vehicle.
   2.1 Starter motor
   2.2 Pistons
   2.3 Windscreen wiper blades.
   2.4 Driver's seat adjustment lever or driver's seat base.

Figure 4.3.4. Exemplar of learner's activity

In conclusion, the learner's exercise books, the project portfolios and the teacher's lesson plans did not have any contextualising references that conform to the TSE theme (Figure 4.3.2, Figure 4.3.3, Figure 4.3.4). This could mean a lack in the interpretation of the work schedule content when developing the lesson plans and the learners' activities that need to be contextualised with reference to TSE.

4.3.1.2 Suzan

In Suzan's case the Grade 7 work schedule was supplied to schools by the Department of Education as a pacesetter. The work schedule appears to be the same as Nomvula's work schedule. Table 4.4 below outlines Suzan's overall results based on the subject matter dimension.

Table 4.4. Overall results of Suzan's documents on the subject matter dimension

Categories	Not at all	Somewhat	To a great extent
1. Information, concepts, principles		Lesson plans, learners' workbooks, project portfolio	Work schedule
2. Approach to the nature of technology inquiry		Lesson plans, learners' workbooks, project portfolio	Work schedule
3. Relationship to everyday life		Lesson plans, learners' workbooks	Project portfolios, Work schedule
4. Image of technology	Lesson plans	Learners' workbooks	Work schedule and project portfolios

Document origins: Work schedules – *Department of Education*; Lesson plans –*Suzan's own*

The results in Table 4.4 show the work schedule classifies under the level "to a great extent" in all the four categories as well as the project portfolio in categories 3 and 4, and "somewhat" in categories 1 and 2 respectively. This is an indication that the work schedule (Figure 4.3.1) and project portfolios (Figure 4.3.5) contain substantive evidence of learning outcomes and assessment standards that defines the core knowledge concepts in each of the categories concerned. Figure 4.3.1, columns 3 and 4 address categories 1 and 2 and column 3 raw 7 addresses categories 3 and 4 (Table 4.4). The results show these lesson plans classified under level "somewhat" in categories 1, 2 and 3 and category 4 "not at all". The learners' exercise books are classified under "somewhat" in all four categories.

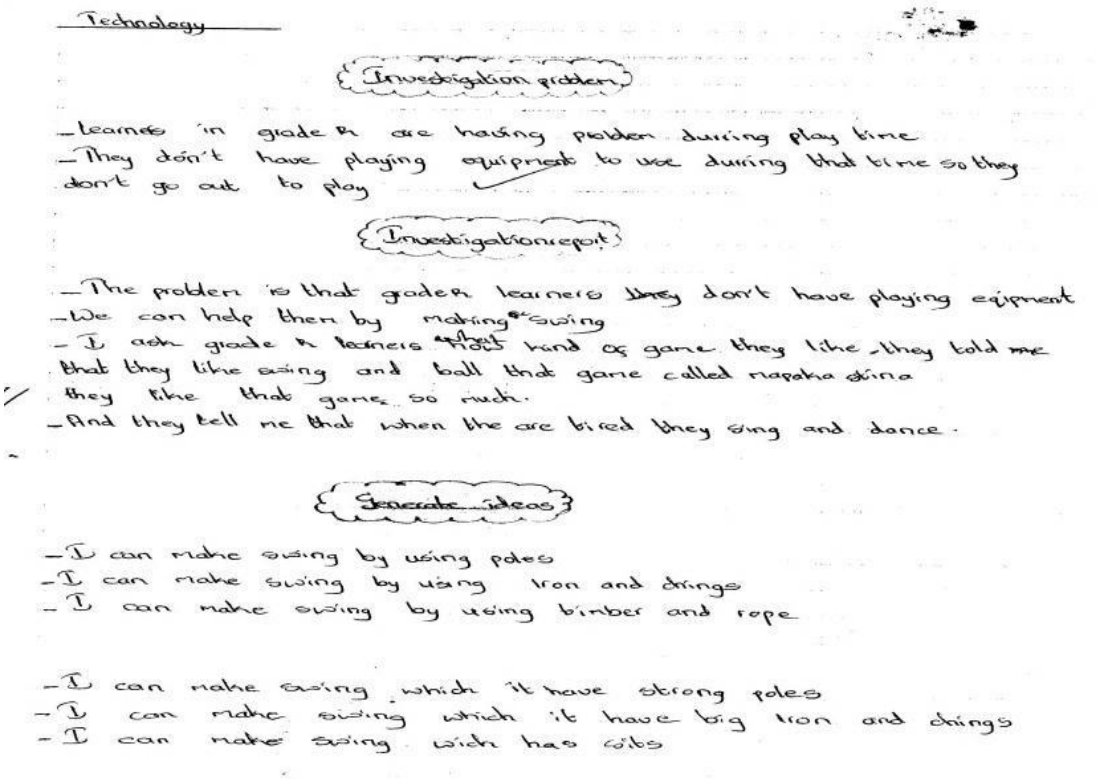
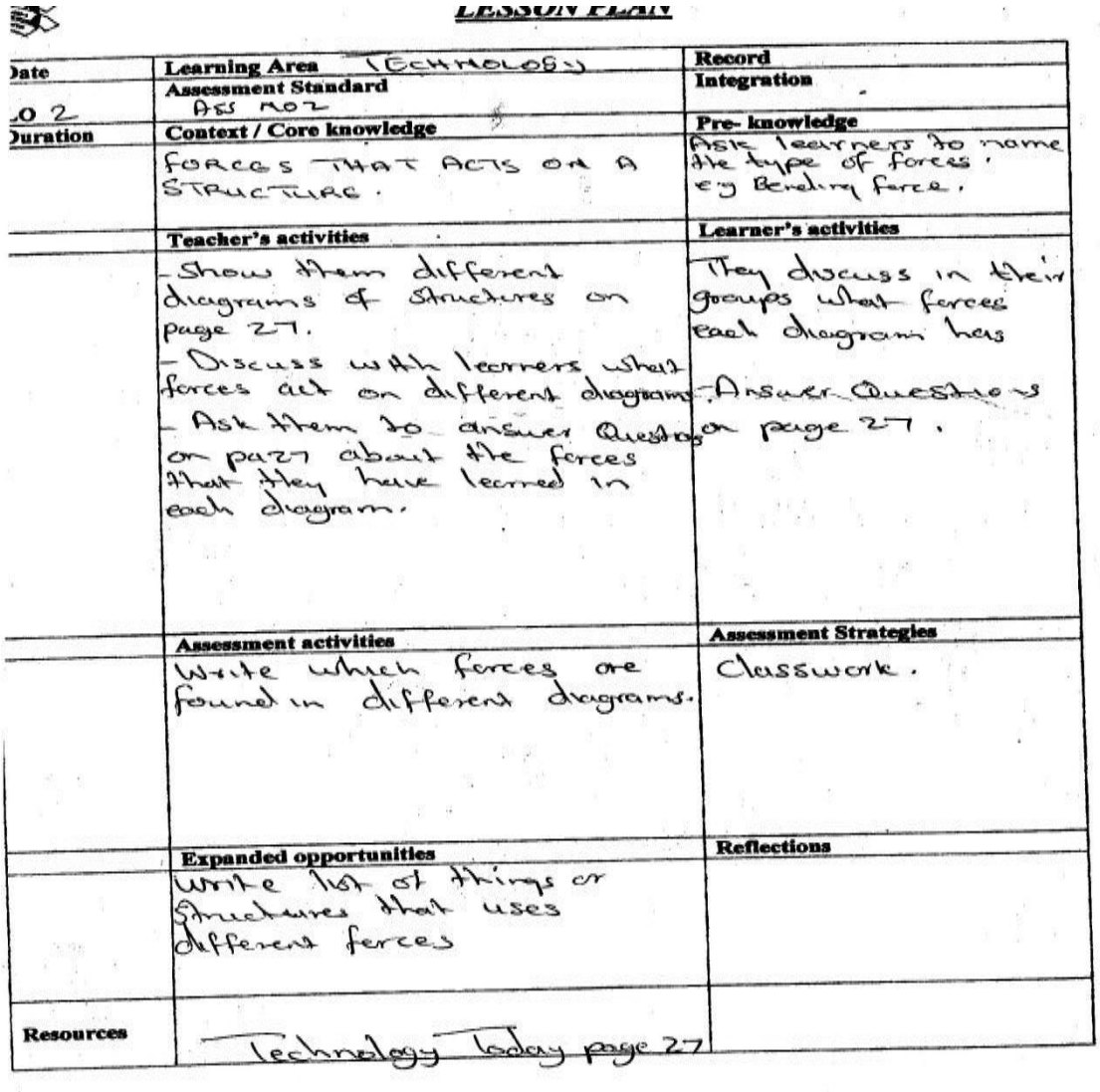


Figure 4.3.5. Example extract from a learner project portfolio

The works schedule emphasises "to a great extent" the aspects that define and present the concepts and their principles in an integrated manner in realising the interrelationship of the Technology themes (Figure 4.3.1). The project portfolio addresses the aspects of problem solving; it embraces project based learning in a creative way based on authentic context to express the meaning of Technology knowledge for society (Figure 4.3.5). The authentic context and Technology knowledge for society are aspects that conform to the requirements of TSE. The learners' workbooks and lesson plans at least present some information and some concepts and principles in relation to TKU in an integrated manner and with minor emphasis on aspects of TSE (Figure 4.3.6, Figure 4.3.7 respectively).



LESSON PLAN

Date .0 2 Duration	Learning Area (TECHNOLOGY) Assessment Standard ASS NO 2 Context / Core knowledge FORCES THAT ACTS ON A STRUCTURE.	Record Integration Pre- knowledge Ask learners to name the type of forces. eg Bending force.
	Teacher's activities - Show them different diagrams of structures on page 27. - Discuss with learners what forces act on different diagrams. - Ask them to answer Questions on page 27 about the forces that they have learned in each diagram.	Learner's activities They discuss in their groups what forces each diagram has Answer Questions on page 27.
	Assessment activities Write which forces are found in different diagrams.	Assessment Strategies Classwork.
	Expanded opportunities Write list of things or structures that uses different forces	Reflections
Resources	Technology today page 27	

Figure 4.3.6. Exemplar of Suzan's lesson plan

The emphasis on TSE was evident in the work schedule and the project portfolios (Figure 4.3.1, Figure 4.3.5). The lesson plans and learners' exercise books showed only some attention of the influence of TSE in the development of technology in society, as reflected in the Technology curriculum document.

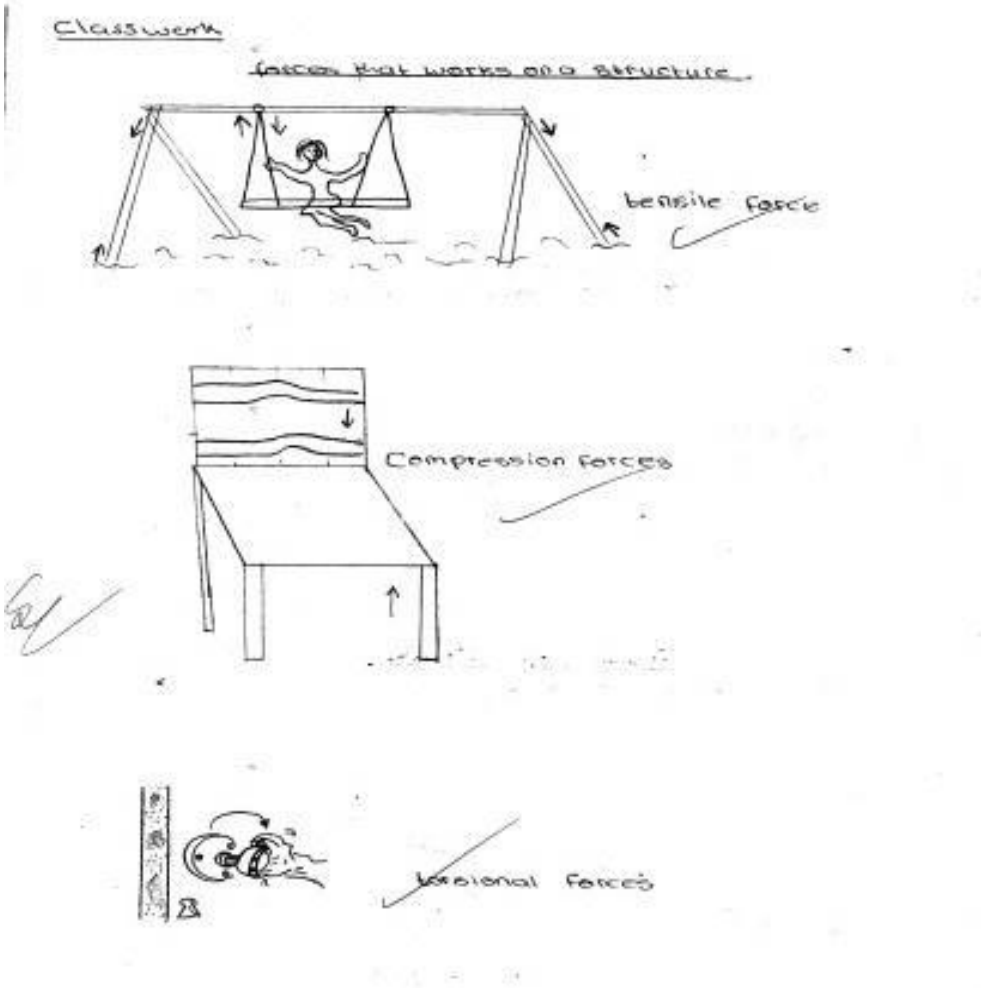


Figure 4.3.7. Exemplar of learner activity

In conclusion, based on the results and discussions the teacher had some idea of interpreting the work schedule and enacts it in developing lesson plans and some learners' activities that are contextualised with reference to TSE.

4.3.1.3 Job

With Job's documents, four types of source documents were analysed: the work schedule, the lesson plans, the project portfolios and the learners' exercise books. The Grade 7 work schedule as pacesetter is the same as Nomvula and Suzan's which were supplied by the

Department of Education. Table 4.5 below outlines the overall results for Job's documents based on the subject matter dimension.

Table 4.5. Overall results of Job's documents on the subject matter dimension

Categories	Not at all	Somewhat	To a great extent
1. Information, concepts, principles		Lesson plans, learners' workbooks	Work schedule and project portfolios
2. Approach to the nature of technology inquiry		Lesson plans, learners' workbooks,	Work schedule, project portfolios
3. Relationship to everyday life		Lesson plans, learners' workbooks,	Work schedule, project portfolios
4. Image of technology	Learners' workbooks	Lesson plans	Work schedule and project portfolios

Document origin: Work schedule – *Department of Education*; Lesson plans – *Job's own*

The results in Table 4.5 show that the work schedule and the project portfolios are classified under the level "to a great extent" in all four categories. This is an indication that the work schedule shown in Figure 4.3.1 and project portfolios in Figure 4.3.8 contain substantive evidence in all the categories. In Figure 4.3.1, column 3 - 4 addresses categories 1 and 2 as well as column 3 raw 7 addresses categories 3 and 4 in Table 4.5. The results show that lesson plans in all categories are classified under level "somewhat" and the learners' workbooks in categories 1, 2 and 3 and in category 4 classified "not at all". This is an indication that lesson plans and learners' workbooks contain some evidence in either all or specific categories of subject matter dimension

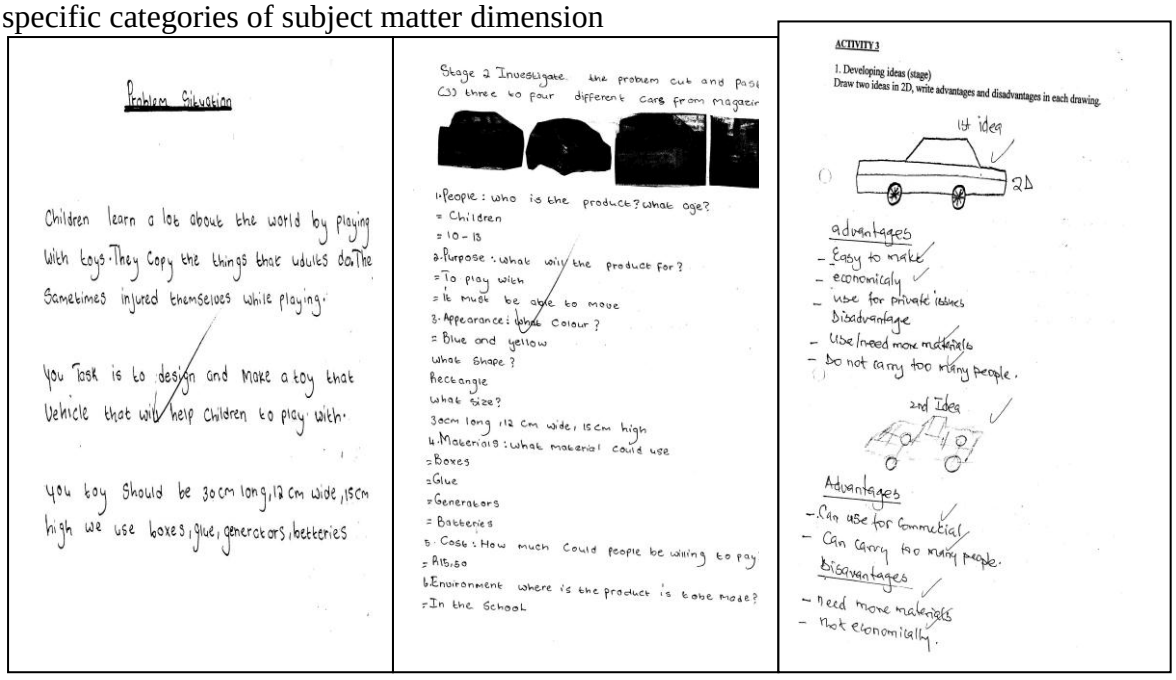


Figure 4.3.8. Exemplar for a learner project portfolio-Job

The works schedules emphasises the aspects that define and present the information, concepts and their principles in an integrated manner "to a great extent" in realising the interrelationship of the Technology themes.

LESSON PLAN DURATION 30min

SUBJECT TECHNOLOGY DATE 02 September 2011

GRADE 7

Context: System and control Core- knowledge: Types of mechanism

Learning Outcomes	Assessment Standards	Integration
LO 1		
LO2 Technological knowledge and understanding.	Demonstrate knowledge and understanding of mechanical system that change the direction of movement e.g. lever system	Maths LO 5 As 1 and 3 1 st add(English) LO 4 as 6.4
LO3		
linking with previous lesson Recapping the following concepts :		
Mechanism ; Mechanical advantage.		
Learning Activities		
_group learners in to a manageable group.		
Activity 1 : In their group let them name six types of basic mechanism ,draw and discussion.		
Activity 2 : Allow learners to respond orally to what they have discussed in their groups.		
Activity 3 :Ask learners to define what a lever is.		
Activity 4 : Paste the pictures on the wall . ask the questions.		
Activity 5 :Calculate mechanical advantage by using the formula mechanical advantage - load /effort		
Activity 6 : learners will be given a class work.		

Figure 4.3.9. An example of a lesson plan

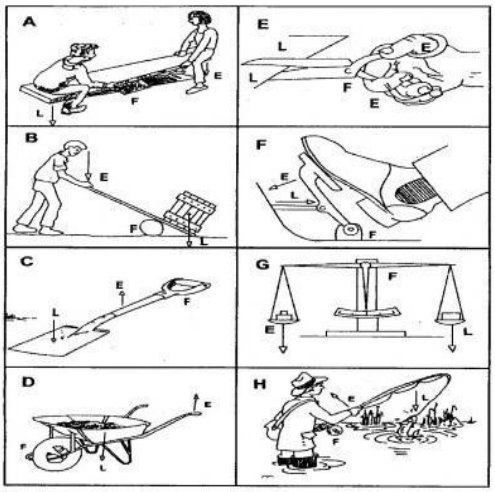
The project portfolio "to a great extent" addresses the aspects of problem solving, which embraces project based learning approach in creative ways based on authentic context to express the meaning of technology knowledge for society (Figure 4.3.8). Authentic context and technology knowledge for society are aspects that conform to the requirements of TSE. The project reflects the ideological concerns and societal needs as TSE requires.

Assessment Task

Class of levers

The class of levers is dependent on the position of L, E and F.

N.B. Remember:
Class 1 levers
The fulcrum is in the middle, with the effort and load on either side.
Class 2 levers
The load is in the middle, with the fulcrum and effort on either side.
Class 3 levers
The effort is in the middle, with the fulcrum and load on either side.



1.1 Refer to the sketches above and write down the letter of the example next to the correct class of lever. [8 marks]

1.1.1 Class 1 e.g. ..... A B E G .....

1.1.2 Class 2 e.g. ..... D F .....

1.1.3 Class 3 e.g. ..... C H .....

1.2 Choose the correct word or fill in the missing word.
1.2.1 The heavier the load, the (close/further) it must be to the fulcrum.
1.2.2 The heavier the load, the (longer/shorter) the arm of the lever must be.
1.2.3 When two or more levers are joined together, it is called a ..linkage..
1.2.4 Give one example of a linkage. [7 marks]

Figure 4.3.10. An example of a learner activity

The learners' exercise books and lesson plans present "somewhat" some information, concepts and principles in relation to TKU in an integrated manner, but with no emphasis on aspects of TSE (Figure 4.3.9, Figure 4.3.10). The learner's exercise books however reflected no contextualisation in some categories. The lesson plans were constructed to cover the themes one at a time.

In conclusion, based on the results and discussions the teacher have an idea of interpreting the work schedule and enact it in developing lesson plans and some learners' activities that are less contextualised with reference to TSE.

4.3.1.4 Jane

In Jane's case, the four source document types, namely the work schedule Grade 9, the lesson plans, the learners' exercise books and project portfolios were analysed. Jane's Grade 9 work

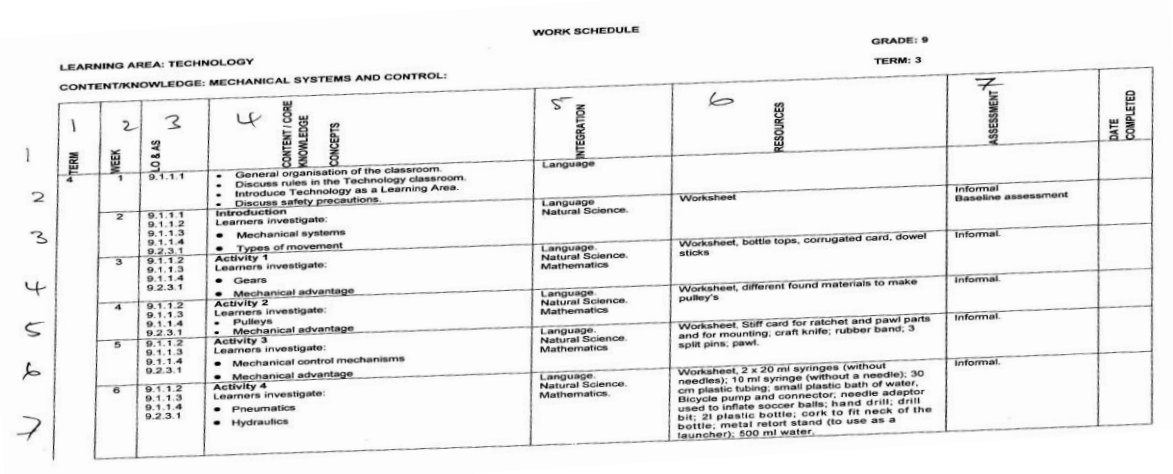
schedule was supplied by the Department of Education as pacesetter. She had lesson plans that she produced herself. The learners' workbooks and project portfolio were obtained from the participating learners. Table 4.6 outlines the overall results of Jane's documents based on the subject matter dimensions.

Table 4.6. Overall results of Jane's documents on the subject matter dimension

Categories	Not at all	Somewhat	To a great extent
1. Information, concepts, principles		Lesson plans, learners' workbooks, project portfolio	Work schedule
2. Approach to the nature of technology inquiry		Lesson plans, learners' workbooks, project portfolio,	Work schedule
3. Relationship to everyday life		Lesson plans, learners' workbooks, project portfolio,	Work schedule
4. Image of technology	Lesson plans, project portfolio	Learners' workbooks	Work schedule

Document origins: Work schedule – Department of Education; Lesson plans – Jane's own.

The results show that Jane's work schedule was classified under "to a great extent" in all four categories. This is an indication that the work schedule contains substantive evidence of each of these categories as shown in the work schedule exemplar below (Figure 4.3.11). The columns numbers and rows numbers are marked by hand on the work schedule exemplar. Column 3 does not show the exact aspects; numbers are used instead to identify the aspects. For an example 9.1.1.1 represents Grade 9, learning outcome 1 and assessment standard 1.1. The table's column 3 and 4 address categories 1 and 2 and column 3 row 7 addresses categories 3-4 in Table 4.6



WORK SCHEDULE

GRADE: 9

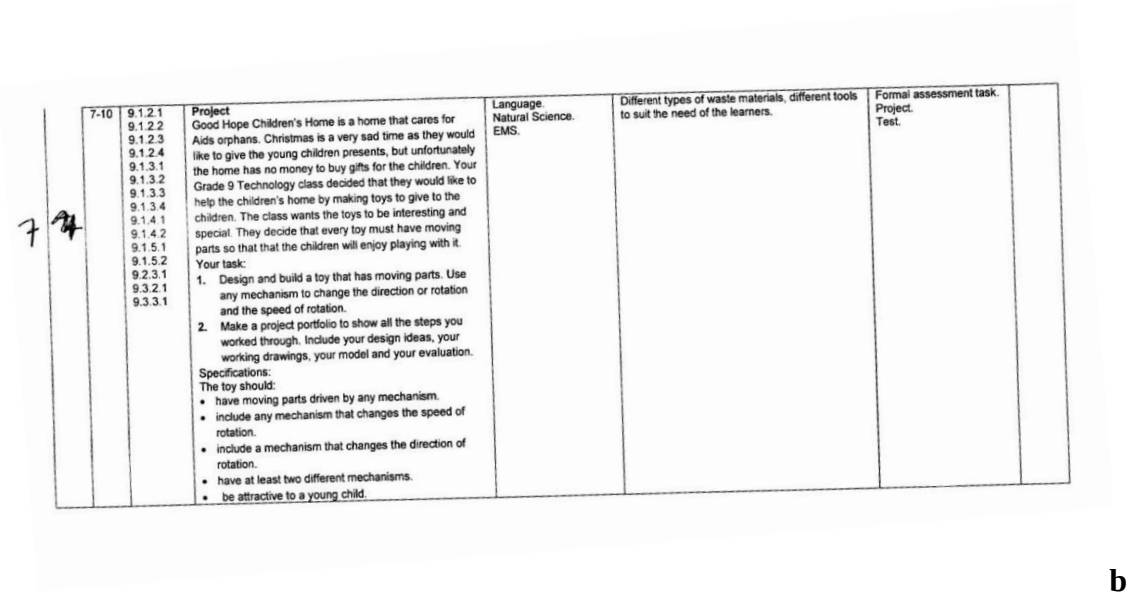
TERM: 3

LEARNING AREA: TECHNOLOGY

CONTENT/KNOWLEDGE: MECHANICAL SYSTEMS AND CONTROL:

1 TERM	2 WEEK	3 LO & AS	4 CONTENT / CORE KNOWLEDGE CONCEPTS	5 INTEGRATION	6 RESOURCES	7 ASSESSMENT	DATE COMPLETED
4	1	9.1.1.1	• General organisation of the classroom. • Discuss rules in the Technology classroom. • Introduce Technology as a Learning Area. • Discuss safety precautions.	Language			
	2	9.1.1.1 9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	Introduction Learners investigate: • Mechanical systems • Types of movement	Language. Natural Science.	Worksheet	Informal Baseline assessment	
	3	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	Activity 1 Learners investigate: • Gears • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet, bottle tops, corrugated card, dowel sticks	Informal.	
	4	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	Activity 2 Learners investigate: • Pulleys • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet, different found materials to make pulley's	Informal.	
	5	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	Activity 3 Learners investigate: • Mechanical control mechanisms • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet. Stiff card for ratchet and pawl parts and for mounting; craft knife; rubber band; 3 split pins; pawl.	Informal.	
	6	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	Activity 4 Learners investigate: • Pneumatics • Hydraulics	Language. Natural Science. Mathematics.	Worksheet, 2 x 20 ml syringes (without a needles); 10 ml syringe (without a needle); 30 cm plastic tubing; small plastic bath of water; Bicycle pump and connector; needle adaptor used to inflate soccer balls; hand drill; drill bit; 2l plastic bottle; cork to fit neck of the bottle; metal retort stand (to use as a launcher); 500 ml water.	Informal.	

a



7 24	7-10	9.1.2.1 9.1.2.2 9.1.2.3 9.1.2.4 9.1.3.1 9.1.3.2 9.1.3.3 9.1.3.4 9.1.4.1 9.1.4.2 9.1.5.1 9.1.5.2 9.2.3.1 9.3.2.1 9.3.3.1	**Project** Good Hope Children's Home is a home that cares for Aids orphans. Christmas is a very sad time as they would like to give the young children presents, but unfortunately the home has no money to buy gifts for the children. Your Grade 9 Technology class decided that they would like to help the children's home by making toys to give to the children. The class wants the toys to be interesting and special. They decide that every toy must have moving parts so that that the children will enjoy playing with it. Your task: 1. Design and build a toy that has moving parts. Use any mechanism to change the direction or rotation and the speed of rotation. 2. Make a project portfolio to show all the steps you worked through. Include your design ideas, your working drawings, your model and your evaluation. Specifications: The toy should: • have moving parts driven by any mechanism. • include any mechanism that changes the speed of rotation. • include a mechanism that changes the direction of rotation. • have at least two different mechanisms. • be attractive to a young child.	Language. Natural Science. EMS.	Different types of waste materials, different tools to suit the need of the learners.	Formal assessment task. Project. Test.	

b

Figure 4.3.11 (a and b). Grade 9 work schedule exemplar extract

In Jane's documents, the work schedule presents information, unifying concepts and their principles. The work schedule highlights the content, core knowledge concepts and integration of content. The work schedule also covers and expresses subject matter knowledge in the three themes and addresses the aspects of problem solving exercises based on authentic contexts rooted in TSE. However, this was not the case with the learners' workbooks, their project portfolios and lesson plans (documents not provided for evidence outside research site) which covered some subject matter knowledge in only TKU theme (Figure 4.3.12).

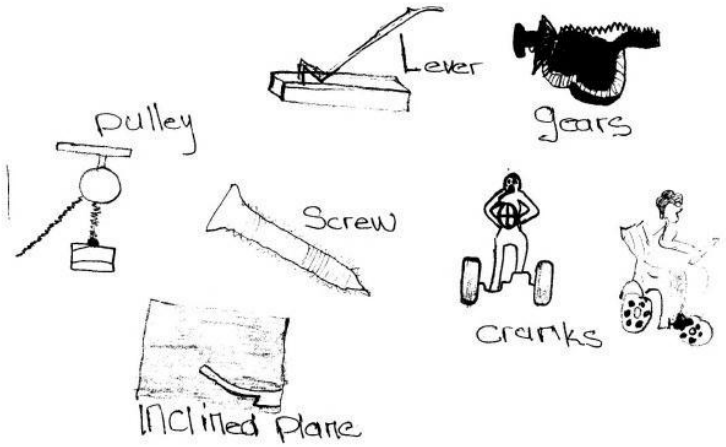


Figure 4.3.12. Example of learner activity

The aspects of technology enquiry, the emphasis on the context and ideological concerns, the needs of society in the lesson plans and the learner's exercise books coverage were not evident. The role of TSE is covered in the prescribed textbook *Technology Today* Grade *9* and in the work schedule for the planned project. If Jane had followed the textbook, she would have contextualised TSE.

In conclusion, based on the results and discussions the teacher lacks many of the skills to interpret the work schedule or to enact it in developing lesson plans and some learners' activities that should be contextualised with reference to TSE.

4.3.1.5 Synthesis of the subject matter dimension of the four cases

The results reveal that the work schedules in all four cases were classified under "to a great extent" in all the categories tabled in the subject matter dimension. The findings reveal that the participants are exposed to work schedules that present all the Technology curriculum themes (Figure 4.3.1, Figure 4.6.1).

The lesson plans and the learners' workbooks were mostly classified under "somewhat" in all the cases. This indicates that the lesson plans and learners' workbooks present some information, some Technology concepts and some general principles in the work schedule that cover the subject matter content. However, the participants do not engage in real contexts rooted in real situation in their approach to planning these activities.

The findings of the lesson plans and the learner's written work reveal that, some of the participating teachers show they are able to interpret and enact the work schedule to plan lessons and design learners written work, but they do that out of context as defined in TSE. This is evident in some lesson plans and learners' written activities (Figure 4.3.4, Figure 4.3.7, Figure 4.3.10, Figure 4.3.12).

The project portfolios results revealed that Job's is classified under "to a great extent" in all categories and Suzan's is classified in categories 3 and 4. The indication is that Job and Suzan's project portfolios contain substantive evidence of each of the categories concerned (Figure 4.3.5, Figure 4.3.8). They both used the problem solving approach which embraces the project based learning approach through the design process in creative ways using

authentic contexts to solve real life problems. Suzan and Job are in the experienced category (section 3.3).

Nomvula's project portfolios are classified under "somewhat" in all categories; Jane's were classified as "not at all" in categories 1, 3 and 4. This is an indication that the learners' project portfolios contain at least some information in specific categories (Figure 4.3.3).

The findings reveal that project portfolios in both categories present at least some Technology curriculum information, concepts and principles; general mode of technology inquiry in authentic contexts and societal link.

The general findings reveal that the experienced teachers are more able to interpret and enact the work schedule to design tasks that engage learners in dealing with real life problems through project based approach than the novice teachers though there are some overlaps in some cases.

These findings suggest that in the subject matter dimension in both categories, the participating Technology teachers managed to interpret the work schedule and design lesson plans and learner activities to cover Technology curriculum themes, but some teachers still experienced challenges in some concepts of mechanical systems.

4.3.2 Learner and the milieu dimensions

The learner and milieu dimensions focus on planning and preparing Technology activities. The categories are combined in Table 4.7. There are 6 categories in this section each of which consists of 2 sub-categories (Table 2.3). The contribution of this section helps to answer research sub-question 2 (sub-section 1.4.2). The section closes with a synthesis of the four types of source documents outlined in Table 4.2 and focuses on how planned and prepared activities address the aspect of TSE.

4.3.2.1 Nomvula

Table 4.7 below presents the results of Nomvula's documents analysis based on the learner and milieu dimensions. A discussion follows.

Table 4.7. Overall results of Nomvula's documents on the learner and milieu dimensions

Categories	Not at all	Somewhat	To a great extent
1. Image of learner		Lesson plans, learners' workbooks, project portfolio	Work schedule
2. Opportunities for learner development		Lesson plans, learners' workbooks, project portfolio	Work schedule
3. Intended focus of instruction		Lesson plans, learners' workbooks, project portfolio	Work schedule
4. Learning style		Lesson plans, learners' workbooks, project portfolio, work schedule	
5. Interaction between society and technology	Lesson plans, learners' workbooks, project portfolio	work schedule	
6. Interaction between society and process of curriculum development	Lesson plans, learners' workbooks, project portfolio	work schedule	

The results show that Nomvula's work schedule in these dimensions is classified under "to a great extent" in categories 1to3 and "somewhat" in categories 4 to 6. This is an indication that the work schedule contains substantive evidence in categories 1 to 3 and contains some evidence in categories 4 to 7 (Figure 4.3.1). The column 4 coupled with column 6 rows 3 to 7 in Figure 4.3.1 address all the categories (1-6) in Table 4.7.

The results reveal that lesson plans, learners' workbooks and project portfolios are classified under "somewhat" in categories 1 to 4 and classified under "not at all" in categories 5 and 6. This is an indication that the lesson plans, learners' workbooks and project portfolios contains some evidence on categories 1 to 4 and contains no evidence in categories 5 and 6.

The work schedule under "to a great extent", presents activities that promote learner involvement in active learning that links the concepts to concrete understanding and to acquire knowledge across the three themes of the Technology curriculum (column 4, Figure 4.3.1). The work schedule offer opportunities for the learner cognitive and skills development (Figure 4.1, column 4 to 6 of Figure 4.3.1). The work schedule presents activities that are designed to create a structured and unstructured learning environment as required to enable different learning styles. This enhances the understanding of technology knowledge in a holistic manner. However, the work schedule "somewhat" emphasize the context that shows

some influences on the development of technology and its development in society. The work schedule "somewhat" reflects on some ideological concerns and societal needs in some activities.

Nomvula's activities in the lesson plans, the learners' project portfolios and workbook were designed to promote learner involvement that somewhat links the concepts of Technology to concrete understanding and acquired knowledge. These types of activities are for the most part covered in the work schedule column 4, Figure 4.3.1. The analysis of all four document types show that to some extent, the activities were planned and prepared to offer opportunities for leaner cognitive and skills development. The activities in Nomvula's lesson plans, the learners' workbooks and project portfolio were "somewhat" planned and prepared to create a well-balanced learning environment and to address some shared interests of learners. The activities were planned to promote cognitive and skills development as they focused more on TKU (Figure 4.3.13, Figure 4.3.14, Figure 4.3.15).

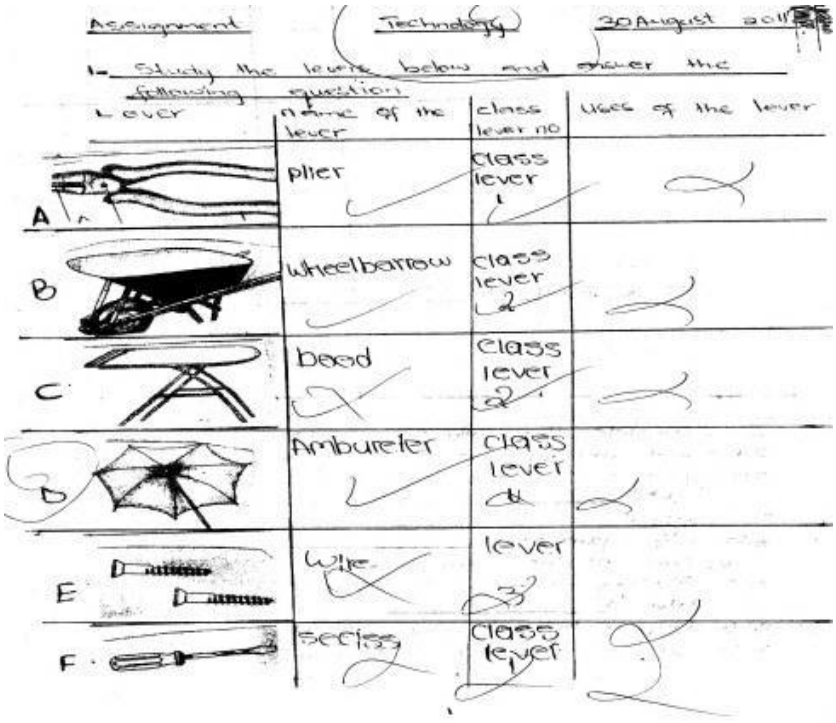
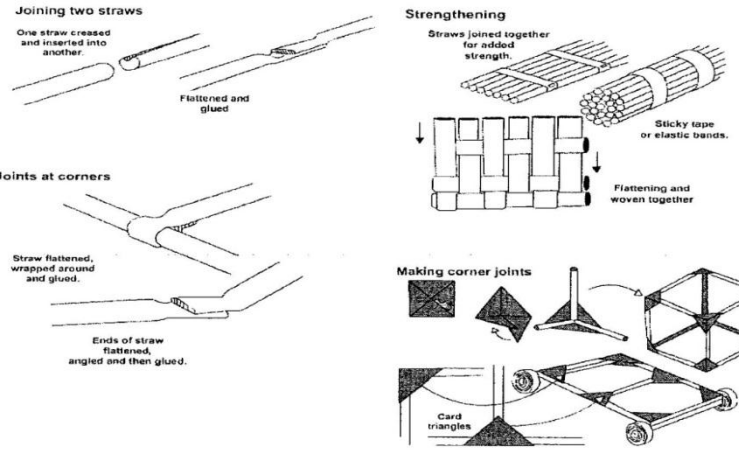


Figure 4.3.13.Example a learner activity focused on knowledge development

For the interaction between society and Technology, the kind of activities outlined in Nomvula's lesson plans, the learners' workbooks and project portfolios do not emphasize the

influence of TSE at all. The work schedule somewhat emphasise the interaction influence of TSE in some places.



Use this information to describe how to:

1. Join two straws for maximum strength [5 marks]
2. Strengthen straws [5 marks]
3. Make joints at corners [5 marks]
4. Make corner joints using card triangles [5 marks]

[20 marks]

Suggested Solutions

Question number	Possible mark	Answers
1	5 marks	Learners' answers will vary.
2	5 marks	Learners' answers will vary.
3	5 marks	Learners' answers will vary.
4	5 marks	Learners' answers will vary.
5	5 marks	Learners' answers will vary.

Appendix of Assessment Tools

Figure 4.3.14. Example of some activities in a lesson plan

The interaction between society and the process of curriculum development the lesson plans, learners' workbooks and project portfolios do not reflect TSE aspects. The work schedule somewhat reflects some aspects of TSE (Figure 4.3.1, column 4 row 7).

Figure 4.3.15. Example of an artefact learners' produced

In conclusion, based on the results and discussions, the teacher has some idea of interpreting the work schedule and enacts it in developing some learners' activities that are slightly contextualised with reference to TSE.

4.3.2.2 Suzan

Table 4.8 below presents the results for Suzan's documents analysis based on the learner and milieu dimensions. A discussion follows

Table 4.8. The overall results of Suzan's documents on the learner and milieu dimensions

Categories	Not at all	Somewhat	To a great extent
1. Image of learner		Lesson plans, learners' workbooks, project portfolio,	Work schedule
2. Opportunities for learner development		Lesson plans, learners' workbooks	Work schedule, project portfolio
3. Intended focus of instruction		Lesson plans, learners' workbooks, project portfolio	work schedule
4. Learning style		Lesson plans, learners' workbooks, project portfolio, work schedule	
5. Interaction between society and technology	Lesson plans, learners' workbooks, project portfolio,	Work schedule	
6. Interaction between society and process of curriculum development	Lesson plans, learners' workbooks, project portfolio,	Work schedule	

The results show that Suzan's work schedule in the learner and milieu dimensions is classified under "to a great extent" in categories 1 to 3 and "somewhat" in categories 4 to 6. The project portfolio is classified under "to greater extent" in category 2. This is an indication that the work schedule contains substantive evidence in categories 1 to 3 and project portfolios contains substantive evidence category 2 (Figure 4.3.1). The work schedule is also classified under "somewhat" in categories 5 to 6. This is an indication that the work schedule contains some evidence on categories 4 to 7 (Figure 4.3.1). Column 4, coupled with column 6, rows 3 to 7 in Figure 4.3.1 address all the categories 1 to 6 in Table 4.8.

The results reveal that lesson plans, the learners' workbooks and project portfolios are classified under "somewhat" in categories 1 to 4 and classified under "not at all" in categories 5 and 6. This is an indication that the lesson plans, the learners' workbooks and project portfolios contains some evidence of categories 1 to 4 and contains no evidence of categories 5 and 6.

The work schedule "to a great extent", presents activities that promote learner involvement in active learning that links the concepts to concrete understanding, and to acquire knowledge across the three themes of the Technology curriculum (column 4, Figure 4.3.1). The work schedule and the activities in the project portfolios, are planned to create opportunities for learners' cognitive and skills development (column 4 to 6, Figure 4.3.1, Figure 4.3.5).

The work schedule also presents activities that are designed to create structured and unstructured learning environment as required, to enable different learning styles. This enhances the understanding of technology knowledge in a holistic manner. However, the work schedule "somewhat" emphasizes the context which shows some influences on the development of technology and its development in society. The work schedule also "somewhat" reflects on some ideological concerns and societal needs in some activities.

The lesson plans, learners' exercise books and the learner's project portfolios in categories 1 to 3 present some activities that link the concepts across the Technology themes (Figure 4.3.7). The lesson plans, learners' exercise books and their project portfolios "somewhat" offer some opportunities for learners' cognitive and skills development (Figure 4.3.15). The lesson plans, learners' exercise books and their project portfolios "somewhat" present some

activities that are designed to create a structured and unstructured learning environment as required enabling different learning styles. Suzan "somewhat" prepared activities to suit different learning environments as required to address different learning styles in understanding technology knowledge holistically.

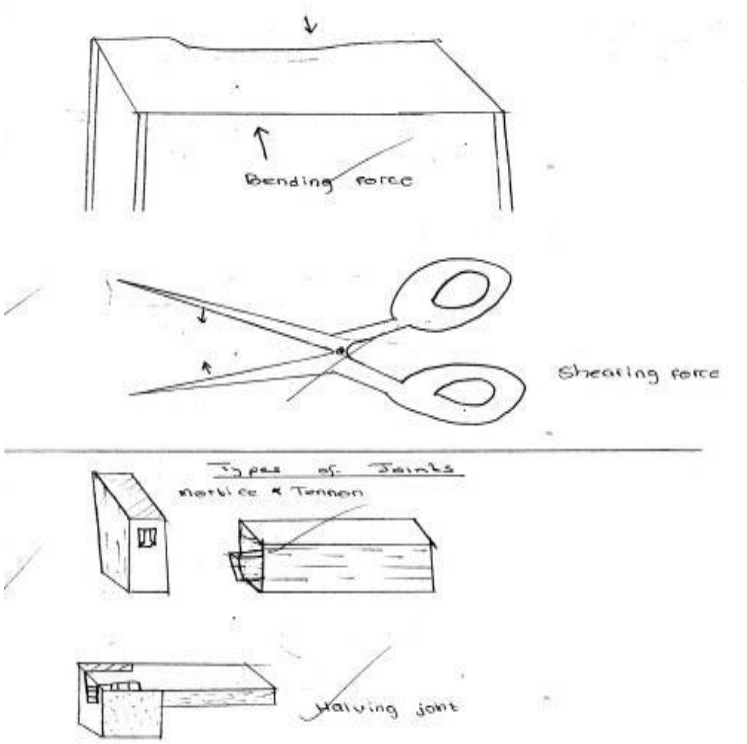


Figure 4.3.16. Example of learner activity cognitive and skills development

The learners' project portfolios in category 2, offer activities that give opportunities for cognitive and skills development through engaging learners in hands-on experiences, and developing knowledge of Technology concepts.

Suzan's activities in her lesson plans, her learners' workbooks and the project portfolios regarding the interaction between technology and society do not emphasize the context that could show the influence of the aspects of TSE. The work schedule somewhat emphasizes the context and shows the influence of TSE in some places.

The interaction between society and the process of curriculum development do not reflect the TSE aspects in the lesson plans, the learners' workbooks or project portfolios (Figure 4.3.6). The work schedule "somewhat" reflects the aspects of TSE aspects in some parts (Figure 4.3.1).

In conclusion, based on the results and discussions the teacher has some idea of interpreting the work schedule and enact it in developing learners' activities that are somewhat contextualised with reference to TSE.

4.3.2.3 Job

Table 4.9 presents the results of Job's document analysis based on the learner and milieu dimensions. A discussion follows.

Table 4.9. Overall results of Job's documents on the learner and milieu dimensions

Categories	Not at all	Somewhat	To a great extent
1. Image of learner		Lesson plans, learners' workbooks	Project portfolio, work schedule
2. Opportunities for learner development		Lesson plans, learners' workbooks, project portfolio	work schedule
3. Intended focus of instruction		Lesson plans,	project portfolio, learners' workbooks, work schedule
4. Learning style		Lesson plans, learners' workbooks, project portfolio	Work schedule
5. Interaction between society and technology	Lesson plans, learners' workbooks	Work schedule, project portfolio	
6. Interaction between society and process of curriculum development	Lesson plans, learners' workbooks, project portfolio	Work schedule	

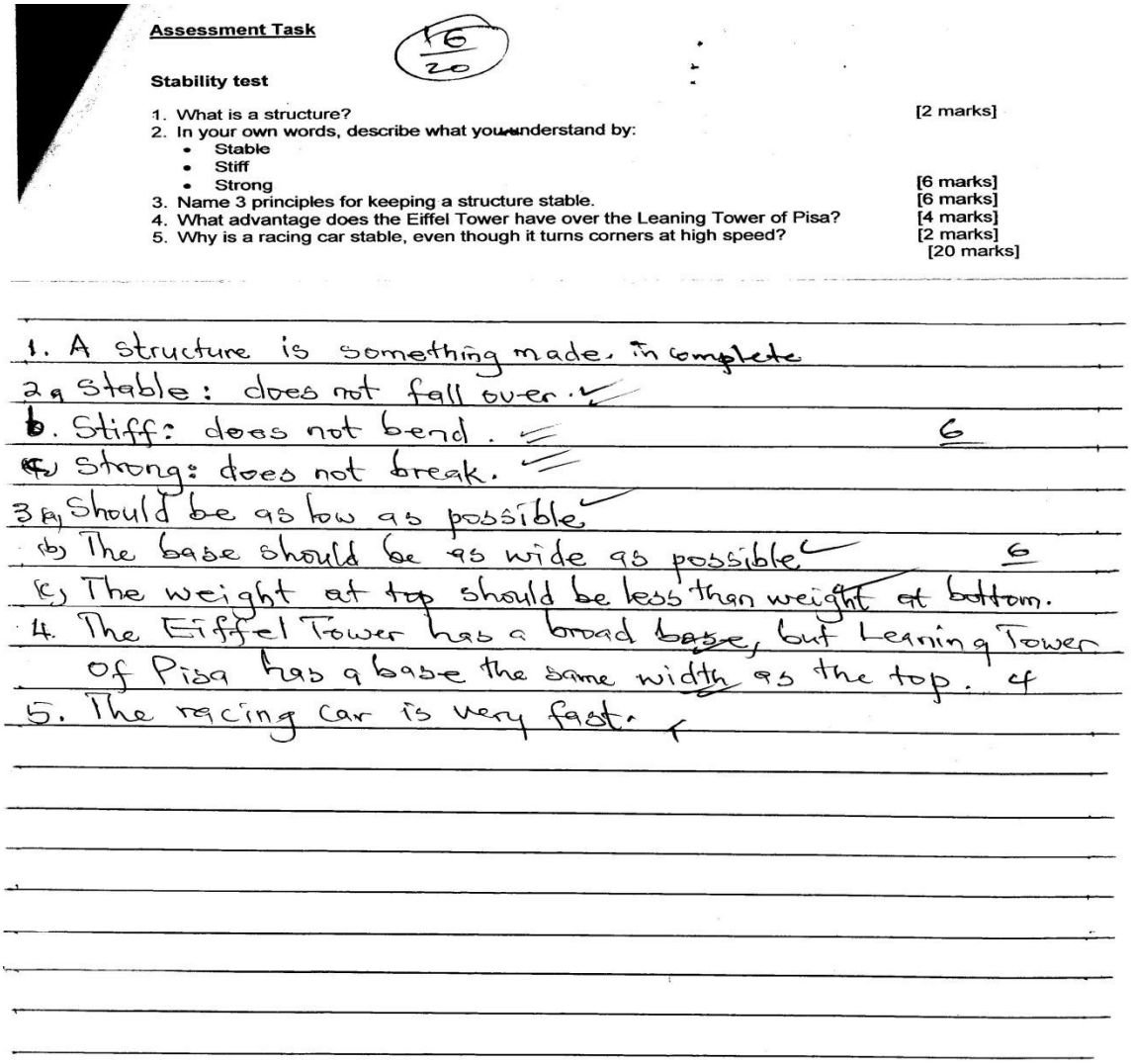
In Table 4.9, the results show that Job's work schedule in the learner and milieu dimensions is classified under "to a great extent" in categories 1 to 4. The project portfolio is also classified under "to greater extent" in categories1 to 3. This is indicates that the work schedule contains substantive evidence in categories 1 to 4 and project portfolios contain substantive evidence in categories 1 to 3. The learners' exercise books were classified under "to a great extent" in category 3. These results indicate that the learners' exercise books contain substantive evidence on category 3.

The results show that the work schedule is classified under "somewhat" in categories 5 and 6. This indicates that the work schedule contains some evidence in categories 4 to 6 (Figure 4.3). Column 4, coupled with column 6, rows 3 and 7, Figure 4.3 address categories 1 to 6 in Table 4.9. The results reveal that lesson plans are classified under "somewhat" in categories 1

to 4 and “not at all” in categories 5 to 6. This is an indication that lesson plans at least contain some evidence on categories 1 to 4 and no evidence in categories 5 and 6. The learners’ exercise books are classified under “somewhat” in categories 1, 3 and 4 and classified under “not at all” in categories 5 and 6. This is an indication that the learners’ exercise books contain some evidence on categories 1, 3 and 4 and no evidence in categories 5 and 6. The project portfolios are classified under “somewhat” in categories 2, 4 and 5 and “not at all” on category 6. This is an indication that the project portfolios contain some information in categories 2 to 4 and no evidence in categories 5 and 6.

The work schedule and project portfolios “to a great extent” present activities that promote learner involvement in active learning that links the concepts to concrete understanding and to acquire knowledge across the three themes of the Technology curriculum (column 4, Figure 4.3.1). The work schedule offers opportunities for learners’ cognitive and skills development (column 4 to 6, Figure 4.3.1). The work schedule, project portfolios and learners’ workbooks are focused in addressing the learning needs of individual learners. The work schedule also presents activities that are designed to create a structured and unstructured learning environment as required to enable different learning styles. This enhances the understanding of technology knowledge in a holistic manner.

However, the work schedule and project portfolios “somewhat” emphasize the context that shows some influences on the development of technology and its development in society. The work schedule also “somewhat” reflects on some ideological concerns and societal needs in some activities.



Assessment Task

16/20

Stability test

1. What is a structure? [2 marks]
2. In your own words, describe what you understand by:
   - Stable
   - Stiff
   - Strong

   [6 marks]
3. Name 3 principles for keeping a structure stable. [6 marks]
4. What advantage does the Eiffel Tower have over the Leaning Tower of Pisa? [4 marks]
5. Why is a racing car stable, even though it turns corners at high speed? [2 marks]

[20 marks]

1. A structure is something made. In complete
2. a Stable: does not fall over. ✓
   b. Stiff: does not bend. ✓
   c) Strong: does not break. ✓ 6
3. a) Should be as low as possible ✓
   b) The base should be as wide as possible ✓ 6
   c) The weight at top should be less than weight at bottom.
4. The Eiffel Tower has a broad base, but Leaning Tower of Pisa has a base the same width as the top. ✓
5. The racing car is very fast. ✓

Figure 4.3.17. Example of a learner activity that promote concrete learning of concepts

The lesson plans and learners' exercise books in category 1 "somewhat" present some activities that promote learner involvement in learning, links the concepts across concrete understanding and acquire knowledge as presented in the Technology themes (Figure 4.3.16). The lesson plans and the project portfolios "somewhat" offer some opportunities for learners' cognitive and skills development (Figure 4.3.10). The lesson plans and learners' exercise books present some activities that are designed to address individual learner and group learning needs. The lesson plans, learners' workbooks and project portfolios are "somewhat" designed to create structured and unstructured learning environment that enable different learning styles (Figure 4.3.8).

The lesson plans and learners' workbooks activities do not emphasize the context that shows influence of society on the development of technology and the development of technology in society the context that shows an influence of TSE.

The lesson plans, learners' workbooks and project portfolios do not reflect on the ideological concerns and social needs in technology.

In conclusion, based on the results and discussions the teacher has an idea of interpreting the work schedule and enacts it to develop learners' activities that are contextualised with reference to TSE.

4.3.2.4 Jane

Table 4.10, presents the results of Jane's documents analysis based on the learner and milieu dimensions. A discussion follows.

Table 4.10. Overall results of Jane's documents on the learner and milieu dimensions

Categories	Not at all	Somewhat	To a great extent
1. Image of learner		Lesson plans, learners' workbooks, project portfolio,	Work schedule
2. Opportunities for learner development		Lesson plans, learners' workbooks, project portfolio,	Work schedule
3. Intended focus of instruction		Lesson plans, learners' workbooks, project portfolio	Work schedule
4. Learning style		Lesson plans, learners' workbooks, project portfolio, work schedule	
5. Interaction between society and technology	Lesson plans, learners' workbooks, project portfolio	Work schedule	
6. Interaction between society and process of curriculum development	Lesson plans, learners' workbooks, project portfolio	Work schedule	

In Table 4.10, the results show that Jane's work schedule in the learner and milieu dimensions is classified under "to a great extent" in categories 1 to 3. This is an indication that the work schedule contains substantive evidence on categories 1 to 3.

The results show that the work schedule is classified under "somewhat" in categories 4 to 6. This is an indication that the work schedule contains some evidence on categories 4 to 6 as shown in Table 4.10. Column 4, coupled with column 6, rows 2 to 8, (Figure 4.3.11) address all the categories 1 to 6 (Table 4.10). The results also reveal that lesson plans, learners' workbooks and project portfolios are classified under "somewhat" in categories 1 to 4 and "not at all" in categories 5 and 6. This is an indication that lesson plans, learners' work books and project portfolios do not contain any evidence in categories 5 and 6. This is an indication that the lesson plans, learners' exercise books and project portfolios have no evidence in categories 5 and 6.

Jane's planning and preparations of activities in the work schedule "to a great extent" promote learner involvement in active learning that links Technology concepts to concrete understanding. This assists learners to acquire knowledge as presented in category 1(Figure 4.3.11). The activities in the work schedule also have a potential to offer opportunities for learner cognitive and skills development in category 2. The activities in the work schedule address the learning needs of individual and group learners.

The lesson plan, project portfolios and learners' workbooks activities "somewhat" promote learner involvement in some learning that links some Technology concepts developing some cognitive and skills development (Figure 4.3.12). The activities in the work schedule, lesson plans, project portfolio and learners' workbooks show some consideration for the learners' learning needs, which are design to create some environment to understand technology knowledge.

The work schedule activities "somewhat" emphasize the context that shows some influence of the society on the development of technology and the development of society (Figure 4.3.11, columns 3 to 4, row 8). These activities reflect some activity integration of the TSE aspects in some parts to meet the societal needs in the curriculum.

In the interaction between technology and society aspect, Jane's lesson plans, the learners' workbooks and project portfolios activities do not emphasise the context that shows the integration of TSE.

In the interaction between society and the process of curriculum development aspects, the lesson plans, learners' workbooks and project portfolios do not reflect the ideological concerns of TSE needs in the curriculum.

In conclusion, based on the results and discussions the teacher's interpretation and enactment of the work schedule to develop some learners' activities are slightly contextualised to TSE, which seem to present a challenge.

4.3.2.5 Synthesis of the learner and milieu dimensions of the four cases

In the learner and milieu dimensions, the lesson plans, learners' workbooks, and project portfolios generally appear across the cases to "somewhat" promote learner involvement in learning concepts to concrete understanding the categories tabled in the learner and milieu dimensions. This indicates that the activities presented in these documents contain at least some evidence in the categories. The lesson plans, learners' workbooks and project portfolios "somewhat" offer opportunities for learner cognitive development and skills (Figures 4.3.11, Figure 4.3.15, Figure 4.3.17). However, the work schedule (supplied by the Department of Education) offers opportunities for learner cognitive development and skills development to a great extent (Figure 4.3.1, Figure 4.3.11). The lesson plans, learners' workbooks and project portfolios (except in the case of Job in some categories) activities are presented to address individual or shared interests of learners to no significant extent but they are addressed "to a great extent" in the work schedules for the novice and experienced teachers (Figure 4.3.1, Figure 4.3.11).

The analysis shows that the teachers' documents were "somewhat" designed to create a structured learning environment, but they do not address the different learning styles that bring the understanding of technology knowledge when integrated with societal needs or the development of technology in society (Figure 4.3.14, Figure 4.3.16, Figure 4.3.17).

The learner and milieu dimension on the aspect of interaction between society and technology reveal that lesson plans, learners' workbooks and project portfolios in the novice and experienced categories "do not" emphasize the context that shows the influence of TSE. However the work schedules in both categories "somewhat" emphasise the context that shows the influence of TSE in some places.

Similarly, the lesson plans, learners' workbooks and project portfolios in the aspect of interaction between society and the process of curriculum development "do not" reflect in the ideological concerns of TSE to address societal needs. The work schedules "somewhat" reflect on the ideological concerns of TSE aspects in some places.

The findings of the learner and the milieu dimension, in relation to the Technology activities, show that Technology teachers in the novice and experienced categories interpret and enact the work schedule to plan learner activities in Technology out of context. They are more content focused. This means minimal engagement with the TSE theme. These findings contribute to answering research Sub-question 2 and Objective 2 in Chapter 1 section 1.3 and sub-section 1.4.2.

4.3.3 Teacher Dimension

The teacher dimension consists of 4 categories and each category has 2 to 4 sub-categories. The teacher dimension is useful to addresses research sub-question 3 as outlined in sub-section 1.4.2. This sub- section concludes with a synthesis of the four document types in all the four cases. The synthesis is outlined in line with what transpired in the four documents types.

4.3.3.1 Nomvula

Table 4.11 presents the results of Nomvula's documents analysis of the teacher dimension. A discussion follows.

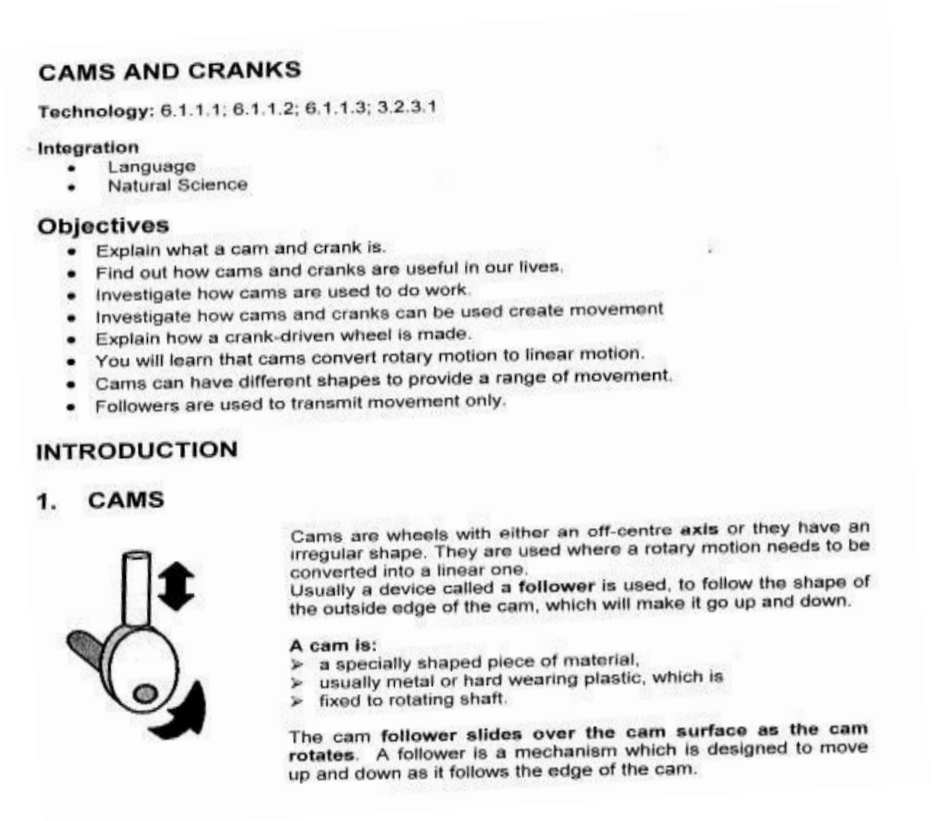
Table 4.11. Overall results of Nomvula's documents on the teacher dimension

Categories	Not at all	Somewhat	To a great extent
1. Communication of developer's considerations to teachers		Lesson plans, learners' workbooks, project portfolio	work schedule
2. Degree of teacher autonomy	Work schedule, lesson plans	Learners' workbooks, project portfolio,	
3. Teachers role in instruction		Lesson plans, learners' workbooks, work schedule, project portfolio	
4. Consideration of teachers' needs		Lesson plans, learners' workbooks, project portfolio	work schedule

The results in Table 4.11, show the work schedule classified under "to great extent" in category 1 and 2. This is an indication that the work schedule presents substantive evidence in category 1 and 2. In most categories lesson plans, learners' workbooks, and their project portfolios are classified under "somewhat" and the work schedule in category 3. This is an indication that these documents present some evidence in category 3. The work schedule and lesson plan are classified under "not at all" in category 2. This is an indication that there is no evidence presented by these documents in category 3.

Nomvula's work schedule activities were "to a great extent" in line with the policy requirements for teaching Technology.

The learners' project portfolios and their books "somewhat" meet the policy requirement due to some variations in the type of activities that were planned for teaching. Nomvula's lesson plans, portfolios and learners' workbooks "somewhat" highlight the subject matter content, the rationale regarding learners, the setting of context and outline her role as a teacher (Figure 4.3.18).



CAMS AND CRANKS

Technology: 6.1.1.1; 6.1.1.2; 6.1.1.3; 3.2.3.1

Integration
- Language
- Natural Science

Objectives
- Explain what a cam and crank is.
- Find out how cams and cranks are useful in our lives.
- Investigate how cams are used to do work.
- Investigate how cams and cranks can be used create movement
- Explain how a crank-driven wheel is made.
- You will learn that cams convert rotary motion to linear motion.
- Cams can have different shapes to provide a range of movement.
- Followers are used to transmit movement only.

INTRODUCTION

1. CAMS

Cams are wheels with either an off-centre **axis** or they have an irregular shape. They are used where a rotary motion needs to be converted into a linear one.
Usually a device called a **follower** is used, to follow the shape of the outside edge of the cam, which will make it go up and down.

A cam is:
- a specially shaped piece of material,
- usually metal or hard wearing plastic, which is
- fixed to rotating shaft.

The cam **follower slides over the cam surface as the cam rotates**. A follower is a mechanism which is designed to move up and down as it follows the edge of the cam.

Figure 4.3.18. Sample lesson plan with objectives

Nomvula "somewhat" managed to identify relevant outcomes and assessment standards from the work schedule and lesson plans (Figure 4.3.1). Although the lessons were pre-developed for her, the activities were planned in a way that she could facilitate teaching and learning without a problem.

In this case, Nomvula was not involved in planning work schedule and or the lessons, so her role as a source of producing these documents cannot be assessed. It is also difficult to judge her mastery of the subject matter knowledge. More information about Nomvula's teaching approach and capacity is revealed in the lesson observation in section 4.4. However, Nomvula's work schedule and lesson plans show that much effort was put into the development of these pieces of work (Appendix D)

4.3.3.2 Suzan

Table 4.12 presents the results of Suzan's documents analysis of the teacher dimension. A discussion follows.

Table 4.12. Overall results of Suzan's documents on the teacher dimension

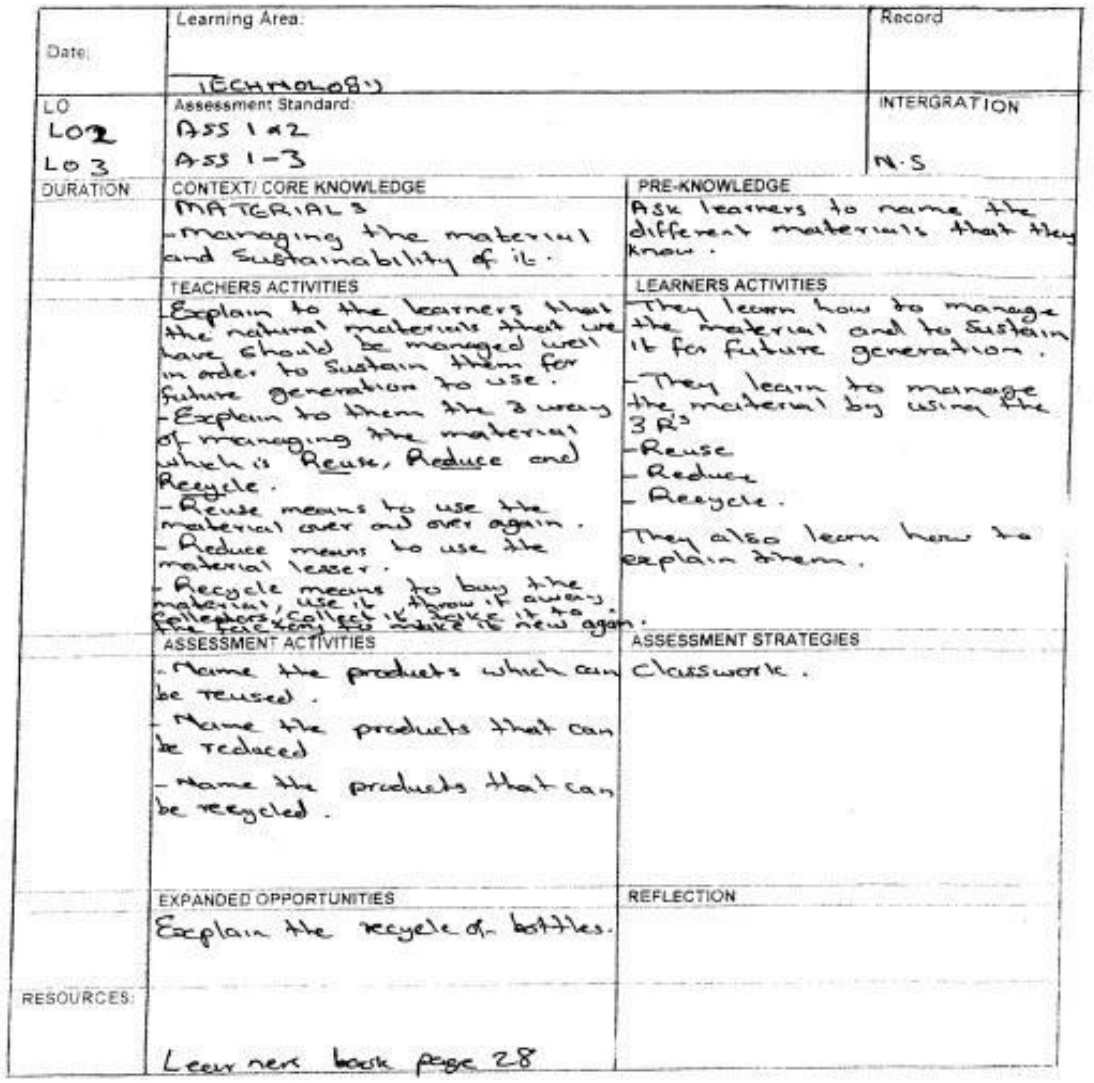
Categories	Not at all	Somewhat	To a great extent
1. Communication of developer's considerations to teachers		Lesson plans, learners' workbooks, project portfolio,	Work schedule
2. Degree of teacher autonomy	Work schedule	Lesson plans, learners' workbooks, project portfolio,	
3. Teachers role in instruction	Project portfolio	Lesson plans, learners' workbooks, work schedule work schedule	
4. Consideration of teachers' needs		Lesson plans, learners' workbooks, project portfolio	Work schedule

The results reveal that the work schedule in the teacher dimension work schedule is classified under "to greater extent" in categories 1 to 4 and classified under "somewhat" in category 3. The indication is that the work schedule present substantive evidence in categories 1 to 4 and contain some evidence in category 3.

The results reveal that lesson plans, learners' exercise books classified under "somewhat" in categories 1 to 4. This is an indication that the work schedule presents some evidence in

categories 1 to 4. The project portfolios are classified under "somewhat" in categories 1, 2 and 4 but classified under "not at all" in category 3. This is an indication that the project portfolios contain some evidence in categories 1, 2 and 4 and contain no evidence in category 3.

Suzan's lesson plans (self-designed), project portfolios and the learners' exercise books "somewhat" indicate that she designed the activities to provide structured and unstructured learning environments. She designed the activities to accommodate learners' different learning styles and to build on the understanding of technology knowledge aspects (Figure 4.3.19, Figure 4.3.5).



Date:	Learning Area: TECHNOLOGY	Record
LO LO2 LO3	Assessment Standard: Ass 1 & 2 Ass 1-3	INTERGRATION N.S
DURATION	CONTEXT/ CORE KNOWLEDGE MATERIAL 3 - Managing the material and Sustainability of it.	PRE-KNOWLEDGE Ask learners to name the different materials that they know.
	TEACHERS ACTIVITIES - Explain to the learners that the natural materials that we have should be managed well in order to sustain them for future generation to use. - Explain to them the 3 ways of managing the material which is Reuse, Reduce and Recycle. - Reuse means to use the material over and over again. - Reduce means to use the material lesser. - Recycle means to buy the material, use it, throw it away, collectors collect it, take it to factory to make it new again.	LEARNERS ACTIVITIES - They learn how to manage the material and to sustain it for future generation. - They learn to manage the material by using the 3 R's - Reuse - Reduce - Recycle. They also learn how to explain them.
	ASSESSMENT ACTIVITIES - Name the products which can be reused. - Name the products that can be reduced - Name the products that can be recycled.	ASSESSMENT STRATEGIES Classwork.
	EXPANDED OPPORTUNITIES Explain the recycle of bottles.	REFLECTION
RESOURCES:	Learner book page 28	

Figure 4.3.19. Exemplar lesson plan of structured learning environment

Suzan's work schedule was supplied by the Department of Education, which compromises her autonomy in designing the work schedule herself. The work schedule covers the work required for Grade7 and clearly shows the Technology content that is to be covered in each quarter of the year (Appendix D). The work schedule and the lesson plans highlight the context, the outcomes, assessment standards and their integration within and across other subjects as well as the teaching methods and strategies. Suzan's work schedule, lesson plans and learners' workbooks "somewhat" give room for a teacher to play a supportive role during teaching and learning.

4.3.3.3 Job

Table 4.13 below presents the results of Job's documents analysis in the teacher dimension, followed by the discussions.

Table 4.13. Overall results of Job's documents on the teacher dimension

Categories	Not at all	Somewhat	To a great extent
1. Communication of developer's considerations to teachers		Lesson plans, learners' workbooks, project portfolio,	Work schedule
2. Degree of teacher autonomy	Work schedule	Lesson plans, learners' workbooks, project portfolio,	
3. Teachers role in instruction		Work schedule, Lesson plans, learners' workbooks, project portfolio	
4. Consideration of teachers' needs			Work schedule, Lesson plans, learners' workbooks, project portfolio

The results reveal that the work schedule in the teacher dimension in Table 4.13 is classified under "to greater extent" in categories I to 4 and classified under "somewhat" in category 3. This indicates that the work schedule presents substantive evidence in categories 1 to 4 and contains some evidence in category 3.

The results revealed that lesson plans, learners' exercise books and project portfolios are classified under "to a great extent" in category 4 and somewhat" in category in categories 1 to 3. This indicates that the lesson plans, the learners' workbooks and their project portfolios contain substantive evidence in category 4 and some evidence in categories 1 to 3.

In Job's case, the learner project portfolios were remarkable as they covered the design process to produce the final product of the project. Job planned the tasks around the project to cover most of the Technology content in an integrated way (Figure 4.3.8).

His approach in these documents reveals that Job dealt with one aspect at a time. His lessons are planned to develop his learners' conceptual understanding of a particular topic, and then he introduces the next topic (Figure 4.3.9). After teaching the content, he introduces learners to a problem situation based on a particular context to facilitate the design process (Figure 4.3.8). He structured his activities to create learning environments that accommodate different learning styles.

The work schedule, lesson plans and learners' workbooks reflect some consideration on the allocation of content in different quarters of the year and the context in which these activities would be implemented. The objectives, the outcomes and teaching strategies are "somewhat" present in all four document types. However, his autonomy of designing the work schedule himself was compromised as the curriculum document was supplied by the Department of education. All Job's activities in these documents were aligned with the objectives and outcomes (Figure 4.3.1, Figure 4.3.9).

4.3.3.4 Jane

Table 4.14 below presents the results for Jane's documents analysis based on the teacher dimension. A discussion follows.

Table 4.14. Overall results of Jane's documents on the teacher dimension

Categories	Not at all	Somewhat	To a great extent
1. Communication of developer's considerations to teachers		Lesson plans, learners' workbooks, project portfolio	Work schedule
2. Degree of teacher autonomy	Work schedule	Lesson plans, learners' workbooks, project portfolio	
3. Teachers role in instruction		Lesson plans, learners' workbooks, project portfolio, work schedule	
4. Consideration of teachers' needs		Lesson plans, learners' workbooks, project portfolio	Work schedule

The results reveal that the work schedule in the teacher dimension in Table 4.14 is classified under "to a greater extent" in categories I to 4 and "somewhat" in category 3. It is also classified under "not at all" in category 2. The indication is that the work schedule presents substantive evidence in category 1 to 4, some evidence in category 3 and no evidence in category 2.

The results further reveal that lesson plans, learners' exercise books and project portfolios are classified under "somewhat" in category 1 to 4. This is an indication that the lesson plans, learners' workbooks and project portfolios contain some evidence in categories 1 to 4.

Jane's work schedule (supplied by Department of Education) is designed to create structured and unstructured learning environments to a greater extent than do her lesson plans, learners' workbooks and project portfolios. The activities in the documents are planned to follow the work schedule closely. The work schedule contains outcomes and assessment standards, rationale, teaching strategies and assessment strategies, forms, and methods of the Technology content to be covered in the year (Figure 4.3.11).

Jane "somewhat" planned the activities in line with the work schedule. However, Jane appeared to lack confidence in some aspects of the content and that seemed to impact on her planning. This translates to the type of work learners write in their workbooks and their project portfolios.

The technological processes and design process hardly take into consideration what learners are interested in and the design and making of products do not follow the required design processes. This absence of context shows and explains little opportunity for the integration of societal needs or technology with society that conforms to TSE.

4.3.3.5 Synthesis of the teacher dimension of the four cases

In the teacher dimension, the findings reveal that lesson plans, learners' workbooks, project portfolios and work schedules in both categories are to a certain extent related to what the teacher considers selecting subject matter, the rationale regarding learners and address the anticipated role of the teacher during implementation.

Setting the context in which learning out to take place is poorly addressed by teachers in their planning. The findings exposed that in both categories all the documents analysed for all the cases "somewhat" contained specific objectives or outcomes. Teacher strategies and particularly the work schedule "somewhat" give room for teachers to develop their own lesson plans.

The lesson plans, learners' workbooks, and project portfolios, somewhat suggest a central role for a teacher as a source of the subject matter knowledge and supportive in guiding learners to independent learning. The lesson plans, the learners' workbooks and project portfolios suggest a need for special training for teachers to teach Technology and address the difficulties they encounter.

This dimension addresses research Sub-question 3 on teachers' pedagogy (Section 1.4) and the third objective (Section 1.3) which addresses the limitations of their teaching methods.

The findings reveal that even though teachers have lesson plans and work schedules their autonomy to design their own work schedule is "somewhat" restricted because work schedules are supplied by the Department of Education. Consequently, this may affect teachers' actions in planning their lessons and teaching their classes. What they teach could be influenced by the pressure to finish the work schedule (which acts as a pacesetter), which could possibly affect the quality of the work presented by teachers.

4.4 Narratives from the semi-structured interviews and the observations

In this section, we examine how Technology teachers interpret, plan and approach the subject curriculum content through semi-structured interviews based on the research questions. The section also explores the success and barriers that participants are experiencing in engaging with the subject curriculum themes. The analysis in this section is based on the themes that emerged from the interviews. The identified emerged themes are, namely, the interpretation of Technology concepts, planning and preparation of Technology activities, instructional approaches, challenges in approaching the Technology themes, and barriers encountered in inter-relating the themes.

4.4.1. Interpretation of Technology concepts

This Section presents the evidence of participants' voices on the respondents' interpretation of TSE and other Technology curriculum concepts during interviews. All four participants' voices are represented and the sub-section which concludes with the synthesis.

4.4.1.1 Nomvula

Interview

Nomvula was direct in her interview and described the challenge she experienced with concepts in the topic systems and control. Nomvula says:

> *concept systems and control those machines thing it needs more knowledge to deliver to learners.*

Nomvula found the theme systems and control (especially with the concept machines), difficult to understand as she had not received training in the college. Her reference to machines could be that she was busy with that section at the time of the study. When asked what she does to make sure that the concepts in systems and control are taught, her response was:

> *Sometimes I can ask assistance from teachers who have more knowledge and the curriculum implementers help by conducting workshops so that the concepts can be clear to teach learners.*

However, she acknowledged that the help she received from the workshops and from Departmental Officials was not enough, as that section of the syllabus is very demanding.
About her familiarity with the themes in Technology, she says:

> *Yes, I am familiar with that because Technology it needs knowledge, skills and resources and must link with the environment and community must also achieve things from that Technology.*

To support to her familiarity with the themes in Technology, Nomvula gave this example:

> *… like in processing learners must know let's take we are making a marula jam this processing help them to not eating dry bread we make jam from marula where need only sugar then we can make homemade jam as the knowledge of processing.*

When probed about where the topic *processing* can be classified, she indicated that it fell within learning outcome number two (LO2). The *processing* topic is an element of the theme technological knowledge and understanding (TKU) in the Technology curriculum.

Nomvula describes the existence of the relationship of the themes in the Technology curriculum by referring to the learning outcomes as follows.

> *All learning outcomes in Technology they are existing because learning outcome one also relates with learning outcome two and three because all of them in Technology through investigating, design, make and evaluate everything LO1.*

She believes that the three themes can be engaged through the society and environment contextualisation of the TSE theme.

Nomvula interprets the theme Technology, society and environment (TSE) as follows.

> *Learners know that what they are busy learning it helps us in the community they must be fruitful in their community to do things on their own, not playing.*

She compares the role that TSE plays in her teaching with what is happening in society. Her interpretation of TSE is seen as setting the context of learning in which learners relate what they do in the classroom with the reality of what is happening in their society.

Observation

During lesson observation Nomvula's comparison of the role TSE plays in her teaching and what is happening in society was not in line with the lesson that she presented during observation. She could not relate well with the context in which it was meant because her teaching topic was on cams. Nomvula taught these concepts out of context, though she tried to clarify the concepts from the beginning and gave relevant examples but failed to link with the context. Although it was a small-scale observation, one might suggest that this could apply to other lessons, as she mentioned during the interviews that she had a problem when it comes to machines.

4.4.1.2 Suzan

Interview

Suzan describes her experiences with concepts in Technology as follows.

> *…it is very difficult we did not understand these concepts because the subject was still new, we struggled a bit but as years go by we were able to do the right thing. We know now how to…explain to learners and how these concepts are done to prepare the lesson…*

However, she highlighted some challenges in understanding other Technology concepts, she explains:

> *… this one of systems and control, this one is a bit challenge to me. I had to think that maybe I am a woman it deals more of machines. I have a problem with these machines I cannot explain them to these learners. Sometimes I want them to make a project that works and if I cannot do it learners also struggles.*

Suzan approaches this challenge, as 'concepts' need to be taught. She describes it as follows.

> *Yes, I have to do it but sometimes I go to male teachers here at school,… asking what does this mean what does machine look like they help me. Sometimes I ask them to come to class for demonstration.*

Suzan further identifies and highlights the three themes in Technology as follows.

> *We have only three of them the first one is Technology process and skills, technological knowledge and understanding and the last one is Technology, society and environment.*

She explains the relationship of these themes as:

> *Yes there is relationship because one cannot be dealt alone we have to do them at the same time all with the three they need to be done at the same time.*

Suzan's interprets the TSE theme as follows.

> *Learners must know the technology they are familiar with today how was it done err, before the impacts of this change to society also if the environment how does it affect the environment now and before as well as the bias part of it if favouring them now on*

Suzan views the role of the concept TSE in teaching Technology as

> *…it plays a very important role though our learners they do not know the things done long ago. Our learners cannot be able to match what was done before because they have no idea of what happened before.*

The illustration Susan gave on how she would engage the TSE theme, is as follows.

> *Let's take in processing. When we do processing we talk about ways of processing. How did long ago people processed food and if you give them an assignment to go and research they come being empty. They do not have enough information how things were done long ago they cannot have knowledge how it affect the society and the bias part of it.*

Observation

I could not observe Susan in the classroom as these observations was done at the participant's request, and Suzan did not request such an observation.

4.4.1.3 Job

Interview

Job describes the concepts that he find challenging in Technology as follows.

> *… the concept or concepts I find very challenging in teaching Technology are all concepts in learning outcome three i.e. indigenous technology and culture, impact of technology, biasness in technology as well as processing in learning outcome two i.e. Technology knowledge and understanding.*

Here Job is referring to the challenge he encounters when teaching and planning lessons on 'concepts'. He was unsure about the way he should incorporate the aspects (concepts) of learning outcome three (LO3). He did not know whether to deal with one at a time or all of

them at once. [This explanation came after a follow up visit for verification of data.] Job highlights the means of dealing with these challenges as follows.

> *To make sure that these concepts are taught in my class. I normally seek help from other teachers, that is to say Technology teachers in my school. I also request to be assisted by the circuit cluster technology team, whereby we conduct lesson studies as a support system.*

Job is familiar with the themes in Technology, as he explains:

> *... I know the technological process and skills, technological knowledge and understanding and Technology, society and environment.*

Of the three themes, Job's interpretation of Technology, society and environment (TSE) is that:

> *... Technology, society and environment theme in the Technology curriculum focuses on the impact, biasness in a particular society and environment.*

He describes TSE's role in teaching Technology as follows:

> *The role of this theme in teaching Technology is to enable us to recognise and identify the positive and negative impact of technology in society and environment to improve people's quality life and come up with strategies of reducing any undesirable events*.

[He thinks it is very necessary to have such a theme in Technology].

Observation

During the lesson observation, Job taught his learners about mechanisms and their mechanical advantage. The focus was on levers. Job assisted the development of understanding of the concept by setting a context in which levers are utilised to lift loads. However, he lost the opportunity of making learners aware of the impact of levers in their real life context. He could have expanded on the lifting of loads using high technology of which learners should be aware, but the lesson focused more on the means used in indigenous technology to move a heavy load.

4.4.1.4 Jane

Interview

Jane describes her challenge with understanding Technology curriculum concepts as follows.

> *The concepts which I find challenging in teaching Technology is thing ya (of) technological knowledge and understanding (TKU) this one of systems and control in fact those ones are challenging to me.*

She finds the concepts of systems and control difficult and frustrating. Jane reveals the way she tries to make sure that the concept is taught. She explains:

> *To make sure that these concepts are taught in my class I approach science teacher in fact to come to my rescue. Meanwhile I am there with him trying to understand these concepts very well, because systems and control is integrated with science things. The most important things they are doing in technology but particularly in systems and control.*

Despite her frustrations regarding the concepts of the systems and control section, she highlighted her familiarity with themes in Technology as follows.

> *The first one, technological processes and skills (TPS), then in that is whereby we follow the technological processes where we investigate, design, make, communicate and evaluate. After that I teach my learners to abbreviate it as IDMEC so that they may follow the procedure achieve in Technology. Even the last one since … I said with systems and control I am not good in. But the learning outcome three which is Technology, society and environment and let them know that nature does not want to be destroyed where we have the indigenous things, bias and what?* [wanted to say impact]".

Jane's interpretation of Technology, society and environment (TSE) is as follows.

> *… where we talk about the indigenous thing whereby we have to involve things … in fact they say technology it was there before is an olden thing even if they have not used it but it was there the olden people they know this thing very well* [meaning technology has been used since time immemorial].

Jane views the role of TSE as follows.

> *Let the learners be aware that the nature should not be disturbed and again they are familiar with the environment and they make sure that they should not harm the environment and the people around it.*

Jane finds it important for learners to be aware that of whatever design is taking place, they should take the aspects of the environment into consideration to protect the environment.

Observation

During the lesson observation in a Grade 9 class, lasting an hour, Jane brought a bicycle to class. Her lesson was about mechanisms with the emphasis on gear systems. She engaged the learners in identifying the different gear systems of the bicycle and in drawing them on their worksheets.

However, she lacked the confidence to handle the section, which resulted in a lost opportunity to set the proper context of teaching the section. Instead, her emphasis was more on the knowledge component than on demonstrating the interrelationship amongst the three Technology themes. During the interview, she confessed to experiencing difficulties with the section of machines and this could be a contributing factor.

4.4.1.5 Synthesis

Nomvula, Suzan and Jane highlighted some difficulties in understanding and teaching the concepts of mechanisms in the topic systems and control of Technology.

Job found it a challenge to engage with the concepts such as indigenous technology and impact and biases in technology when planning and teaching. These are components of the theme Technology, society and environment (TSE).

All four participants confirmed that in handling these concepts as part of the Technology curriculum they seek help from their colleagues within and outside their school. Suzan and Jane reported quite clearly that they ask these colleagues to co-teach with them.

All four participants are familiar with the three themes in Technology. Suzan and Jane identify these themes in line with the learning outcomes.

Nomvula and Suzan managed to describe the relationship that exists amongst the themes in Technology. Job and Jane, however, did not clearly describe their understanding of the relationship that exists amongst the Technology themes.

Suzan articulated her understanding of TSE without difficulty. However, she was not sure about the role TSE plays in the teaching of Technology as she related it to history.

On the other hand, Nomvula and Job struggled to formulate a clear interpretation of the theme TSE. Jane struggled to articulate her understanding of the theme TSE but she attempted to describe the role it plays in the teaching of Technology showed concern for the environment and advocated its protection.

Of the three lessons given by Nomvula, Job and Jane that I observed, only Job's lesson presentation mentioned indigenous technology (a component of TSE) as the context of the lesson. Nomvula and Jane's lessons were taught out of context and lacked focus on any real life situation. Their lessons addressed pure content.

4.4.2 Planning and preparation of Technology activities

This sub-section presents the evidence of the participants' voices gathered during the interviews on linking TSE to other themes in the Technology curriculum. All four participants' voices are represented and the sub-section concludes with a synthesis of their responses.

4.4.2.1 Nomvula

Nomvula describes the nature of technology activities as follows.

> *To link technology which they are doing at home.*

She indicates the kind of activities she engages her learners as follows.

> *I prefer written activities and oral activities also practical activities help learners to understand better" [for an example] "we have test as the written activity, test must recall what they have learned practical and knowledge and skills and they must investigate before and there must be a problem that should be solved.*

Regarding preparation for teaching, Nomvula affirms that Technology is an interesting subject to teach provided there are relevant resources as the nature of the subject links with what learners are faced with on a day to day basis. She conceded by saying the following:

> *When we plan technology we find it difficult because it needs resources and it needs more practical work.*

When probed to clarify what she means, she explains:

> *When teaching inside the classroom learners are participating because they have knowledge, their minds are not empty they have something that they know they only need opportunity to give to expand it and help them.*

Nomvula describes the process of planning as follows.

> *I focus on the learning outcomes and assessment standards focusing on the learning content and learning context, aims and objectives and also considering integration of other learning areas and taking into consideration the duration of the lesson as important. The other aspect I consider is prior knowledge as linking prior knowledge and learning context helps learners to understand better.*

4.4.2.2 Suzan

Suzan identifies the nature of technology activities as follows.

> *The activities in Technology usually are more of making skills has to show how to make and develop things and skills cannot be done alone for we start with knowledge to apply skills.*

She describes the type of activities in which she engages her learners in class as follows.

> *We usually do the activities about knowledge in the form of classwork and homework. I also give them a project sometimes I give them the research project then we also do a project we do all the steps of the technological process and skills.*

Looking at planning, Suzan describes the way she plans activities for teaching as follows.

> *I usually check the policy documents on the themes and check the assessment standards. Then I have to look at first the main assessment standard, then I will go*

and check with the other themes that one has to match with this assessment standard and I am correlating with them in designing for instruction.

Suzan identifies objectives as the way to check whether the themes are properly covered. She describes this process as follows.

I always, but sometimes when you teach the learners one of the themes when interacting with learners if one of the themes fails the objective is not achieved.

She pointed out that the objectives are derived from assessment standards.

4.4.2.3 Job

Job describes the nature of technology activities as follows.

Assignments, projects, case studies, investigative activities, research, tests, and …practical for instance based on learning outcome 2 where we have to take content out of it. Then I give them a classwork and homework and learning outcome 1 - technological processes and skills, I engage them with a project.

Job normally gives the types of activities mentioned in his dialogue above to his learners in his technology classes.

Job explains his experiences in planning as follows.

My experience in planning and teaching Technology in my class, I usually focus on the three themes described in learning outcome 1, 2 and 3. I make sure that the assessment standards are informed by the learning outcomes and the learning outcomes are derived from the three Technology themes.

Job describes the extent to which he engages TSE when planning as follows.

In designing my instruction I normally engage learners in learning outcome 3 in my teaching and learning activities because this theme addresses day-to-day problems in the society.

4.4.2.4 Jane

Jane indicates the nature of technology activities as follows.

> *...the nature of technology activities is based on projects, research and ...case study.*

Jane mentions the kind of activities she normally gives to the learners.

> *When I designing for teaching and learning I make sure that I understand what is this thing ya [of] TSE and let the learners again to understand then again and again.*

Jane explains her experience in planning and teaching Technology as follows.

> *The experience have is that most learners they enjoy this subject of Technology and when I attend them I make sure that I plan very thoroughly. And I know my things very well because it might happen that I find these intelligent learners asking me different questions. Then I plan very well but the challenge is ...sometimes you find that we do not have much resource so we improvise something.*

The question of engaging the themes when designing for teaching, Jane explains

> *...when designing for teaching and learning I make sure that I am familiar with TSE (theme) so that I may be able to impart this knowledge to learners.*

4.4.2.5 Synthesis

Nomvula and Job described the nature of technology activities as written work such as classwork and homework with a slight difference.

Suzan defined the nature of technology activities as activities addressing aspects of skills and knowledge.

Jane referred the nature of technology activities as forms of assessment and tasks.

Suzan and Job were clear about how technology activities are to be planned in an integrated manner as described in the lesson planning processes.

Nomvula found it difficult to plan, and cited the lack of resources and practical kits.

Jane could not clearly describe or explain her planning of Technology activities.

The four participants were not clear on how to engage TSE during planning.

4.4.3 Instructional approaches

This sub-section presents the evidence of the participants' voices speaking about their pedagogical approach towards the Technology curriculum themes recorded during interviews. For three of the participants the observation of one of their lessons is discussed to support, challenge or develop an understanding of their own descriptions of their pedagogical and teaching approaches. Rogan-Grayson profile of implementation was utilised in this section during the observations. The reason for this choice is that it has levels that define the levels in which the teachers and learners operate during teaching and learning. These levels are contextualised in line with the study as discussed in Section 2.8 (see pages 22, 23). All four participants' voices are represented and the sub-section concludes with a synthesis.

4.4.3.1 Nomvula

Nomvula describes her pedagogical approach towards Technology as follows

> *When we come to the method of teaching I prefer the learner centred method because it allows learners to share what they are having. Even in group discussions they allow themselves … they engage with their peers to sharing of knowledge with others.*

Nomvula describes the way she ensures that the interrelatedness of themes is catered for in her approaches as follows.

> *On the issue of skills, to see if those skills ... have been achieved there must be a product from that skill. They have achieved knowledge, when they have achieved knowledge to ensure that the skill is achieved.*

Observation

Nomvula's lesson lasted for an hour in a senior phase, Grade 7 class. The topic was on cams taken from *mechanisms* in *Systems and Control* as prescribed in the work schedule for the 3rd term (Appendix D). Nomvula mainly used a teacher centred approach. She started by

recapping the previous lesson. She asked questions about cam followers in which she encouraged chorus responses. Nomvula demonstrated the concepts of cams and followers and gave relevant examples of linkages in the textbook.

Nomvula missed the opportunity to relate the lesson to day-to-day experience by not setting a real life context. She led an activity that required learners to recall what the teacher was talking about and to create a drawing of a cam and follower. The learners found difficult as there were no creative ways of approaching the activity.

The lesson may be analysed on the degree to which the lesson was teacher or learner centred in terms of the Rogan-Grayson profile of implementation (Rogan and Grayson, 2003), (Table 2.4, Section 2.8).

In the teacher centred category, Nomvula focused on the concept of cams and cranks as content knowledge only and delivered a purely content focused lesson. Learners responded to the teacher's questions, wrote notes and did rough sketches on an activity sheet (Appendix D, activity sheet 2).

In the learner category, learners responded by doing written exercises in their class workbooks. There was no project or activity that required knowledge to solve a problem.

In conclusion, on average Nomvula operated in the rather low (Level 1) of the profile of implementation. This means that she has not satisfied the expectation level of being an independent designer of lessons that would achieve the cognitive and skills development of the learners. This inadequacy includes the community and cultural opportunities of exploration by learners, as intended in the curriculum and the TSE theme.

4.4.3.2 Suzan

Suzan explained her pedagogical approach towards Technology as follows.

> *I usually do the explaining of it if it comes to the knowledge … I do experiment when it comes to skills. I do demonstrations.*

Suzan explains the way she handles the interrelatedness in her approaches.

When I prepare my lesson, for a start, I make sure my documents are there by taking the document to choose the right assessment standards. Looking for another one … that from the part of the document, I know I have done the correct thing.

Observation

There was no observation of a lesson given by Susan. Her own description suggests (Level 1) of the Rogan-Grayson profile of implementation – a primarily teacher centred approach to teaching Technology, demonstrating the apparent lowest level of learner engagement.

4.4.3.3 Job

Job describes his approach to Technology as follows.

I normally apply learner centeredness, experiential learning and co-operative learning.

Job describes the extent to which the approaches he identified assist him to achieve his objective as follows.

I design my teaching instruction normally as I indicated, I usually engage them in Technology, society and environment theme in my teaching and learning activities because the theme addresses day to day problems in society.

Job describes how he ensures that interrelationship of themes in his approaches as follows.

During planning of teaching and learning instruction I make sure that all themes are integrated – no theme should be used in isolation because these themes are related to each other.

Observation

Job's lesson was based on Levers for the senior phase, Grade 7, class. Levers are part of mechanisms in system and control which itself is part of the theme, technological knowledge and understanding.

Job first created an atmosphere where learners were allowed to state their expectations and in this way, he catered for the outcome on the use of language, and so showed integration in this area.

Job used various teaching approaches using teacher-centred and learner-centred approaches interchangeably. He first checked learners' understanding of concepts from a preceding lesson. For the activities, he grouped the learners and handed out worksheets on levers.

Job used a question and answer strategy to stimulate an understanding of the importance of levers in real life contexts. Figure 4.4.1 below, shows some of the charts he used in class to illustrate that levers simplify the business of moving heavy objects.

Figure 4.4.1. Charts used by Job during lesson presentation

Job explained this statement by introducing the concept mechanical advantage where he discussed with learners the use of effort to move a load. He discussed with the learners the effects of the distance between the effort and the load.

Job gave various examples including the falling of an apple. He gave learners an activity to calculate mechanical advantage and he gave feedback to learners' work and discussed the meaning of the value of mechanical advantage after calculating (Appendix D).

At the end of the lesson, Job revisited the outcomes of the lesson with learners to verify if they were met it or not, and they confirmed that all the outcomes were met.

However, although the lesson was a success according to Job's reflections, he could have expanded more on the indigenous technological way of lifting loads compared to the modern high technology applications learners are familiar with. He could cover aspects of Level 4 in Table 2.4, Section 2.8 and aspects of the impact of technology on society, as outlined in the Technology-Society-Environment (TSE) theme.

After Job had completed his lesson presentation, the researcher provided feedback. In the process, the researcher tried to find out from Job about his next lesson plan. Job responded by saying that he would create a problem situation in the form of an investigative activity for learners to identify and apply the lever principles of mechanisms to solve the set problem.

According to the profile of implementation adapted from Rogan and Grayson (2003), discussed in Section 2.8, Table 2.4, the reflection of Job's lesson is analysed in terms of placement within levels that express the degree to which the lesson is teacher or learner centred.

In the teacher category, Job satisfied the expectations of Level 2 with some minor omission in the case of examples and applications from everyday life to illustrate the concepts of levers. Job's lesson was more content focused as he missed an opportunity to explore the use of levers in different cultural groupings. Little was done to give examples of objects that need levers for lifting. Job assisted learners to explore the explanations of levers, and this was completely based on content.

In the learner categories, Job managed to give learners the opportunity to ask questions based on the lever concepts they had learned about, but little was done to explore the context of their everyday life experiences. Learners did not get an opportunity to do investigative activities. The type of activities they did are provided in Appendix D. Learners were not given a project to explore but the participant did mention that in a future lesson they would be required to do a project to explore the use of levers on a day to day basis.

On average, Job operates on Level 2 of the expectation profile of teacher *vs.* learner-centeredness and he has occasionally satisfied (or rather promised) towards Level 3 for some learner centred approaches and the TSE contextualisation expected by the curriculum.

4.4.3.4 Jane

Jane explains her approaches towards Technology teaching as follows

> *Since this subject Technology is hands on learning area whereby learners need to be engaged in a practical…in most cases we do practical in class but unfortunately because of lack of resources I let them go and do at home but it is making it difficult to them because I do not see them while they are doing, meanwhile this thing is meant to be done in class so that I can be there to monitor and doing and making sure that everything it went right.*

Jane highlights the way she ensures the interrelatedness of themes in her approaches.

> *This thing I see it while we do projects. For instance a project, when we do a project is whereby we come up with a project portfolio it is whereby I see the interrelationship of this things because they need to investigate and they need to follow these processes until they come up with a project.*

Observation

The lesson observation took place in senior phase; Grade 9, class for 45 minutes from 09h00 to 09h45. The topic was about gears in the mechanisms section.

Jane brought a bicycle into the classroom. She first recapped on the previous lesson and introduced the topic of gears. She referred learners to the bicycle to identify different mechanisms involved and their functions. She demonstrated how to make a gear wheel. She gave learners a task to get card boxes and make gears of different sizes.

She struggled to address the concept of a gear ratio to the class. (It became difficult for me as an observer to keep quiet so I assisted her in working out the gear ratio due to the challenges she was experiencing in handling the section.) At the same time, some unruly learners did not listen but made noise. She was saved by the bell. Besides all the struggles, the lesson was

focused on addressing content, which is an aspect of technological knowledge and understanding.

The researcher used the Rogan and Grayson (92003) (Table 2.2, Section 2.8) profile of the implementation construct to determine the level of teacher centeredness the teacher used in her lesson.

An analysis of the level of the teacher's lesson regarding the degree to which the lesson was teacher or learner centred. An analysis was performed with the Rogan-Grayson profile of implementation.

In the teacher category, Jane used a bicycle to explain the use of mechanisms as examples of gears used in real life. Although she brought the bicycle to the classroom, the focus of the lesson was mainly on content to understand the concept of gears and gear ratio and did not deal with a specific issue or problem in the community. The teacher assisted the learners to understand the concept of gears and how to draw them, but she did not help them to master the application of their new knowledge (Appendix D for samples of the learner's drawings).

In the learner category, learners were given an opportunity to examine the bicycle to identify mechanisms. They then made drawings towards understanding the concepts of gears. This was an opportunity for them to interact with science and technology in their classroom e.g. the use of bicycles in society. Learners were not given a project to work on in their community except a class and homework task to cut cardboard to make models of gears of different sizes.

In conclusion, on average Jane operates at Level 1 of the profile of implementation despite the challenges she faces with the content section of machines.

4.4.3.5 Synthesis

Nomvula relates the pedagogical approaches to methods of teaching and teaching strategies.

Suzan confined pedagogical approaches to knowledge and skills developed through experiments and demonstrations.

Job believes that his approach is learner centred, experimental and allows co-operative learning.

Jane defines pedagogical approaches as defined through practical work.

Nomvula indicated that the interrelationship of themes during teaching should be in the form of activity to build skills and knowledge.

There is no explanation of interrelationship of themes during teaching for Suzan, as she did not want to be observed.

Job believes that the interrelationship of themes sets the context and they should be put into place during planning, because themes cannot be isolated from one another.

Jane sees the interrelationship through projects that learners do in class.

Only Job presented the lesson in an interactive and interrelated way in class when he used teacher and learner centred approaches. He taught this lesson within the context of indigenous technology as one component of TSE. His next lesson would be on the design process for problem solving skills. This may somewhat have provided an opportunity for further integration and enhanced learner centeredness.

Nomvula's lesson was more teacher-centred and delivered pure content out of context.

Jane had difficulties with the content.

Nomvula and Jane on average operate at the same level (Level 1) of the level of expectation for the Rogan and Grayson (2003) profile of implementation of the Technology curriculum.

If Suzan's description of her pedagogy is used, she too lies at Level 1.

Job operates at Level 2, with some aspects of Level 3. True integration of themes to satisfy the TSE theme of the Technology curriculum, requires at least Level 3 functioning.

4.4.4 Challenges in approaching the Technology themes

This sub-section presents the evidence of participants' voices on the successes and failures in interrelating the Technology themes during planning and teaching. All four participants' voices are represented and the sub-section concludes with a synthesis.

4.4.4.1 Nomvula

Nomvula attributes her successes in approaching planning and teaching in an interrelated manner as follows.

> *When I approach my learners if for an example if ask why we make the car, they have knowledge that the car takes me from point A to point B or I what to help the community doing this and that is the car.*

About the failures that might occur in interrelating the themes in her approaches, Nomvula says:

> *I shall, I can, say no because this things are related and they link together … when maybe planning sometimes can be difficult because when linking, let's take you want to link processing with the society. Now is June time, sometime where there is no marula* [an indigenous wild fruit often used for preparing jam or preserves], *we are going to link this … finds it difficult because there is no marula until at the beginning of the year where we can find the fruit.*

Another factor contributing to Nomvula's failure to interrelate themes in Technology is attributed to the lack of knowledge in dealing with other aspects of content in Technology like systems and control.

4.4.4.2 Suzan

Suzan explains the approaches that she uses leading to her success in inter-relating the themes as follows.

> *Sometimes I do, as I said, that I sometimes get my objectives, sometimes I do not. I sometimes check kuri* [whether] *in that assessment standard I have achieved this one but this one I did not.*

She highlights things that seemed to lead to her failure when interrelating the themes during planning and teaching as:

> *It depends on the topic that I am dealing with. Sometimes of these topics are easy to interrelate them, some are not … especially to that one that I mentioned problems* [referring to the topic systems and control-mechanisms].

Suzan indicates the frustrations she is experiencing in dealing with these failures as follows.

> *It is difficult because sometimes we do go to the workshops but we come back without the knowledge and again we are not being helped. When they (curriculum advisors) come to they do not come to assist us. At least I can say they only come if they bring assessment task if ever they give themselves time.*

She pointed out that the officials do not give themselves time to look at the problems she is facing but they assist her instead:

> *They just deliver the common tasks without attending to our problems.*

4.4.4.3 Job

Job describes his approaches that lead to success in interrelating the themes as follows.

> *Sometimes when you plan your teaching and learning activities you find out that sometimes learners have a barrier of maybe language of teaching and learning.*

Job highlights the failures of approaches to interrelate the themes as follows.

> *The resources sometimes tend to be a barrier leading to failure to interrelating the technological themes successfully and as I indicated before some of the learning activities need learners to express themselves in the language of teaching and learning.*

On the question of how he deals with the failures, Job explains.

> *I just discuss all these failures with the other teachers who are teaching Technology in my school and refer the problem to school management team so as to assist us.*
> [He sometimes gets help].

4.4.4.4 Jane

Jane indicates the following regarding her success in approach in interrelating the themes.

> *The approaches that I use, they lead to success because at the end of the day we come up with something that is concrete. But we follow all those successes of themes so that we may come up with something that we need. Hence we said in technology is whereby learners - they need to solve the problems - then to show that this problem has been solved we see by product or the results.*

Jane describes her failure of interrelating the themes during planning and teaching as follows.

> *I can say, hence I have said, I do not have much more information about the concepts of … systems and control. It makes me be uncomfortable while teaching these things* [referring to machines] *because I am not familiar with this thing* [referring to machines].

She explained how she deals the failures to succeed as follows.

> *In trying to deal with this I request somebody* [a colleague] *whom we are on the same curriculum or some subject area* [referring to science] *where this thing there is. Integration, it might happen that he understands or she understands this* [the section] *better than me then I call him or her to come to my rescue.*

4.4.4.5 Synthesis

Nomvula, Job and Jane failed to articulate their successes in interrelating the themes in Technology.

Suzan's success in interrelating the themes is attributed to her because she followed a proper planning process to integrate the assessment standards.

Job indicates that the failures are caused by learners with language barriers and that they lack resources. In my view, these cannot be a total hindrance to interrelate the themes.

Nomvula, Suzan and Jane based their failure to interrelate the themes in Technology on the lack of understanding of central concepts in Technology such as mechanisms.

Suzan attributes her failure to interrelate the themes as lack of support from the Department of Education, as curriculum implementers do more administrative work than curriculum matters when they meet with the teachers.

4.4.5 Barriers encountered in interrelating themes

This sub-section presents the evidence of participants' voices on the barriers encountered in interrelating the themes in Technology during interviews. All four participants' voices are represented and the sub-section concludes with a synthesis.

4.4.5.1 Nomvula

Nomvula describes her barriers to success as follows.

> *There more barriers because first of all learners are divided into three groups gifted, average and those needy and we know that Technology has lesser number of periods. Minutes are very short, the more you teach and time is running out and there is a problem of learning materials … if we have more material that learners do practical that would help those needy learners.*

She says the following in relation to the teaching material that she is referring to:

> *Resources that we need to do now we are on cams those eccentric wheels, sliding doors can help us.*

Nomvula outlines part of the solution in addressing these barriers as follows.

> *Sometimes, I have time with those needy learners after school for 40 minutes - try to help them, to teach them.*

4.4.5.2 Suzan

Suzan explains that the cause of barriers she experiences is because she tried to deal with successes in interrelating the themes as follows.

> *There are barriers … sometimes it come to this one - the second one - technological knowledge and understanding, as I have said, something that I do not understand becomes difficult to pass the knowledge through to learners. And even if I want to prepare the lesson, I get stuck because I do not have more information. Sometimes the*

text books are a problem - they do not give us more information. Sometimes you get stuck when you look for help and you tend to overlook such.

Her response to the question of how she would address the barriers to succeed in interrelating the themes, she categorically states:

I am not addressing because I do not know where to get help from.

She indicated that:

I am trying with the knowledge I got from the training but sometimes I get stuck.

She hinted on the cluster she is attending that the problem is not solved as follows.

In our cluster most teachers will tell you [switched to her mother tongue] *leswi hina ahi switivi leswi swa matechnology vo hi nyika leswi ahi switivi* [meaning this Technology is just allocated to us and we do not understand its content] *so you find that you are a group of people who do not know anything.*

In the light of all this, she indicates her intentions to address this barrier irrespective of the challenges she is facing as follows.

I am thinking of studying further. Maybe it could help us. And another thing, again there is opportunities for teachers where teachers are trained again in full-time during school holidays where they will be doing these things practically. But the challenge is you find that the way they choose teachers to get bursaries to go and study is not understandable. As you find a principal is selected instead of the teacher who is teaching the subject, not given an opportunity to upgrade and after training such people do nothing with the information gained during training..

When probed on what she thinks could be done to improve the teaching of Technology in schools, Suzan's response is:

I think because this subject is very new to most of the teachers … the department can find names of teachers who teach Technology to [do] *course during school holidays where we will discuss sections in which we experience problems.*

Suzan however finds it is quite easy to link policy with the development of her work-schedule and activities as she outlines

> *I do not have any problem* [with] *that* [referring to linking policy with the development of work-schedule up to activity level] *... the only problem is ... when I want to link or I do my presentation well ... is only when I do not have the knowledge of that (referring to concept).*

4.4.5.3 Job

Job describes the barriers that he encounters as follows

> *We as Technology teachers, we normally do not get enough training in this regard* [referring to interrelating the themes].

When asked how he addresses this barrier to succeed, Job's response was

> *To succeed in addressing these barriers I think if my school can arrange experts on this field to come and train us we can be able to overcome this barrier.*

With reference to experts in Technology, Job concedes that there are not enough experts in the field of Technology Education in South Africa as it is a relatively new subject. Job outlines a suggestion to curb the situation as follows.

> *To make sure that teaching and learning is successful, I think, the planning must start from school level - whereby Technology teachers must come up with strategies. They must indicate their weaknesses ... they must come up with strategies that can help them to teach Technology successfully and ... the school based workshops must be conducted. Whereas ... circuit or district must constitute structures such as circuit teams ... all the problems that are encountered by teachers must be referred to the circuit team. This can enable us to teach Technology very successfully and the school must also support teachers in buying resources that are relevant to these themes.*

4.4.5.4 Jane

Jane describes her barriers to interrelating the themes as follows.

> *Number one is the lack of resources we do not have much resources. For instance, when we want to make ... mechanical system, we did not have resources to make*

those driver and driven gears. But instead, we improvised by drawing it on the chalkboard. Since … is a practical, it needs something that … we must cut until they understand.

Jane indicates the way she addresses the barriers to succeed as follows.

I have tried to talk to my managers about this thing, and again. In the past there were people from the whole school evaluation. I told them about the problem with the hope that they will help. I, however, let learners do the tasks at home without my supervision.

4.4.5.5 Synthesis

Barriers identified by teachers

Nomvula indicates that the barriers that she sees in interrelating the themes are too few periods, a shortage of learning materials and limited resources.

Suzan does not have a problem with planning but the main problem is when dealing with difficult concepts and conceptual content in Technology. Being clustered with teachers who themselves are not trained to teach Technology but are teaching it in their respective schools, is not helpful.

Job identifies a barrier in a lack of proper training in interrelating the themes.

Jane's barriers are resources and difficult concepts such as mechanisms.

Suggested solutions to these barriers:

Nomvula spends extra time with weaker learners after school.

Suzan thinks a solution is to re-skill Technology teachers through further studies.

Job suggests that schools be supplied with the required resources in technology.

He also suggested the establishment of supporting teams starting from school level up to district level conduct workshops led by experienced and well-trained teachers to deal with the

Technology Education related problems. (This overlaps with Suzan's idea of using some expert teachers to guide teacher development).

Jane currently deals with barriers of lack of resources by giving tasks and small projects to learners to do at home.

4.5 Discussion

This section presented the analysis of data from documents, interviews and observations to understand how Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment theme with the other two themes in the Technology curriculum. The data were collected from the four cases that were classified into two categories, the novice and the experienced.

The analysis of the documents, interviews and observations (novice and experienced categories; sections 4.3.1 and 4.4.1), revealed that work schedules and somewhat project portfolios contain some unifying concepts across the Technology themes. However, teachers find it difficult to understand some concepts in the Technology curriculum. The analysis revealed that there was little mention made of societal issues that reflect the aspects of TSE, and this posed a challenge for some teachers in the sample. Despite teachers being familiar with the themes in the Technology curriculum, some are not sure of what the role of TSE is in planning and teaching. This might be a cause of the Technology concepts being taught out of context.

The analysis of sections 4.3.2 and 4.4.2 revealed that although all the documents promote learner involvement in learning concepts to the level of concrete understanding (somewhat), both novice teachers and one experienced teacher did not emphasise the context to show the influence of TSE in their planned activities. What the experienced teachers claimed during interviews on the planning process, did not translate into activities that allow learners to grasp the nature of technology.

Selecting subject matter and implementing it is core to planning and teaching. The analysis of sections 4.3.3 and 4.4.3, reveal that the teachers' curriculum documents in both categories

somewhat contain specific objectives or outcomes, but setting the context is poorly addressed in their planning. The teachers in both categories view the pedagogical approaches in the Technology curriculum differently. For this reason the realisation of the interrelationship of themes are explained differently during the interviews. The observations reveal that the teachers used different approaches for the different aspects, and that none of them operates on Level 3 of the construct of implementation, which would give a true interrelationship of themes and satisfy TSE theme of the curriculum.

The analysis of sections 4.4.4 and 4.4.5 reveals that there were more failures than successes in interrelating the themes. Some of the failures were attributed to planning and lack of support. The rest of the failures mentioned are caused more from the lack of teaching resource than the actual planning and teaching. Some of the failures mentioned by the teachers translate into barriers such as lack of proper training in interrelating the themes, little support and having to deal with difficult concepts in the Technology curriculum.

4.6 Synthesis

This chapter presented a detailed analysis of the data that emanated from the document analysis, the interviews and the lesson observations. The chapter outlined the biographical detail of the participants based on their contexts in the study. It discussed the document analysis based on the four dimensions (subject matter, learner, milieu and teacher dimensions) adapted from the Ben-Peretz (1990) scheme of curriculum documents analysis. The categories of the dimensions' were adapted in line with the unique scope and features of Technology. The chapter analysed the data obtained through interviews and observations. It concluded with a discussion of the interpretation. As a result these discussions are integrated into the concluding chapter that also discusses the summary of findings.

CHAPTER 5

SUMMARY OF FINDINGS AND DISCUSSIONS, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

This chapter summarises the findings and discussions, the limitations and the recommendations, and draws conclusions of the research. The study aimed to investigate Technology teachers' interpretation and enactment of the interrelationship of the Technology-Society-Environment (TSE) theme with the other themes of the Technology curriculum.

5.1 Summary of the findings and discussions

The prime research question is:

> How do Technology teachers interpret and enact the interrelationship of the Technology-Society-Environment theme with the other learning themes of Technology curriculum?

This question guides this study through five sub-questions, each of whose key findings are discussed in relation to the question.

5.1.1 Sub-question 1

> How do Technology teachers interpret the Technology-Society-Environment theme in the Technology curriculum?

5.1.1.1 Discussion

The study established that although teachers are familiar with Technology themes in the novice and experienced categories, the majority (three of the four teachers who participated in this study) still struggle with the concepts of mechanical systems in the Technology curriculum. However, all four participants acknowledged seeking help from fellow colleagues within and outside their schools. The experienced category of teachers managed to

describe the relationship that exists among the Technology themes but the novice category could not describe that relationship.

The study revealed that participants in both categories struggle with interpreting the role of the Technology-Society-Environment theme in their teaching, and how it is interrelated with other Technology themes. This was evident in both novice and experienced teacher categories.

This difficulty with the interpretation was observed in the classrooms where lessons were content focused and two of the three observed teachers had a problem understanding the concepts they were teaching.

The curriculum documents revealed that the concepts in the themes of technological processes and skills and technological knowledge and understanding featured most frequently in their lesson plans and work schedules. The work schedule (supplied by the Department of Education) is the only document that has all the themes covered in a single quarter (term) based on the topics for that particular quarter (Appendix D). The study reveals that compared with the novice teachers, their experienced counterparts were able to interpret and enact the work schedule to design tasks that engage learners in real life situations. There are some overlaps though. However, it appears that individual teachers have their own interpretations of the work schedules they produce for lesson plans (Werner, 1993).

Despite the fact that the Department of Education supplies teachers with curriculum materials, teachers appear to remain unclear about the meaning of some Technology concepts in the work schedule. In consequence, the novice and experienced teachers struggled to interpret the Technology curriculum content in context (section 4.3.1 and section 4.4.1). This might be a sign of teachers either being “ill-equipped” or and being having insufficient “expertise” to handle the Technology themes (Hodson, 2009:271).

5.1.2 Sub-question 2

How do Technology teachers link the Technology-Society-Environment theme to the other themes in Technology?

5.1.2.1 Discussion

The literature in Chapter 2 identifies the philosophy of technology as artefact, knowledge, activities and as part of our being human that blend to enrich technology activities (De Vries and Dakers, 2009). Four modes are identified as the main modes of interest in the philosophy of technology. They are artefacts, knowledge, activities and part of being human (Mitcham, 1994)

The study has established that the type of activities teachers plan, normally address technology as knowledge rather than blending the aspects of artefact and the part of being human (Chapter 2 section 2.1). The novice teachers find it difficult to articulate the nature of technology activities compared to their experienced counterparts. The experienced teachers were clear about how Technology activities are planned in an integrated manner, but the activities were planned out of context in relation to TSE. What they said during the interviews was different from their documented lesson plans and their teaching. The participants were not clear on how to incorporate TSE in their planning and in their teaching. (section 4.3.1 and section 4.4.2).

The novice and experienced teachers were not clear on how to engage the Technology-Society-Environment theme during their curriculum planning in spite of the work schedule outlining such activities (section 4.3.1). Hodson (2009:272) suggested that one of the reasons some teachers are not engaging with the STS approach in their planning, is that some teachers are either not committed to the approach or unsure of it, which might pose a threat in their classroom authority. Hodson (2009) pointed out that even if some teachers are committed to the approach they might still not implement it because they lack time to plan lesson activities that integrate content and social concerns.

5.1.3. Sub-question 3

How do Technology teachers approach the themes from a pedagogical perspective?

5.1.3 Discussion

The findings reveal that teachers have lesson plans and work schedules, they have no autonomy to develop their own work schedules as their work schedules are supplied to them

by the DoE as pacesetter (section 4.3.1.1 and section 4.3.1.4). This might affect teachers' planning and teaching in their classrooms as they may feel pressured to rush through the work schedule. The study revealed that teachers viewed pedagogical approaches differently. The experienced teachers viewed pedagogical approaches in two ways: as knowledge and skills developed through experiments and demonstration, and as leaner centred that allows co-operative learning. The novice teachers on the other hand view the pedagogical approaches as methods of teaching and teaching strategies; that can be defined through practical work. The differences in views regarding the pedagogical approaches in Technology might mean that the participating teachers are struggling to understand the pedagogy of technology with regard to planning and classroom practice (Mapotse, 2012:57).

The study exposes the perspectives participants in both categories have towards the relationship of the Technology themes. Some teachers are of the opinion that the relationship of Technology themes is through activities that set the contexts in which the projects are done. Reddy et al. (2003) noted five principles central for teaching Technology, such as facilitation of learning, learner-centeredness, active and participative learning, creative and critical thinking and problem solving. These principles are the remnants of the approaches for learning and teaching in the Technology Education.

Chapter 2, section 2.7 of the literature review presents a problem solving approach, which embraces project based learning aimed at engaging learners in real life contexts, thereby interrelating the themes of the Technology curriculum, and the Technology-Society-Environment theme. The project-based approach promotes creative and critical thinking and enforces some other skills such as management, research, data handling and communication. This approach encourages socio-environmental awareness to learners (Gauteng Department of Education, 2005). The novice and experienced teachers claimed that they taught the design process in a project-based approach. However, the study revealed that the teachers focus on content in their teaching which is not contextual. This is evident in Chapter 4, section 4.3.2, where the types of activities that teachers plan and the learners engage in are shown.

One of the experienced teachers claimed that in her planning, she allocates time in her lessons to integrate concepts within real-life contexts but this was not evident in her lesson plans.

Even lesson plans supplied by the service provider in-service schools project for one of the teachers did not show integration of the Technology-Society-Environment theme.

5.1.4 Sub-question 4

What are the successes and failures in interrelating the themes?

5.1.4.1 Discussion

The study revealed that the participants in both categories had a problem articulating their successes of interrelating the themes. Only one experienced teacher explained during the interview that she successfully planned for the interrelation of the themes, but this was not confirmed in her lesson plans or the learners' workbooks.

The study showed that lack of understanding of some concepts in the Technology curriculum might contribute to the problem. Lack of adequate support was also attributed towards their failure to interrelate the themes in the study (section 4.4.4).

5.1.5 Sub-question 5

What are the barriers that teachers identify regarding their intentions and attempts to teach the relationship between Technology-society-environment and other themes and how may these barriers be addressed?

5.1.5.1 Discussion

The research revealed that despite the participants having basic qualifications in technology, they still have the problem of understanding the content aspect (Table 3.1 and Table 4.1). The lack of understanding remains a major barrier, as the teachers do not seem to have effective support systems at school or from the district. This specific barrier makes it difficult for them to succeed with interrelating the Technology themes. Consequently, in the interpretation of curriculum materials, participants tended to adhere to textbooks and resort to teaching the subject out of context.

The next section offers a reflection on the findings based on the conceptual framework and provides further discussion.

5.2 Further discussions on the findings based on conceptual framework

This section presents discussions of the findings in line with the conceptual framework (Chapter 2, Figure 2.1). The major aspects under discussion are the curriculum interpretation, engaging the planning domain; and the curriculum enactment, engaging the implementation domain.

5.2.1 Curriculum interpretation

The RNCS, Grade R-9, 2002 requires teachers to interpret the curriculum documents before planning (DoE, 2002b).

The official Technology curriculum has three themes: (1.) Technological processes and skills, (2.) Technological knowledge and understanding, (3.) Technology-Society-Environment. These themes represent the technology knowledge components, conceptual knowledge and procedural knowledge. The three themes are identified as three learning outcomes in the RNCS and contain aspects of knowledge that address content, context and processes. These aspects are seen as addressing the skills, knowledge and values that emanate from the unique features and scope of the Technology subject.

The type of activities that teachers plan and teach in senior phase should be in line with unique features and scope for Technology. To realise this, we need teachers who are capable of interpreting the curriculum materials to plan activities that address the interrelationship of content, context and processes (Booyse and Du Plessis, 2008). However, the study revealed that teachers find it a challenge to interrelate these aspects in both categories. Teaching Technology places the design process at the centre of project based as the approach in problem solving. As mentioned in the rationale, teaching Technology from a contextual point of view could make the curriculum interesting and more relevant. Context in this case means putting the Technology-Society-Environment theme at the centre as shown on Figure 2.1 (the conceptual framework).

According to Magano (2009:86), to interpret the curriculum materials, we need teachers who are "experienced and have initiative". In most cases, interpreting the curriculum relies on the individual teacher, depending on the context exposed to the teacher, and the teacher's priorities at the time (Werner, 1993). After interpreting the curriculum material (work schedule) teachers need to translate the interpretations into planning classroom activities. Then the planning process starts as discussed in the next section.

5.2.1.1 Planning

The planning process starts with the identification of the outcomes and the objectives, the assessment standards, the content areas, the teacher's and learners' activities, the assessment tasks and the resources for the year (DoE, 2003). These outcomes and objectives enable the teacher to determine the kind of activities to include in the work schedule, in the lesson plan and the learner's work sheets. In this study, the experienced teachers compared to their novice counterparts, managed to articulate the planning process in relation to the Technology activities. The planning process becomes a challenge if the teacher is unable to interpret the official curriculum document and translate it into an intended curriculum. The study reveals that based on the empirical evidence, teachers in two categories availed their curriculum documents such as work schedule, lesson plans, project portfolios and learners' workbooks, but the work schedules in all four cases were supplied by the Department of Education (description of these documents in Table 4.2). In one case, the novice teacher produced lesson plans that were supplied to the school as part of a service provider in-service project. This poses a challenge, as we do not have enough empirical evidence to show whether the teacher can successfully plan lessons or not. The only evidence is that three of teachers managed to produce the lesson plans and one relied on the textbook activities.

The classroom activities start the process of teaching and learning. This study sought to establish whether teachers are able to interpret and enact the interrelationship of the Technology-Society-Environment theme with other Technology curriculum themes. The study reveals that the nature of the activities in the curriculum materials that were analysed, rarely show the incorporation of the aspects of Technology-Society-Environment theme. This incorporation is mainly found in the work schedules.

In most of the curriculum materials that were analysed, the subject content concepts (aspects of technological knowledge and understanding theme) are the ones covered most frequently.

The following section reflects on the enactment of the curriculum.

5.2.2 Curriculum enactment

The implementation of the Technology curriculum (outlined in Chapter 2) has a number of challenges. The teachers of Technology need to understand the philosophy that underpins Technology as a subject and a broad understanding of the unique features and scope of Technology found in society.

There are different methods of teaching Technology I highlight only two: using the design process (IDMEC) and delivering a series of shorter, discrete tasks, and then introducing a project (Mapotse, 2001). These tasks require teachers who can understand and interpret the Technology curriculum. However, the study reveals that some Technology teachers in the novice and experienced categories find it a challenge to assign meaning to some of the concepts (e.g. topic on systems and control) that emanate from the themes and to keep them in line with the curriculum requirements.

The study reveals additional challenges, like a lack of resources (such as text books, technology tool kits and the time allocated to the subject) and a lack of technological skills to handle actual teaching and provide the appropriate learning resources (Mapotse, 2012). Some of the participants in the novice category do not have the capacity to assist learners deal with designing a project portfolio. The lack of resources and technological skills might lead to compromising the sound teaching of the Technology.

The study reveals during class observations, two of the cases in novice and experienced categories concentrate more on content and less in engaging learners with activities that expose learners to actively engaged TSE aspects.

5.3 Realisation of research objectives

The research was aimed at determining how teachers of Technology interpret and enact in their planning and their teaching the interrelationship of the Technology curriculum themes with a particular focus on the Technology-Society-Environment theme. To realise this aim the following objectives were pursued:

- To determine how teachers interpret Technology Education within the context of TSE. Their interpretation may identify the kind of influence it has in their teaching practice.

  The empirical evidence, which was drawn from the interviews, the document analysis and the observations, presented finding that led to the conclusions of the study. This objective was achieved, and the pertinent discussions (sections 4.5 and 5.1.1).

- To investigate the manner in which Technology teachers show the interrelationship between TSE and the other Technology themes, and to establish the teachers' view of the importance of teaching Technology Education within the broader context of Technology.

  The information for this objective derived from the interviews, the document analysis and the observations, where specific categories for this objective were used. The objective was achieved and discussed (sections 4.5 and 5.1.2).

- To identify the types of methods used by Technology teachers when teaching Technology themes.

  The objective was achieved and the findings and conclusions are discussed (section 4.5 and 5.1.3).

- To establish the successes and/or failures that Technology teachers experience in interrelating TSE with other Technology themes.

The objective was achieved and the findings and conclusions discussed (sections 4.5 and 5.1.4).

- To establish the barriers that Technology teachers may experience in interrelating the Technology themes.

  The data were collected through interviews with the participating teachers. The objective was achieved as discussed (sections 4.5 and 5.1.5).

5.4 Limitations of the study

Several limitations were identified during the course of the study. Some of these may provide opportunities for future research.

The study was limited to a qualitative research approach (Chapter 3). However, the qualitative data was useful to inform how Technology teachers interpret and enact the integration of TSE theme with the other Technology themes during their planning and teaching. The subjectivity in the qualitative enquiry helped the researcher to gain in-depth understanding of the cases in their natural context (Simons, 2009). The researcher used subjective interpretation of the qualitative data to gain an understanding of the way Technology teachers interpret and enact the interrelation of the Technology themes with reference to TSE theme. The subjective interpretation brings an aspect of bias in the study, which is also a limitation. A biased account could have been balanced through the inclusion of curriculum advisors in the sample to engage objective data sources in the interpretation of data. It would be advisable though, to test the findings on a larger scale.

The study was limited to a case study design. Case study research has its own challenges and limitations (Yin, 2009). One of the limitations is that it concentrates on a small sample. Case study affords minute basis for “scientific generalisation” and is subjective in its nature (Simons, 2009:161-164). However, this study engaged multiple case studies which after comparing the cases accorded an opportunity to generalise the findings within the sampled cases. The study involved four cases of one teacher each in four schools. The participating

teachers were classified into two categories, novice and experienced senior phase Technology teachers respectively. The four cases were studied in depth to establish and describe their interpretation and enactment of the Technology themes. The findings cannot be generalised beyond these four teachers. At best, the current sample showed that the experienced teachers knew about the need to integrate the themes, or contextualise themes within societal needs or situations, but the less experienced (novice) teachers of Technology presented no evidence of the integration of the content, process and societal themes. A bigger sample could contribute to further exploration and may well contribute additional aspects of the implementation of the intended Technology curriculum. This study accorded an opportunity to establish the teaching status of the Technology themes in these four senior phase classes, and yielded a rich picture of the experiences and practices of teachers of Technology. We are somewhat better informed of how teachers with different lengths of teaching experience address the themes in Technology.

Interviews, observations and document analysis were three data collection instruments used to acquire the data. These instruments accorded a rich data presented in Chapter 4 and their interpretation and findings in Chapter 5 respectively. The limitation though was that the researcher administered document analysis protocol in qualitative form than its original intention of quantitative form (Ben-Peretz, 1990:99). The researcher adapted the dimensions in the document analysis protocol to suit the study context. The researcher admits that the administering of these instruments was not easy as a novice researcher. However, the researcher managed to collect enormous amount of data from the four cases (Chapter 4).

The study was limited to three participants giving samples of all the four document sources. The researcher collected the data towards the end of the third schools calendar term. In some schools the researcher managed to make copies of documents for analysis. However, in one school it was not possible because of their tight schedule and managed to obtain only a work schedule and some learners' drawings of mechanisms discussed (section 4.3).

The study was limited to three lessons and with observation session each. Observations of more lessons may have yielded greater variety of teaching approaches used by participant teachers and provide more information about the trends in the classroom. The present study helped to establish that Technology is taught in four different sampled classrooms in the

senior phase. The study at least suggests what might be happening in other technology classrooms.

It was clear that teachers in the four cases had difficulty interrelating the themes, and expressed their difficulties with the basic concepts of Technology. However, we were able to triangulate the data, which gave us some view of what teachers are experiencing in the field of teaching Technology.

The curriculum materials that are not produced by the participants themselves hindered establishing how teachers may develop their own. Particularly the work schedule, which was provided by the Department of Education in all cases, and the lesson plans which were provided by a project in the case of one teacher. The study however afforded an opportunity to interact with teachers' lesson plans, learners' workbooks and project portfolios, which in fact represented the actual implementation of the curriculum.

5.5 Recommendations

The findings of the study offer several recommendations outlined into three groups, namely policy, practices, further research.

5.5.1 Recommendations for policy makers and implementers

- Support for Technology teachers from the Mpumalanga Department of Basic Education must be improved:
    - The Mpumalanga Department of Basic Education could establish forums for Technology teachers to share their experiences. As a novice and an experienced teacher asked a colleague of a related subject to assist with concepts or in class presentation indicates that teachers may well embrace peer support opportunities (sections 4.4.1.2, 4.4.1.4).

    - When teachers claim that the support specialists do not actively support them with training in content knowledge or with the appropriate materials, the Department should investigate and address the problem.

- Teachers must be encouraged to develop their own lesson plans after orientation on how to interpret the documents, particularly the contextualisation of the knowledge (TKU) and process (TPS) aspects of the TSE theme. This would help the teachers to achieve the intended integration of the themes of Technology.

- The district curriculum implementers may be encouraged to identify Technology teachers within a cluster and empower them through training on the integration of the Technology themes to assist their fellow teachers in the cluster.

These findings may indicate that the Department of education support staff (curriculum implementers) need to design programmes to assist Technology teachers more effectively than they have done in the past. More attention may be given to novice teachers.

5.5.2 Recommendations for practicing Technology teachers

- Teachers are at the epicentre of the curriculum implementation in the classroom. Technology teachers need to improve their Technology content knowledge through further studies and training to be better informed in their practice. This will empower them with profound knowledge of Technology, which contributes to a better quality of practice in the classroom.
- Teachers may engage in designing lesson plans that will empower learners to be able address the needs and wants of the society.
- Technology teachers need to engage with RNCS and CAPS policies documents in their clusters to find clarity about the subject and its requirements.
- Technology teachers need to join associations such as South African Association of Science and Technology Education (SAASTE) to keep abreast with current issues in Technology and to build relationship with other Technology specialist in the development of the subject in schools.

5.5.3 Recommendations for further research

In light of the findings presented by the study, the following could be recommended for future research.

- A similar study could be facilitated to explore the same inquiry on a large scale and engage different contexts.

- A study of the teachers' views on the importance of teaching Technology in a broader context.
- A study on enhancing the teachers' practice by incorporating Technology-society-environment aspects in teaching through intervention.
- A study to provide a practical guide on translating the RNCS and CAPS contents in the actual planning and teaching using the available resources.
- A study to establish a model to facilitate teachers' knowledge of interaction with technology learning and teaching materials for classroom practice.

5.6 Conclusion

The results of the study and the discussions of the findings conclude that teachers need assistance beyond their qualification to teach the Technology curriculum successfully. The participants expressed their frustrations with the policy and subject content issues to such an extent that something ought to be done about the status of Technology teaching in the sampled schools. This study reveals that there are not enough support programmes to support teachers to understand the subject adequately. This lack of adequate support could have led to the inconstancies that occur in interpreting the Technology themes. The reason the novice and experienced teachers not able to articulate TSE could be the cause of teaching Technology out of context. This is clear evidence that requires appropriate teacher support to interpret the Technology curriculum documents and to translate them into classroom teaching.

The use of the conceptual framework in this study enabled the researcher to examine the interpretation and enacting of the interrelationship of the Technology-Society-Environment theme with the other Technology curriculum themes. The conceptual framework provided a frame in which data were collected and ordered and the findings were established. The conceptual framework helped to focus the study in line with the research questions, aims and objectives. The conceptual framework was instrumental in producing the analytical frame as it was linked to the Ben-Peretz (1990) scheme of curriculum documents analysis as well as the Rogan and Grayson (2003) implementation readiness taxonomy during lesson observations and document analysis. The conceptual framework contributed to realising the alternative approach towards teaching and learning from a different dimension of the

Technology-Society-Environment theme. This theme sets a context for teaching Technology. There is a need for Technology teaching to be based in real life or authentic context or technological practice (Fox-Turnbull, 2006).

The insight gained in this study, about the way teachers interpret and enact the interrelationship of Technology themes, could be seen as the springboard for the Department of Education support staff and Higher Education institutions to design support programmes that will equip pre-service and practicing Technology teachers to understand better the content and the dynamics of the subject that are useful in the classroom environment.

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APPENDICES

Appendix A1: letters of request for consent
Letter for permission: Participant

Dear Participant

You are invited to participate in a research project, which is aimed at investigating the understanding Technology teachers have on interrelating and enacting the interrelationships of Technology, society and environment with the other Technology curriculum themes. The process will include recorded interviews, class observations and content analysis of work schedule, lesson plan, policy documents and learners' written work.

Your participation in this research project is voluntary and confidentiality of information is guaranteed. The anonymity will also be preserved. You have a right to withdraw from participating from the research at any stages of the study should you wish not to continue. There will be no incentives in monitory terms for participating in the study.

The results from this study will be used to identify barriers that teachers may be experiencing in approaching planning and teaching of Technology lessons. The identification of barriers that may exist will inform future research.

If you are willing to participate in this research project, please sign this letter as a declaration of your consent as stipulated in paragraph two (2) above.

Participant signature: _____Date:_____

Yours Faithfully

Elliot Ndlovu (Mr)
Researcher

Prof MWH Braun
Head of Department:
Science, Mathematics &Technology Education

Letter for permission: School

Dear Sir/Madam

Request for conducting research in your school under the topic: how Technology teachers interpret and enact the interrelatedness of Technology-society-environment theme with other Technology curriculum learning themes.

I hereby request permission to conduct research in your school. I am a Master's in Education (MEd) student at the University of Pretoria. The aim of the research project is to investigate the understanding Technology teachers have on interpreting and enacting the interrelationship of the Technology, Society and Environment (TSE) theme with the other Technology curriculum themes.

The process of research methodology will include recorded interviews, class observations with your senior phase Technology teacher and content analysis of work schedule; lesson plans; policy documents and learners' written work. This process will not affect the normal running of school even though observations will be done during teaching periods.

The results from this study will be used to identify barriers that teachers may experience in approaching the planning and teaching of Technology lessons. This may lead to recommendations for future research.

I will appreciate if my request is granted and I wish to hear from you at your earliest convenience.

Yours sincerely

Elliot Ndlovu (Mr)
Researcher

Prof MWH Braun
Head of Department:
Science, Mathematics & Technology Education

Letter for permission: District

Dear Sir/Madam

Request for conducting research in your school under the topic: how Technology teachers interpret and enact the interrelatedness of Technology-society-environment with Technology curriculum learning themes.

I hereby request permission to conduct research in three schools of your district. I am a Master's in Education (MEd) student at the University of Pretoria. The aim of the research project is to investigate the understanding Technology teachers have on interpreting and enacting the interrelationship of the Technology, Society and Environment (TSE) theme with other two Technology curriculum learning themes.

The process of research methodology will include recorded interviews, class observations with senior phase Technology teachers and content analysis of work schedule, lesson plans, policy documents and learners' written work. This process will not affect the normal running of schools even though observations will be done during teaching time.

The results from this study will be used to identify barriers that teachers may experience in approaching the planning and teaching of Technology lesson. This may lead to recommendations for future research.

I will appreciate if my request is granted and I wish to hear from you at your earliest convenience.

Yours sincerely

Elliot Ndlovu (Mr) Researcher

Prof MWH Braun
Head of Department:
Science, Mathematics & Technology Education

Letter for permission: Parents (English)

Dear Parent or Guardian

Request for consent to use your child's schoolwork for the purpose of research.

My name is Elliot Ndlovu. I am student of the Masters in Education (MEd) at the University of Pretoria. I have to complete a research module and one of the requirements is that I conduct research and write a research report about my work.

The topic is entitled: How Technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment theme with other Technology curriculum themes. The aim of the research project is to investigate the understanding that Technology teachers have on interpreting and enacting the interrelationship of the Technology, Society and Environment (TSE) theme with the other Technology curriculum themes. The TSE theme is seen as the opportunity to establish a context for the other process and design themes, and we do not yet know to what extent teachers actually use this opportunity.

I would like to ask your permission for your child to take part in this research. I request permission to use your child's schoolwork (workbooks, exercise books and project portfolios) in the Technology learning area as part of research data collection.

If you grant me permission to do the research at your school, I shall record an interview with your senior phase Technology teacher and perform a content analysis of work schedules, lesson plans, policy documents, and view some learners' written work. This process will not affect the normal running of school as interviews and discussions with teachers will be done after teaching periods. Only my supervisor and I will have access to this information.

The results from this study will be used to identify successes and barriers that teachers may experience in approaching the planning and teaching of Technology lessons. This may lead to recommendations for future research and may contribute to improvement of teacher education or support.

All participants, teachers and learners, are free to refuse to participate. We will be able to view the learner's work only if the parents or guardians of learners give permission for their child to participate in this research. If you give permission, your child will be asked to agree to take part in this research. No learners will be forced to take part if they do not want to and they will not be penalised if they choose not to allow me to look at their work. Your child can also withdraw at any time.

The identities of the district, schools and all participants will be protected. Only my supervisor and I will know which schools were used in the research and this information will be treated as confidential. Pseudonyms will be used for teachers during data collection and analysis. Learners whose work is looked at will remain fully anonymous. The information that is collected will be used for academic purposes only. In my research report and in any other academic communication, pseudonyms will be used for the school and teachers and no other identifying information will be given.

Finally, I have to produce a research report and a scholarly article will be written about the findings, but no one will be able to trace any information back to your child, to the school or to any of the teachers.

If you agree to allow your child to take part in this research, please fill in the attached consent form. If you have any questions, do not hesitate to contact my supervisor or me at the numbers given below, or via E-mail.

If you give permission to participate, please complete the consent form below and return it to school principal or Technology teacher:

Yours sincerely

_____	_____
ELLIOT NDLOVU (MR)	PROF MWH BRAUN
Researcher	Supervisor & Head of Department
	Science, Mathematics &Technology Education

Letter for permission: Parents (Sepedi)

Go Motswadi

Kgopelo ya gor ngwana wa lena a lekolwe ka mo phaphosing ka go dira dinyakisiso tsa dithutho.

Leina la ka ke Elliot wa ga Ndlovu. Ke moithuti. Ke dira Masters in Education (Med) yunibesithing ya Pitoria (Tshwane) ke swanetse ke feleletse thuto yaka le gona e tee ya tse di nyakegago ke gore ke dire dinyakisiso ke ngwale pego ka mosomo waka

Hlogo taba ke : "Naa barutisi ba setegeniki ba tlhalosa bjang ebile ba nyalantsha bjang lefase la se tegeniki le Karikhulamu ya se tegeniki."

Maikemisetso ya dinyakisiso tsa projeke ye ke go nyakisisa kwisiso ya barutisi ba setegeniki eo ba nago le yona go tlaloseng le go nyalantsha mo setegeniking le mo mmotong le nageng ya rena le kharikhulamu ya setegeniki, SMN e bonwa bjalo ka monyetla wa go bopa lefase go di tsweletso tse dingwe le go tlhama dihlohleletso tse dingwe, gape ga re eso ra tseba gore monyatla wo barutisi ba tla o fihlisa kae.

Bjale ke kgopela gore ngwana wa lena a be o mongwe wa ba tsea karolo go di nyakisisa tse.

I dira kgopelo go nyakisisa mesongwana le dipoledisano mola ngwana wa lena a tloba a le motsea karolo go kgobeketso tsebo e.

Dipoelo go dinyakisiso tse, di tla somisiwa go hwetsa ditsweletso le tharollo eo barutisi ba ka le yona go peakanya le thutong ya setegeniki. Se saeka thuso gore go dumelelwe go di nyakisiso tsa boka moso le go thusa gore barutisi ba kaonafatse thuto e boba go e thekga.

Ba tsea karolo, barutisi le barutwa ba na le tumelelo ya go gana go tsenela dinyakisiso tse ge ba rata. Re ka kgona go lebelela mosomo wa ngwana ge motswadi a re file tumelelo gore ngwana a tsenelele dinyakisiso tse ge le dumela, ngwana wa lena o tla kgopelwa go dumela gore a tsee karolo go dinyakisiso tse. Ga go morutwana yo a kago gapeletswa go dire se, ge yena a se nyake lo gona ba ka se bewe molato ge ba se ntumelele go nale maatla a go tlogela nako efe goba efe

Dipoelo tsa selete, dikolo le bohle ba tsea karolo di tlo sireletswa. Ke feela mohlahli wa ka le nna re tlago tseba gore ke dokolo dife tseo di tsenetsego dinyakisiso tse le tsona e tlaba Sephiri. Ma ina ao a sego a nnete a tla somisetswa go barutisi nakong ya dinyakisiso. Mesomo ya barutwana eo e bonwego e tla ba e feletse ebile e ka se dula e tse etswe hlogong gore mang o dirile eng, bjang. ka mantsu a mangwe ge go fedile, go fedile, ke pheto. Tsebo

eo tlago kgoboketswa, etla somiswa go dithuto tsaka feela. Go pego yaka ya di nyakisiso le go dipoledisano, maina ao e se go ya nnete a tla somiswa mo sekolong le go barutisi feela, e sego go fana ka tsebo. Maina a nnete a bana a ka somiswe

Mafelelong, ke swanetse pego gape "article" ya sekolo e tla ngwala go ya ka tseo di humanwego, le go ele bjalo, ga go yo a ka ngwana ofe goba ofe, le go morutisi ofe goba ofe.

Ge le dumela gore ngwana wa lena a tsee karolo go nyakisiso e, ka kgopelo le boikokobetso, tlastsang go foromo eo e filwego ka tlase. Ge le nale potsiso, le seke la tshaba goba go dikadika go dinomoro tseo di leka ka fase, le ge ele E-mail ya ka.

Ge ele gore la mpha tumelelo hle, tlatsang foromo eo e elego ka tlase mme le e busetse go hlogo ya sekolo boga morutisi wa Technology.

Wa lena

_____	_____
ELLIOT NDLOVU (MR)	Prof MWH BRAUN
Munyakisisi	Mohlahli mogolo le hlogo ya lefapha le Saense, Dipalo le Thuto ya Setegeniki

Letter for permission: Parents (Xitsonga)

Eka Vatswari kumbeVahlayisi va vana

Xikombelo xa mpfumelelo wo endzela eklasini leyi n'wana wa n'wina anga ka yona hi xikongomelo xo endla ndzavisiso loko thicara a riku dyondziseni

Vito ra mina ndzi Elliot Ndlovu muchudeni wa yunivesiti ya Pitori. Ndzile ka xiyenge xo hetisa ndzavisiso (research) tani hixiphemu xo hetisela xa digiri ya Master in Education (MEd).

Nhloko mhaka ya ndzavisiso yiri: "How Technology teachers interpret and enact the interrelatedness of the Technology-society-environment theme with other Technology curriculum themes". Xikongomelo nkulu xa projeke leyi iku lavisisa matwisisselo lawa maticara ya Technology mangana wona ku hundzuluxa na ku endla hiku kombekisa vuxaka bya nkatsakanyo wa ti nhlokomhakankulu (leti tinga, technological processes and skills; technological knowledge and understanding & technology, society and environment) ta Technology loko va pulanela ku dyondzisa niloko vadyondzisa. Xitrand xa TSE xi languteka xitisa swiyimo swa madyondziselo ya kahle ya Technology loko swo landzeleriwa, kambe a switiveki kuri maticara va xitwisisa kufikela kwihi xitrand lexi. Leswi swilavaka ndzavisiso.

Hikwalaho ka xiyimo lexi ndzikombela mpfumelelo wa ku n'wana wa n'wina ava xiphemu xa projeke leyi hi kundzi pfumelela leswaku ndzivana mpfumelelo wo langutisa thicara a riku dyondziseni n'wana wa n'wina ari kona. Leswi ndziswi endla tani hi xiphemu xa ndzavisiso wo kuma vuxokoxoko wakuri vana dyondza njhani nakuri vava dyondzisa njhani e Technology.

Mbuyelo wa projeke leyi wu ta tirhisiwa ku kumisisa kuri kuna ku humelela kumbe kutikeriwa loku maticara vahlanganaka na kona eku lulamiseleni ni le kudyandziseni ka Technology. Leswi swita pfuna kuri kuva na swibhumabhumelo swandzavisiso lowu nga antwisaka madyondziselo ya Technology eswikolweni.

Loko swo endleka minyika vana van'wina mpfumelelo wakuva xiphemu eka projeke leyi. Vatava na malungelo yo nghenelela kumbe kukala vanganghenelelo eka xiyenge lexi. Nakona hinga kota ntsena kulangutisa ntirho wa vana loko vatswari va hi nyike mpfumelelo wo endla tano. Akuna n'wana na unwe loyi angata sindzisiwa himani kumbe mani ku nghenelela loko mutsawri/mulanguteri wa n'wana anga hi nyikanga mpfumelelo wo endla tano. Nakona hambi mutswari o nyiketa mpfumelelo nw'ana una mfanelo wo tshiketa kuva xiphemu xa projeke leyi nkarhiwun'wana ni wun'wana loko angaha switsakeri.

Ntiviso wa xifundza, xikolo, maticara na vana lavanga ta nghenelela eka projeke leyi mavito ya vona yata sirheleriwa swinene. Mavito ya ta tiviwa hi mulavisis na mulanguteri wayena (supervisor) ntsena. Eka tiripoti kuta tirhisiwa mavito yoka mangari yavona hakanene (pseudonyms) lava nga va naxiyave ekantirho lowu. Nakona hinkwaswo leswinga ta kumiwa eka ndzavisiso lowu swita tirhiseriwa xikongomelo xa ndzavisiso ntsena hayi swin'wana.

Emakumu ka projeke leyi kuta tsariwa report ya ndzavisiso na ku tsala article hileswi swinga tava swi kumiwile kambe akuna vito ra n'wana na un'we loyi anga xiphemu xa ndzavisiso leringata humelerisiwa erivaleni.

Loko mipfumela leswaku n'wana wa n'wina ava xiphemu xa ndzavisiso lowu ndzi kombela mitata papila ra mpfumelelo leri fambaka na papila leri minyika n'wana ari thlerisela ka nhloko ya xikolo kumbe ticara wa yena wa Technology.

Yours sincerely/Wa N'wina

_____	_____
ELLIOT NDLOVU (MR)	PROF M.W.H BRAUN
Researcher	Supervisor & Head of Department
	Science, Mathematics &Technology Education

Appendix A2: letters of granting permission and consent forms

Letter of permission: District

education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

BOHLABELA DISTRICT OFFICE

Private Bag X 1024
Hazyview 1242
Hoxane College of Education
Kruger National Park Road
Mpumalanga Province
Republic of South Africa
Tel: 013 708 5000/5067
Fax: 013 708 5065

Litiko leTemfundvo Umnyango weFundo Departement van Onderwys Umnyango wezemfundo

Enq: Ms T C Mabuza
Tel: 013 766 0303

Mr Elliot Charles Ndlovu
University of Pretoria
Department of Science, Mathematics and Technology
PRETORIA

SUBJECT: PERMISSION TO CONDUCT A RESEARCH IN BOHLABELA EDUCATION DISTRICT

I, Lushaba Mfana J, Head of District Ehlanzeni and Caretaker of Bohlabela District, Mpumalanga Province, agree to allow the research project titled: "**How technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment strand with other Technology curriculum strands",** to be performed in Bohlabela Education District. I understand that in up to four schools one or two teachers of technology will be interviewed about this topic for approximately 30 to 60 minutes at a venue and time that will suit them, but will not interfere with school activities. The interview will be audio taped.

Some written work and portfolios of learners will be reviewed, and some classes may be observed, but only if parents or guardians have given permission for their child to take part and learners agree.

I understand that the researchers subscribe to the principles of:

- Voluntary participation in research, implying that the participants might withdraw from the research at any time.
- Informed consent, meaning that research participants must at all times be fully informed about the research process and purposes, and give consent to their participation in the research.
- Safety in participation; put differently, that the human respondents should not be placed at risk or harm of any kind e.g., research with young children.
- Privacy, meaning that the confidentiality and anonymity of human respondents should be protected at all times.
- Trust, which implies that human respondents will not be respondent to any acts of deception or betrayal in the research process or its published outcomes.

DISTRICT DIRECTOR
MR MJ LUSHABA

23/05/2021
DATE

Letter of permission and consent form: School A

CONSENT FORM

I, (your name), Headmaster of the school Malwana agree ~~/ do not agree~~ (delete what is not applicable) to allow the research project titled: **How technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment strand with other Technology curriculum strands** to be performed in this school. I understand that one or two teachers of technology will be interviewed about this topic for approximately 30 to 60 minutes at a venue and time that will suit them, but that will not interfere with school activities. The interview will be audio taped.

Some written work and portfolios of learners will be reviewed, but only if parents or guardians have given permission for their child to take part and the learners agrees. If invited to do so by the teacher, I may observe some lessons, during which I will take field notes and will discuss them with the teacher in available time.

I understand that the researchers subscribe to the principles of:

- *voluntary* participation in research, implying that the participants might withdraw from the research at any time.
- *informed consent*, meaning that research participants must at all times be fully informed about the research process and purposes, and must give consent to their participation in the research.

afety in participation; put differently, that the human respondents should not e placed at risk or harm of any kind e.g., research with young children.

rivacy, meaning that the *confidentiality and anonymity* of human respondents hould be protected at all times.

ust, which implies that human respondents will not be respondent to any acts f deception or betrayal in the research process or its published outcomes.

Letter of permission and consent form: School B

CONSENT FORM

I, (your name), Headmaster of the school Mpikaniso **agree / ~~do not agree~~** (delete what is not applicable) to allow the research project titled: **How technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment strand with other Technology curriculum strands** to be performed in this school. I understand that one or two teachers of technology will be interviewed about this topic for approximately 30 to 60 minutes at a venue and time that will suit them, but that will not interfere with school activities. The interview will be audio taped.

Some written work and portfolios of learners will be reviewed, but only if parents or guardians have given permission for their child to take part and the learners agrees. If invited to do so by the teacher, I may observe some lessons, during which I will take field notes and will discuss them with the teacher in available time.

I understand that the researchers subscribe to the principles of:

- *voluntary* participation in research, implying that the participants might withdraw from the research at any time.
- *informed consent*, meaning that research participants must at all times be fully informed about the research process and purposes, and must give consent to their participation in the research.
- *safety in participation*; put differently, that the human respondents should not be placed at risk or harm of any kind e.g., research with young children.
- *privacy*, meaning that the *confidentiality and anonymity* of human respondents should be protected at all times.
- *trust*, which implies that human respondents will not be respondent to any acts of deception or betrayal in the research process or its published outcomes.

Letter of permission and consent form: School C

CONSENT FORM

I, (your name), Headmaster of Mzimba Senior Sec School agree / ~~do not agree~~ (delete what is not applicable) to allow the research project titled: **How technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment strand with other Technology curriculum strands** to be performed in this school. I understand that one or two teachers of technology will be interviewed about this topic for approximately 30 to 60 minutes at a venue and time that will suit them, but that will not interfere with school activities. The interview will be audio taped.

Some written work and portfolios of learners will be reviewed, but only if parents or guardians have given permission for their child to take part and the learners agrees. If invited to do so by the teacher, I may observe some lessons, during which I will take field notes and will discuss them with the teacher in available time.

I understand that the researchers subscribe to the principles of:

- *voluntary* participation in research, implying that the participants might withdraw from the research at any time.
- *informed consent*, meaning that research participants must at all times be fully informed about the research process and purposes, and must give consent to their participation in the research.
- *safety in participation*; put differently, that the human respondents should not be placed at risk or harm of any kind e.g., research with young children.
- *privacy*, meaning that the *confidentiality and anonymity* of human respondents should be protected at all times.
- *trust*, which implies that human respondents will not be respondent to any acts of deception or betrayal in the research process or its published outcomes.

Letter of permission and consent: School D

PERMISSION LETTER FOR NDLOVU EC TO CONDUCT A RESEARCH IN TECHNOLGY

Primary School permits you to conduct your research in Technology at the Institution.

As you have asked to conduct it in senior phase you will be doing it on grade seven only and the teacher whom you will be doing this with is she is responsible for Technology grade seven.

I hope and believe that this will not interrupt our classes it will be conducted after school, parents of the learners also will be made aware of what is going to happen to their children.

Hope you will find this in order.

PRINCIPAL

CONSENT FORM

I, (your name), Headmaster of the school Majembeni agree / ~~do not agree~~ (delete what is not applicable) to allow the research project titled: **How technology teachers interpret and enact the interrelatedness of the Technology-Society-Environment strand with other Technology curriculum strands** to be performed in this school. I understand that one or two teachers of technology will be interviewed about this topic for approximately 30 to 60 minutes at a venue and time that will suit them, but that will not interfere with school activities. The interview will be audio taped.

Some written work and portfolios of learners will be reviewed, but only if parents or guardians have given permission for their child to take part and the learners agrees. If invited to do so by the teacher, I may observe some lessons, during which I will take field notes and will discuss them with the teacher in available time.

I understand that the researchers subscribe to the principles of:

- *voluntary* participation in research, implying that the participants might withdraw from the research at any time.
- *informed consent*, meaning that research participants must at all times be fully informed about the research process and purposes, and must give consent to their participation in the research.
- *safety in participation*; put differently, that the human respondents should not be placed at risk or harm of any kind e.g., research with young children.
- *privacy*, meaning that the *confidentiality and anonymity* of human respondents should be protected at all times.
- *trust*, which implies that human respondents will not be respondent to any acts of deception or betrayal in the research process or its published outcomes.

Signature:_ Date: 29-08-2011

Researcher details:
Mr Elliot Charles Ndlovu
Cell: 0791963866
E-mail: ecjnr@yahoo.com

Supervisor:
Prof MWH Braun
Cell: 0834520356
max.braun@up.ac.za

Head of Department: SMTE
Prof MWH Braun
Tel: 012 420 5659
max.braun@up.ac.za

Appendix B: instruments for data collection

Instrument of data collection: Interviews

Interviews Protocol

1. Tell me, how do you plan and teach Technology in your classroom.
2. Which concepts do you find challenging in teaching Technology?
3. What do you do to make sure that these concepts are taught in your class?
4. What nature activities are involved in the planning and teaching of Technology?
5. Are you familiar with themes in Technology curriculum?
6. Which once can you highlight?
7. Is there any relationship that exists amongst the themes that you can explain?
8. What is your understanding of TSE theme in Technology curriculum?
9. What role does TSE theme play in your teaching of Technology?
10. How do you engage the Technology curriculum themes in designing your lesson plan for teaching?
11. To what extent do you engage TSE when designing for instruction?
12. What kind of activities do you normally give to your learners?
13. What teaching approaches do you apply in the teaching of Technology?
14. How do you ensure that the interrelationship of themes is catered for in your approaches?
15. Do the approaches that you use lead to success in interrelating the themes?
16. Is there anything you can say about failures in interrelating the themes during your planning and teaching?
17. What do you do in trying to deal with failures?
18. Are there any barriers that you encounter in interrelating the themes? (If yes, which are those barriers?)
19. How do you address these barriers to succeed?

Instrument of collecting data: Document Analysis scheme

RUBRIC: Scheme of document analysis adapted from the Ben-Peretz's (1990) scheme of analysing curriculum materials featuring the unique features for Technology

Dimension	Category	Not at all	Somewhat	To a great extent
Subject Matter	Information, concepts, Principles	The document material does not present information, emphasize unifying concepts and general principles	The document material present some information, emphasize unifying concepts and general principles to a certain extent	The document material present information, emphasize unifying concepts and general principles
	Approach to the nature of technology inquiry (problem based)	The document material does not imply the existence of general mode of technology enquiry	The document material somewhat imply the existence of general mode of technology enquiry	The document material imply the existence of general mode of technology enquiry
	Relations to everyday life	The document does not convey and express subject matter knowledge for individual learner and society	The document convey and express subject matter knowledge for individual learner and society to a certain extent	The document convey and express subject matter knowledge for individual learner and society
	Image of technology	The document does not address aspects of problem solving in a creative ways based on authentic contexts rooted in real situation and does not address knowledge in an integrated manner within the subject	The document addresses some aspects of problem solving in a creative ways based on authentic contexts rooted in real situation and addresses knowledge in an integrated manner within the subject	The document addresses aspects of problem solving in a creative ways based on authentic contexts rooted in real situation and addresses knowledge in an integrated manner within the subject
Learner	Image of a learner	The document material does not promote learner involvement in active learning that links technology concepts to concrete understanding and it does not assist a learner to acquire knowledge as presented in curriculum document	The document material promotes some learner involvement inactive learning that links technology concepts to concrete understanding and assists a learner to acquire knowledge as presented in curriculum document	The document material promotes learner involvement inactive learning that links technology concepts to concrete understanding and assists a learner to acquire knowledge as presented in curriculum document
	Opportunities for learner development	The document does not offer opportunities for learner cognitive development and psychomotor skills (use of technological skills)	The document offer some opportunities for learner cognitive development and psychomotor skills (use of technological skills) to a certain extent	The document offer opportunities for learner cognitive development and psychomotor skills (use of technological skills)
	Intended focus of instruction	The document material does not address particular individual and or a group needs and shared interests of learners	The document material addresses a particular individual and or a group needs and shared interests of learners to a certain extent	The document material addresses particular individual and or group needs and shared interests of learners
	Learning style	The document material is not designed to create a structured and unstructured learning environment as required to enable different learning styles for learners to understand the Technology knowledge in a holistic manner	The document material is designed to create some structured and unstructured learning environment as required to enable different learning styles for learners to understand the Technology knowledge in a holistic manner to a	The document material is designed to create a structured and unstructured learning environment as required to enable different learning styles for learners to understand the Technology knowledge in a holistic manner

			certain extent	
Milieu	Interaction between technology and society	The document material does not explicitly emphasize the context that shows influence of the society on the development of technology and the development of technology in society	The document material emphasizes the context that shows some influence of the society on the development of technology and the development of technology in society	The document material explicitly emphasizes the context that shows influence of the society on the development of technology and the development of technology in society
	Interaction between society and process of curriculum development	The document material does not reflect on the ideological concerns and societal needs in the curriculum	The document material somewhat reflects on the ideological concerns and societal needs in the curriculum	The document material reflect on the ideological concerns and societal needs in the curriculum
Teacher	Communication of developer's considerations to teachers	The curriculum material does not relate with developer's consideration regarding selection of the subject matter, the rationale regarding learners, the setting of context and addresses teacher's anticipated role during implementation	The curriculum material relates with some developer's consideration regarding selection of the subject matter, the rationale regarding learners, the setting of context and addresses teacher's anticipated role during implementation to a certain extent	The curriculum material relates with developer's consideration regarding selection of the subject matter, the rationale regarding learners, the setting of context and addresses teacher's anticipated role during implementation
	Degree of teacher autonomy	The material does not contain specific objectives or outcomes, teaching strategies are not specified, background material, it does not offer teaching alternatives and gives room for the teacher to develop own units.	The material contains some specific objectives or outcomes, teaching strategies are specified, background material, it offers teaching alternatives and gives room for the teacher to develop own units to a certain extent.	The material contains specific objectives or outcomes, teaching strategies are specified, background material, it offers teaching alternatives and gives room for the teacher to develop own units.
	Teacher's role in instruction	The document material does not suggest any central role for a teacher as a source of subject matter knowledge and it is not supportive in guiding learners in independent learning	The document material somewhat suggests a central role for a teacher as a source of subject matter knowledge and supportive in guiding learners in independent learning	The document material suggests a central role for a teacher as a source of subject matter knowledge and supportive in guiding learners in independent learning
	Consideration of teachers' needs	The developers do not manifest awareness for the need for special training to teach Technology, possible difficulties are not addressed and it does not reflect consideration of opinions and attitudes	The developers manifest some awareness for the need for special training to teach Technology possible difficulties are addressed and it reflects consideration of opinions and attitudes to a certain extent	The developers manifest awareness for the need for special training to teach Technology possible difficulties are addressed and it reflects consideration of opinions and attitudes

Instrument of collecting data: Observation Protocol

Teacher Name		
Grade being observed		
Time and date		
Lesson Topic		
Dimension	Aspects of teaching for observation	Comment/observation
Instructional planning	Is the lesson linking well with the lesson objective(s)/learning outcome(s)?	
	Is the lesson linking with context?	
	Are the lesson activities relate to lesson outcome(s) and assessment standards? /.objective(s)?	
	Is there any integration within or across the subjects?	
	Does the lesson build on learner's interest and understanding of the topic?	
Learner questioning	Are learning activities communicate and support learning?	
	Are learning activities include higher order thinking?	
	Does the teacher develop the relationship between the topic and other knowledge?	
	Is the teacher's approach to the lesson appropriate (learner centred, addresses misconception(s))?	
	Is the classroom management effective?	
Assessment	Does the lesson develop new knowledge from previous knowledge?	
	Are assessment tasks related to learning outcome(s) & assessment standard(s)/objective(s)?	
	Are the teacher assessment strategies appropriate in integrating the task activities?	
	Does the teacher make use of the information gathered and learner responses?	
Lesson presentation	Does the teacher offer information and insights beyond what is available in class?	
	Does the teacher available him / herself to take suggestions from the learners or adapt methods to accommodate contingencie	
	Does the teacher demonstrate sufficient understanding of the subject content?	

	Are the methods and content adapted to suite the learner's grade?	
	Does the teacher's approach to the subject matter help learners to understand different aspects of subject content?	
Teacher Reflections	Were the lesson assessment standard(s)/objective(s) met or not?	
	Did learners delivere proof of learning i.e. written or oral task?	
	Were the highlights and low lights of the lessons stated?	
	Did the teacher comment on the general lesson presentation and suggest improvements in the next lesson?	

Profile of implementation: Technology in Society (adapted from Aldous & Rogan, 2009)-Rubric

Dimension	1	2	3	4
Teacher	Teacher did not use examples and applications from everyday life to illustrate technological concepts	Teacher uses examples and applications from everyday life to illustrate technological concepts with omissions	Teacher fairly uses examples and applications from everyday life to illustrate technological concepts with omissions. everyday life to illustrate short term benefit but resulting long term detrimental effect	Teacher uses examples and applications from everyday life to illustrate technological concepts
	Teacher based a lesson not on a specific problem or issue faced by local community.	Teacher bases a lesson on specific problem or issue faced without referring to any community.	Teacher bases a lesson on a general problem or issue faced by local community.	Teacher base a lesson on specific problem or issue faced by local community.
	Teacher does not assist learners to explore the explanations of technological phenomena by different cultural groups.	Teacher assists learners to certain extent to explore the explanations of technological phenomena by different cultural groups.	Teacher fairly assists learners to explore the explanations of technological phenomena by different cultural groups.	Teacher assists learners to explore the explanations of technological phenomena by different cultural groups.
Learner	Learners do not ask questions about technology in the context of everyday life.	Learners ask some questions with difficulty about technology in the context of everyday life.	Learners ask questions about technology in the context of everyday life with minor difficulties.	Learners ask questions about technology in the context of everyday life.
	Learners do not investigate the application of science and Technology in their environment.	Learners investigate the application of science and Technology with uncertainty in their environment, mainly by means of data gathering methods such as surveys.	Learners investigate the application of science and Technology in their environment, mainly by means of data gathering methods such as surveys.	Learners actively investigate the application of science and Technology in their environment, mainly by means of data gathering methods such as surveys.
	Learners do not undertake a project in their local community in which they apply technology to tackle a specific need e.g. investigating a problem/need to bring solution to the community.	Learners undertake a project in their local community with difficulty in which they struggle to apply technology to tackle a specific need e.g. investigating a problem/need to bring solution to the community.	Learners undertake a project in their local community in which they fairly apply technology to tackle a specific need e.g. investigating a problem/need to bring solution to the community.	Learners actively undertake a project in their local community in which they apply technology to tackle a specific need e.g. investigating a problem/need to bring solution to the community.
	Learners do not explore the long term effects of community projects e.g. project have short term benefit but resulting long term detrimental effects	Learners explore the long term effects of community projects with difficulty e.g. project have short term benefit but resulting long term detrimental effects	Learners explore with minor omissions the long term effects of community projects e.g. project have short term benefit but resulting long term detrimental effects	Learners explore the long-term effects of community projects e.g. project have short term benefit but resulting long-term detrimental effects.

Level description

1. Leaner or teacher has not satisfied the level expectation for profile of implementation
2. Leaner or teacher has partially satisfied the level expectation for profile of implementation
3. Leaner or teacher has satisfied with minor omissions the level expectation for profile of implementation
4. Leaner or teacher has satisfied the level expectation for profile of implementation

Appendix C: transcripts

Face to face interviews transcripts

(Underlined sentences in italics represent corrections made during member checking for validation)

Case # 1(Nomvula)	**Case # 2 (Suzan)**	**Case # 3 (Job)**	**Case # 4 (Jane)**
Transcript #1 - School A R: Ok, Err…tell me about your experience in planning and teaching Technology in your classroom. P: Ok..as Technology is the most interesting subject teaching Technology is very simple *when* we have the relevant resources. It links, Technology also links with what learners must do at home. R: (probing) so how do you plan that? and how do you teach that? How is your experience on that? Actually how do you find to be when you do planning? P: Umm...when you plan Technology we find difficult because it needs resources and it needs more *practical* work, ja. R: (probing) Ok what do you mean by that? Do you mean planning you need to think about the resources that are needed ok, so how do you find it when you teach in the classroom? P: (follow up response) Umm…when teaching inside the classroom learners are participating because they have knowledge their minds are not empty they have something that they know they only need opportunity to give to expand it and help them. R: Ok, which concepts do you find challenging in teaching Technology? P: Concept systems and control those	**Transcripts # 2- -School B** R: Err, as a Technology teacher I would like to ask you the following questions, please feel free to express yourself in the language that you understand best if sometimes you feel you're not comfortable in using English. R: Tell me about your experience in planning and teaching Technology in your classroom. P: It is err, very difficult we did not understand these concepts and because the subject was still new we struggled a bit but as years go buy now we were able to do the right thing may be the right thing at least simpler .we now knew how to err, err, explain to the learners how these concepts err…are err…done to err…prepare the lesson properly and err…correlating them with the learning outcomes. R: (Follow up) Ja, I heard you talking that you are able to explain concepts much better which concepts are you referring to. P: Err, this one of control err…what is it? Err…systems and control this one is a bit challenge to me. I had to think that may be is because I am a woman it deals more of machines I have a problem with these machines I cannot explain them to these learners. Sometimes I want them to make a	**Transcripts # 3 –School C** R: Err…I would like welcome you to this interview session, you will realise that my questions that I am going to ask you as I have given earlier on are covering five major questions but under each question we have sub questions to clarify the questions that we want to answer. R: Tell me about your experience in planning and teaching Technology in your classroom. P: Ok, my experience in planning and teaching Technology in my class I usually focus on the three themes i.e. LO 1, LO2 & LO3. I make sure that the *AS (assessment standards)* are informed by the LOs and the LOs are the three technological themes. R: Which concepts do you find challenging in teaching Technology? P: Err…the concept or concepts I find very challenging in teaching Technology are all concepts in learning outcome 3 i.e. indigenous Technology and culture, impact of Technology, biasness in Technology, as well as processing in learning outcome 2 i.e. Technology knowledge and understanding. R: So what do you do to make sure that these concepts are taught in your class since they are prescribed in your Grade7	**Transcript # 4-School D** R: Tell me about your experience in planning and teaching Technology in your Classroom. P: Umm…the experience I have in that err…most learners they enjoy this subject of Technology and when I attend them I make sure that I plan very thoroughly and I know my things very well because it might happen that I find these intelligent learners ask me different questions then I plan very well but the challenge is err…sometimes you find that we do not have much resources .so we improvise sometimes ja. R: Which concepts do you find challenging in teaching Technology? P: err… the concepts which I find challenging in teaching Technology is this thing ya TKU (technological, knowledge and understanding) this one of systems and control in fact those once are challenging to me. R: What do you do to make sure that these concepts are taught in your classroom? P: To make sure that these subjects are taught in my class I approach science teacher in fact and come to my rescue meanwhile I am there with him trying to understand these concepts very well.

machines thing it needs more knowledge more the teacher must have to deliver to learners.
R: So, what do you do to make sure that these concepts are taught in your class?
P: Umm…sometimes I can I ask assistance from other teachers who have more knowledge and the curriculum implementers help us to by conducting workshop so that the concepts must be clear to learners.
R: Do you normally give your learners activities?
P: yes.
R: Umm…what do you think is the nature of Technology activity?
P: (phone rings) yes is to link Technology which they are doing at home, ja.
R: Ok, So are you familiar with the themes in Technology curriculum?
P: Yes, I am familiar with that because Technology it needs knowledge, skills and Resources and must be links with the environment. Community must also achieve things from that Technology.
R: Ok, which once can you highlight?
P: Umm…Like processing, in processing learners must know let's take we are making marula jam this processing help them to not eating bread without any without making bread dry then we make jam from marula we only need sugar then we can make homemade jam from marula and is the knowledge of processing.
R: (follow-up) where can you classify it under the LOs?
P: (follow-up response) Learning Outcome number 2.
R: Which are? Ok, is there any relationship that exists amongst the themes that you can
explain like you said LO1, LO2 and LO3?

project that works and if I cannot do it the learners also struggles.
R: What do you do to make sure that these concepts are taught in your classroom? because as you will agree with me that systems and control is part of the Technology syllabus.
P: Yes, I have to do it but sometimes I go to male teachers here at school err…asking them what does this mean what does this machine is look like they help me sometimes I ask them to come to class for demonstration.
R: Ok, did not you do these concepts in much detail in ACE programme?
P: No, no there was no much practical.
R: What do you think is the nature of Technology activities?
P: The activities in Technology usually are more of making skills has to show how to making things developing things.
R: Which means you concentrated much on skills what about knowledge?
P: Those skills cannot be done alone we usually start with the knowledge thereafter we go apply and the skills.
R: Are you familiar with themes in Technology?
P: Yes, I am.
R: Which once?
P: We have only three of them the first one is Technology process and skills, the second one is technological knowledge and understanding and the last one is Technology, society and environment.
R: Is there any relationship according to you that exist among the themes that you can explain?
P: Yes, there is relationship because one cannot be dealt alone we have to do them at the same time all with the three they

senior phase document?
P: To make sure that these concepts are taught in my class, err…I normally seek help from other teachers that is to say Technology teachers in my school. I also request to be assisted by the circuit cluster Technology team, whereby we conduct lesson studies as a support system.
R: Ok, are those structures helping you to be able to plan as you wish?
P: Ja, sometimes.
R: What do you think is the nature of Technology activity?
P: The types of activities I normally teach are as follows assignments, projects, case studies, investigation activities, research, tests and err…practicals.
R: So which means those are the forms of assessment you are dealing with?
P: Yes.
R: But in those forms of assessment what type of activities do you normally engage your learners with?
P: I normally give them class work, homework and practicals.
R: In what? can you just elaborate a bit, based on what?
P: *For instance based* on learning outcome 2 where we have to take the content out of it then I give them a class work and homework. Err…LO 1 technological process I engage them in projects.
R: I heard you earlier on telling me that you engage with the three themes in Technology err…are you really familiar with the themes in Technology curriculum?
P: Yes.
R How familiar are you?
P: Err…I know the technological process and skills, technological knowledge and understanding and Technology, society and environment.

R: Do you mean the science teacher do understand these concepts in systems and control?
P: Because this thing (ya) system and control is integrated with err…science things the most important things they are doing in science are the same things they are doing in Technology but particularly in systems and control.
R: What do you think is the nature of Technology activities?
P: Err…the nature of Technology activities are they is based on project, research and (ya) case study.
R: Are you familiar with themes in Technology curriculum?
P: Yes, I am familiar with it.
R: Which once can you highlight?
P: Err…I can highlight the first one TPS which stands for technological processes and systems then in that are whereby we follow the technological process where we investigate, design, make, communicate and evaluate after that the in short I teach my learners abbreviate it as IDMEC so that they may follow the procedure.
R: Is that the only one that you can highlight?
P: Even the last one since I in the first question I said with system and control I am not good in but the learning outcome 3 which is Technology, society and environment is whereby I teach my learners to be familiar with the environment and let them know that the nature does not want to be destroyed where we have the indigenous things, bias and what.
R: Is there any relationship amongst the themes that you can explain?
P: Ja, according to me I think there is a relationship because for everything the learners need to investigate and make in

P: All learning outcomes in Technology they are existing because LO1 it also relates with
LO2 and also LO3 because all of them in Technology through investigating they must investigate do design, make and evaluate everything.
R: How do you engage the three of them?
P: Umm…err...they are engaged in society and environment.
R: What is your interpretation of Technology, society and environment (TSE) theme in Technology education? How do you interpret that one?
P: Umm..err..as learners now that they are the in the fruitful are busy learning (door opens) it helps us an in the community they must be fruitful in their community to do things on our own not to buy.
R: What role does TSE play in planning Technology activities?
P: It helps us to understand what is happening in our society.(knock on the door, door opens).
R: How do you engage the Technology curriculum themes in designing for instruction? meaning by that we are referring to when you design for teaching and learning.
P: Because when we are designing must involve learners and must also involve parents because sometimes when we are designing things we request learners to bring things from home. Parents in other ways are also playing an important role. (*I focus on the learning outcomes and assessment standards, focus on the learning content and learning context aims and objectives are also considered, integration of other learning areas and duration for the lesson are important, prior knowledge is also important in my teaching because we know* need to be done at the same time.
R: What is your interpretation of Technology, society and environment theme?
P: My interpretation on this is err, that learners must know the Technology they are familiar with today how was it done err, before the impact of this change to the society also if the environment how does it affect the environment now and before
and also the bias part of it if favouring them now or before
R: What role does Technology, society and environment theme play in your teaching of Technology?
P: It plays a very important role though our learners they do not know the things done long ago our learners cannot be able to match what was done before because they have no idea of what happened before.
R: So can you give an illustration of an activity may be where you engage this Technology, society and environment theme?
P: Let's take in processing when we do processing we talk about ways of processing how did long ago people process food and if you give them an assignment to go and research they come being empty they do not have enough information how things were done long ago they cannot have knowledge how it affect the society and the bias part of it.
R: How do you engage the Technology curriculum themes in designing for teaching and learning (instruction)?
P: I usually check the policy documents on the themes and check the assessment standards then I have to look at first the main assessment standard then I will go and check with the other themes which one has to match with this assessment standard and I am correlating with them in
R: According to your thinking is there any relationship that exists amongst the themes that you can explain?
P: Ja, they are related there is no err…learning outcome which is working in isolation they are all interrelated.
R: Do you mind to give a bit of illustration of some kind, how are they related?
P: It is like when you plan a project there are some skills that the learner have to get but before they must get the content from LO 2 so as to apply the skills by doing a practical work like a project. Err…and all the problems that they encounter or they anticipate in the environment they have to solve them through the problem.
R: What is your interpretation of Technology, society and environment theme in the Technology curriculum?
P: Come again
R: (Repeated the question) How do you interpret it?
P: Err…Technology, society and environment theme in Technology curriculum focuses on the impact, biasness in particular society and environment.
R: What role does TSE play in your teaching of Technology?
P: The role of this theme in teaching Technology is to enable us to recognise and identify the positive and negative impact of Technology in society and environment so as to improve people's quality life and come up with strategy of reducing any undesirable events.
R: Is it necessary to have such theme in Technology curriculum?
P: I think so.
R: How do you engage the Technology curriculum themes in designing for teaching and learning i.e. instruction?
P: Come again.
TSE it is an indigenous thing they have to investigate with the grand fathers and grandmothers or older people about the things they were doing in the past so I think there is a relationship between the two though I said I do not understand the second one but in it I can see that there is a relationship because in systems and control it is whereby we need to make something that can move with or without electricity again here they can investigate, they can design, make and evaluate that is why I end up by saying there is a relationship.
R: What is your interpretation of Technology society and environment theme in the Technology curriculum?
P: Err…my interpretation is that the TSE is whereby we talk about the indigenous thing whereby we have to involve things err…in fact they say Technology it was there before is an olden thing even if they have not used it but it was there the olden people know this thing very well.
R: what role does TSE play in the teaching of Technology?
P: Let the learners be aware that the nature should not be disturbed and again they are familiar with the environment and they make sure that they should not harm the environment and the people around it.
R: How do you engage the Technology themes in designing for teaching and learning?
P: Umm…err…I make sure that I am familiar with this thing ya TSE so that I may be able to I impart this knowledge to earners.
R: What about these other themes TPS and TKU?
P: Ja with them I teach them to search information for themselves more especially the first one they should be able

that learner know something. Linking prior knowledge and learning context helps learners to understand better).

R: If you think of planning for teaching, how do you engage these themes, I mean learning outcomes?
P: At the end learners must have knowledge and skills and from that they must achieve something from that be able to do things on their own.
R: To what extent do you engage TSE when designing for teaching and learning? Does it sometimes come to your mind I have to engage it up to this level?
P: Umm…Ja…Yes because when we are teaching there must be objectives and at the end of the lesson objectives must be achieved.
R: (follow-up) so are you trying to say that you make sure that these things appear in your objectives?
P: yes
R: Ok, what kind of activities do you give to your learners?
P: Yes, I prefer written activities and oral activities also practical activities help learners to understand better.
R: (follow up) so on those written and oral whatever activities what type of activities do you give is it in the form of project or form of activities that they look for information or is it an activity where they have to recall what they have learnt?
P: We have test as the written activity, test must recall what they have learned in project they must do know what they have learned practical and knowledge and skills and they must investigate before and there must be a problem that should be solved.
R: What pedagogical approaches do you apply in the teaching of Technology in designing for instruction.
R: To what extent do you engage Technology, society and environment theme when designing for teaching and learning?
P: I usually, I always but sometimes when you teach the learners one of the theme when interacting with learners if one of the theme fail I did not achieve the objective of it.
R: What do you mean by objective are you referring to or where are you
P: From the assessment standard.
R: What kind of activities do you normally give to your learners?
P: We usually do the activities about knowledge in the form of classwork and homework. I also give them a project sometimes I give them the research project then we also do a project we do all the steps of technological process and skills.
R: How do you ensure the relationship of themes to what you have just mentioned?
P: The relationship is there as I said before that I cannot isolate the themes are working together I cannot say I am doing err. Technological process and skills alone there must be knowledge and there must be society and environment.
R: So, what pedagogical approaches, here I am referring to methods of teaching and learning approaches do you apply in your Technology class.
P: I usually do the explaining part of it if it comes to the knowledge err…I do experiment when it comes to skills. I do demonstrations.
R: How do you ensure that the interrelationship of themes is catered for in your approaches?(Cyrene rings)
P: When I prepare my lesson for a start I make sure my documents are there by taking the document to choose the right
R: How do you engage the Technology curriculum themes in designing for teaching and learning or instruction?
P: Err…I normally conduct projects err…while I am doing that I think it is addressing that aspect.
R: To what extent do you engage TSE when designing for teaching and learning or instruction?
P: In designing my instruction I normally engage learners in LO 3in my teaching and learning activities because this theme addresses day to day problems in the society.
R: What kind of activities do you normally give to your learners?
P: I normally give them class work, assignments, tests, projects and practical work.
R: What pedagogical approaches or teaching approaches do you apply in the teaching of Technology?
P: I normally apply learner centeredness, experiential learning and co-operative learning.
R: To what extent are those approaches assisting you to achieve your objectives or outcomes?
P: Come again
R: (Question repeated)
P: I design my teaching instruction normally as I indicated; I usually engage them in LO 3 that is Technology, society and environment theme in my teaching and learning activities because this theme addresses day to day problems in society.
R: And how do you ensure that the interrelationship of themes is catered for in your approaches?
P: Come again.
R: (Question repeated)
P: During planning of teaching and learning instruction I make sure that all
to go and look information for themselves and at the endof the day they must come up with something that is concrete then I have teach them to abbreviate it as IDMEC at the end of the day they must be able to evaluate the thing and if they do not find the answers which it is in fact they should go back and re-do that process again.
R: So to what extent do you engage TSE theme when designing for teaching and learning?
P: Umm…when designing for teaching and learning I make sure that I understand what is this thing ya TSE and let the learners again to understand then again and again.
R: What kind of activities do you normally give to your learners?
P: Umm…I give them research, practical work and projects.
R: What pedagogical approaches do you apply in the teaching of Technology?
P: Since this subject ya Technology is a hands on learning area whereby learners they need to be engaged in a practical thing in most cases we do practical things in class but unfortunately because of the lack of resources I let them go and do at home but it is making it difficult to them because I do not see them while they are doing mean while this thing is meant to be done in class so that I can be there to monitor and doing and make sure that everything it went right.
R: How do you ensure that the interrelationship of themes is catered for in your approaches?
P: Err…this thing I see it while we do project for instance a project ya when we do a project ya is whereby we come up with a project portfolio it is whereby I see the interrelationship of this things because they need to investigate and they

your classroom? Here we are referring to methods and approaches.
P: When we come to the method of teaching I prefer the learner cantered method because it allows learners to share what they are having even if group discussions they allow themselves they engage with their to sharing of knowledge with others.
R: How do you ensure that the interrelationship of themes is catered for in your approaches? Remember earlier you mentioned that it cover SKV (repeat).
P: On the issue of skills to see if those skills the learners have been achieved there must be a product from those skills they have achieved knowledge, when they have achieved knowledge to ensure that the skill is achieved.
R: All right, do the approaches that you use lead to the successes in interrelating the themes?
P: Yes
R: How?
P: Umm…when I approach my learners if for an example if I ask why we make the car? They have knowledge that car takes me from point A to point B or I want to help the community doing this and that with the car.
R: Is there anything you can say about linking the themes to make sure that it addresses the SKVA at once?
P: I shall, I can say no because this things are related and they link together.
R: (follow up) such that you do not have a problem when planning and teaching?
P: (follow up) Ja, Umm…when may be planning sometimes can be difficult because When linking lets' take you want to link processing with the society now is June time sometime where there is no marula we are going to link this finds it difficult

assessment standard looking for another one err…that from the part of the document I know I have done the correct thing.
R: Do the approaches that you use lead to success in interlinking the themes?
P: Sometimes, sometimes I do as I said kuri I sometimes I get my objectives sometimes I, I get them sometimes I do not. I sometimes check kuri in that assessment standard I
have achieved this one but this one I did not.
R: is there anything you can say about successes or failures in interrelating the themes?
P: Err…yes especially to that one that I mentioned problems.
R: But in terms of relating the themes is there anything that you are failing on interrelating the themes?
P: It depends on the topic which I am dealing with, some of these topics are easy to interrelate them some are not.
R: What do you do in trying to deal with these failures?
P: It is difficult because sometimes we do go to the workshops but we come back without the knowledge and again we are not being helped.
R: But did you try you try to talk to your advisors about this?
P: Usually when they come they do not come to assist us at least I can say they only come if they bring common assessment task if ever they give themselves time say err…I am for you tell me everything that you have a problem with that would help
because I would tell them so they usually come when they bring common assessment task.
R: Are there any barriers that you encounter in trying to deal with interrelating the Themes? by barriers I mean something that hinders you not to succeed in

themes are integrated no theme should be used in isolation because these themes are related to each other.
R: Do the approaches that you use lead to success in interrelating the themes?
P: Ja sometimes.
R: Err…can you elaborate on that?
P: Err…the thing sometimes when you plan your teaching and learning activities you find out that sometimes learners have got a barrier of maybe a barrier of the language of teaching and learning.
R: Is there anything you can say about failures in interrelating the themes during your planning and teaching.
P: Ja the resources sometimes tend to be a barrier leading to a failure to interrelating the technological themes successfully.
R: Besides resources is there anything you can mention?
P: Ja as I indicated before some of the learning activities need learners to express themselves in the language of teaching and learning.
R: What do you do in trying to deal with these failures?
P: I just discuss all these failures with the other teachers who are teaching Technology in my school and refer the problem to school management team so as to assist us.
R: Do you get any help regarding that?
P: Ja sometimes.
R: Are there any barriers that you encounter in trying to deal with successes in interrelating the themes?
P: Ja, we as Technology teachers we normally do not get enough training in this regard.
R: Is that the only barrier you are

need to follow these processes until they come up with a project.
R: Do the approaches that you use lead to successes in interrelating the themes?
P: Yes, it do. Yes.
R: can you elaborate on that?
P: Umm…the approaches that I use they lead to success because at the end of the day we
come up with something that is concrete but we follow all those successes of the themes so that we may come up with something that we need hence we said in Technology is whereby learners they need to solve the problems then to show that this problem has been solved we see by product or the results.
R: Is there anything you can say about failures in interrelating the themes during planning and teaching?
P: Yes I can say hence I have said I do not have much more information about the concepts of TUS systems and control it make me be uncomfortable while teaching
this things because I am not familiar with this thing.
R: What do you do in trying to deal with that?
P: In trying to deal with this I request somebody whom we are on the same curriculum or
some subject area where this thing there is an integration it might happen that he understand or she understand this better than me then I call him or her to come to my rescue.
R: Are there any barriers that you encounter in dealing with the success in interrelating the themes?
P: Yes there are some barriers.
R: Which are those barriers?
P: Umm…number one is the lack of

because there is no marula until at the beginning of the year where we can find the fruit.
R: (Followup) following the work programme as supplied by the department of education and you find dealing with mechanisms in systems and control do you find it difficult in planning and teaching.
P: Ja, I find difficult because also me as educator do not have the knowledge concerning machines, knowledge concerning levers workshopped on that which means in short what makes it difficult is the knowledge of maybe I can deliver a fruitful.
R: (Follow up-which means in short what makes it difficult is the lack of knowledge in dealing with the content).
P: (Ja)
R: What do you do in trying to deal with the failure of lack of knowledge of some of these contents?
P: Ja… I am working hard umm…busy attending departmental workshops and using internet for more information.
R: But do you find it easier to acquaint yourself with such contents.
P: Not in such way because sometimes it needs more explanation more especially as it needs practical work because I can have pamphlets but I cannot do it on my own sometimes especially practical work. Umm...more especially in special practical work in such way because sometimes it needs more information I can have pamphlets but still experience problems.
R: Are there any barriers that you encounter in trying to deal with successes in interrelating the themes?
P: Ja… there are more barriers because first of all learners are divided into interrelating the themes together.
P: There are barriers err…sometimes it come to this one the second one technological knowledge and understanding as I have said something that I do not understand becomes difficult to pass the knowledge through to learners and even if I want to prepare the lesson I get stuck because I do not have more information, sometimes the text books are a problem they do not give us more information sometimes you get stuck when you look for help and you turned to overlook such.
R: How do you address these barriers to succeed?
P: I am not addressing because I do not know where to get help from.
R: Have you tried some other means to see yourself may be acquainting yourself with those sections that are difficult to you?
P: Err… I am trying with the knowledge I got from the training but sometimes I get stuck.
R: What do you normally do in your cluster meetings, do you discuss some of these barriers?
P: That is what I want to say in our cluster most teachers will tell you (switched to mother tongue) hina a hi switivi leswi swa maTechnology vo hi nyika leswi a hi switivi (meaning this Technology it's just allocated to us and we do not understand its content) so you find that you are a group of people who do not know anything.
R: Are you thinking of doing something about that in terms of your personal development?
P: I am thinking of studying further may be it could help us and another thing again there are opportunities for teachers where teachers are trained again in full time during school holidays where they will be doing these things practically but you find referring to or you still have some you which mention besides the training?
P: Ja, presently are those barriers that I have.
R: How do you address these barriers to succeed?
P: to succeed in addressing these barriers I think if my school can arrange *experts* on this field to come and train us we can be able to overcome these barriers.
R: Do you think you have enough *experts* in the field?
P: Come again
R: (Repeated the question)
P: No we do not have enough.
R: Ok, what is your suggestion regarding the whole situation as a teacher how would you like to see the teaching of Technology happening in your school, or in your district or your province?
P: To make sure that teaching and learning is successful I think the planning must start from school level where by Technology teachers must come up with the strategies they must indicate their weaknesses in fact they must come up with SWOT analysis. They must check their weaknesses. They must come up with the strategies that can help them to teach Technology successfully and err…the school based workshops must be conducted where as err…I also motivate that the circuit or the district must constitute structures such as circuit teams in the way that all the problems that are encountered by teachers at the school level must be referred to the circuit team by so doing I think we can be able to teach Technology very successfully and the school must also support teachers in a way of may be buying the resources that are relevant to these different themes.
R: Thank you very much for your time.
resources we do not have much resources for instance when we want to make this thing ya mechanical system we did not have resources to make those driver and driven gears but instate we improvised by drawing it on the chalkboard since well this thing is a practical thing it needs something that we must do in class cut, cut, cut until they understand what is it that we want to teach than in fact but we do sometimes improvise by drawing and they just have a little understanding.
R: How do you address these barriers to succeed?
P: Err…I have tried to talk to my managers about this things and again in the past there were people from the whole school evaluation I told them about this things may be I am just hoping that they will try to help me and give me those resources because with my managers we did several times but we fail what do we do we just concentrate on the things that we have or let the learners go and do at home of which that is not good it was supposed to be done in class monitored by a teacher and make sure that these learners when they are using this thing resources thing they should not hurt or prick each other. I learn kahle kahle ndzi vadyondzisa responsibility ku loko vatirhisa swilo leswi they must handle it with care.
R: Which means safety first?
P: Yes
R: Ok, in general what can you say could be done to improve the teaching of Technology?
P: to improve the teaching of Technology in fact this learning area ya Technology is very nice is very interesting the only thing with this thing is that we people from rural schools we do not have much resources as it Is required by this

three groups gifted, average and those needy and we know that Technology has lesser periods number of periods, minutes are very short the more you teach and time is running out R: How do you address these barriers to succeed in your planning and teaching? P: Sometimes I have time with those needy learners after school for 40min try to help them to teach them. R: Are these the only barriers that you have in dealing with barriers or are you still having others? P: There is a problem of learning materials Ja...learning materials if we have more material that learners do practicals those will help those needy learners. R: So, learning materials referring to what? Text books or what or also resources? P: Resources that we need to do now we are on cams those eccentric wheels, sliding doors can help us. R: Thank you very much for giving attention to these interviews. P: It is my pleasure.	that the way they choose teachers to get bursaries to go and study is not understandable but some of them can you imagine a principal going to study while you as the teacher who is supposed to teach the learners you are not given an opportunity and when they come back with the information there is nothing they do about it. R: What kind of support do you get from the district in terms of do they give you some documents where they guide you on how to handle some of the sections. P: No none R What do you think could be done to improve the teaching of Technology in schools? P: I think because this subject is very new to most of the teachers as I said most of the teachers they teach because of subject allocation and of which some of the teachers do not have an idea, I think if the department can find the names teachers who are teaching Technology in class taking them to the courses during school holidays where we will tell them the sections in which we get problems in for an example I tried to go to Nelspruit studying on Saturdays and they said they are offering Technology I attended those sessions once a month, but when I was there I thought I could be helped about what I am unable to do in class but I found that those teachers who attended the classes cannot write the work schedule ,lesson plans and learning programmes they said they do not have any idea and it did not reach a place where we were taught about those concepts we wanted. If we can organise for us a course where we can be taught there concepts and we do them practically there we can be able to tell them where we find difficult that will be much easier.		subject is whereby sometimes we just improvise there and there try to teach the theory part of it forgetting the practical part of it of which the most important thing is the practical part of it. R: Thank you very much.

	R: Do you find it easier if you were to link what is in your policy in developing your work schedule and link them together up to learning activity level. P: No … no I do not have any problem in that I said the only problem is when I want to link or I do my preparation well is only when I do not have the knowledge of that. R: Thank you very much for your time to participate in this interview, I wish you all the best in your teaching career.		

Field notes: Observations

Dimension	Nomvula*	Job*	Jane*
Instructional planning Lesson objectives and context. Activities relate to lesson outcomes and assessment standards Integration within or across the subjects Lesson builds on learner's interest and understanding of the three themes	(observations took 45 minutes) Started by introducing the lesson recapping on the previous lesson. Explain the link between knowledge, skills, problems solved on day to day and solutions brought about by the cams.	(observations took 55 minutes) Introduced the visitor. Discussed the content outcomes and language outcomes displayed on the chart showing how the lesson will be rolled out. Activities are outline as defining what levers are, describing how direction in an object changes when mechanisms used and calculate mechanical advantage. Integration is more on maths and language no integration within the learning area. Not even mention of LO1 and LO3 aspects.	(At the time of visit the school was busy with trial examinations. Observation took 45 min) She made an agreement with the other teacher also teaching Grade 9 science for co-presentation. This arrangement did not work as I did not have any consent letter from this second teacher and the school. Jane had to present the lesson alone in Grade 9. Jane was not confident with the topic under observation.
Learner questioning Learning activities communicate and support learning Learning activities include higher order thinking The teacher develop the relationship between the topic and other knowledge	Asked questions and demonstrated the concepts of cam followers. Asked relevant questions	Engaged learners in some activity where they identified and drawn different mechanisms. The focus was more on knowledge and understanding (LO2). High order questions such as why? What? Were asked during the learners responses and learners were articulate in their responses. E.g. they were able to articulate a point where one has to use more effort to move the load and managed to explain the effects of the distance between the effort and load in terms of mechanical advantage.	Engaged in some activity to identify different gear systems and draw them.

Classroom practice Effective classroom management The teacher's approach to class discipline is appropriate The lesson is learner centred Identifying learners' misconception(s) Developing new knowledge from previous knowledge. The assessment tasks related to LO & assessment standards. The teacher assessment strategy appropriate in integrating the task activities. The teacher makes use of the information gathered.	Used teacher centred approach (chalk and talk) Encouraged chorus responses. Activity is just a recall of what the teacher was talking about no creative ways came out of the activity. Exposition of content	Created an atmosphere where learners could mention their expectations and the use of language catered for. Checked with the class from previous lesson on levers. Used learner centred approach at all levels. Learners in groups were engaged in a group activity on mechanisms and of which they later presented to the whole class.	Handed in worksheets and focused on the aspects of knowledge and understanding dealing mechanisms on gears. Jane first recapped what they have done in the previous lesson.
Lesson presentation The teacher offers information and insights beyond what is available in class The teacher is available to take suggestions from the learners or adapt methods to accommodate contingencies The teacher demonstrate sufficient grasp of the subject content The methods and content are adapted to be suit the learner's grade The teacher's approaches to the subject matter help the learners to understand different aspects of subject content. The teacher motivates the learners	Lesson application could not relate well with day to day life Clarified concepts used in the lesson. Gave relevant examples but could have done more to link with real life situation Which might suggest is the trend even on the previous activities given	Used question and answer method to try to bring understanding of the importance of levers in our day to day life simplify the business of carrying heavy loads (suggestion could have shown the impact levers have in the world of carrying loads). This was done in a way of introducing the concept of mechanical advantage where the teacher gave an example of falling apple and it was supposed to have been linked with natural sciences Learners were given chance to present their	Brought in the bicycle in class allowed learners to identify different mechanisms involved and their functions. After that she requested learners to complete the worksheet provided and discussed the feedback with learners. Jane gave a task for learners to go home and collect used card boxes to make different gears as outlined during the lesson. However it was not a smooth run for Jane as she was having some difficulties on the topic.

The learning barriers are identified and they are addressed The teacher expands the opportunities for leaners to relate the content with realities of their day to day experiences		responses of activity in a more interactive manner. The teacher always gave feedback on the activities in some cases in the form of corrections. (Suggestions: firstly could have expanded more from indigenous Technology way of lifting loads to high tech to cover the aspects of cultural groupings and LO3 and aspects of impact. Secondly could have an investigative activity for learners to identify and apply the lever principles of mechanisms. The teacher revisited the set outcomes to check if they are met or not with the learners.	
Teacher reflections The assessment standards/ lesson objectives whether are met or not? The learner's ability to complete the activities.	The assessment standard is partially met because we were doing it theoretical, there did not perform practical work by their own but they have little knowledge about cams and follower because they know how to make toys (cars) with wires. They only know to write the types of followers but failed to indicate by drawing because of not having good knowledge of machines.	Assessment standards were successfully covered. Learners managed to complete the task given	No reflections on the part of the teacher

How learners delivered proof of learning i.e. written or oral task. Recommendation required by needy learners to achieve the same Ass/learning objectives with the rest of the class, the strength (high points)and weaknesses (low points) of the lesson The general lesson presentation and suggest improvements in the next lesson.	They participate and answer question when the educator asks them they answer what they think is the correct answer (oral). Written class activity was given and the part of the drawing was difficult to them. Resources and teacher orientation can help needy learners to achieve these assessment standards. The teacher must improve on good planning and organise the resources that are needed in time and allows learners to do things on their own and also request learner to bring some materials that they can have at home	There is proof of written and oral work. After written exercise learners were given feedback in the form of corrections. Strong points - I managed to outline the objectives from the beginning of the lesson. -learners were actively involved. - learners were given opportunity to work individually and in groups Weak points Failed to identify learners with learning difficulties.	

	e.g. card box , wires etc. teachers must also be workshopped with this assessment standards e.g. systems and control.		

Profile of Implementation

(Classroom observations)	**Nomvula**	**Job**	**Jane**
Teacher			
The use of examples and applications from everyday life to illustrate technological concepts	Level 1	Level 3	Level 3
Lesson based on a specific problem or issue faced by local community.	Level 1	Level 2	Level 2
Assisted learners to explore the explanations of technological phenomena by different cultural groups.	Level 2	Level 3	Level 2
Learner			
Learners asked questions about technology in the context of everyday life.	Level 1	Level 3	Level 3
Learners investigated the application of science and technology in their environment.	Level 1	Level 2	Level 2
Learners undertook a project in their local community in which they apply technology to tackle a specific need e.g. investigating a problem/need to bring solution to the community.	Level 1	Level 1	Level 1
Learners explored the long term effects of community projects e.g. project have short term benefit but resulting long term detrimental effects			

	Level 1	Level 2	Level 1

Level description

1. Leaner or teacher has not satisfied the level expectation for profile of implementation;
2. Leaner or teacher has partially satisfied the level expectation for profile of implementation
3. Leaner or teacher has satisfied with minor omissions the level expectation for profile of implementation
4. Leaner or teacher has satisfied the level expectation for profile of implementation

Field notes: Document analysis

Nomvula	Suzan	Job	Jane
Exercise books Activities include practical and related on day to day life to everyday life problems. Some of the highlighted activities are food processing and how to plough or prepare soil for food planting and material and its properties identified the classification of each material to its properties. Lesson plans Pre-planned lesson from the service provider in -service schools project starting from lesson 1 up to 66. These lessons contained all the aspects of the three themes in Technology which identifies the skill, knowledge in a specific context. Work schedule Though they have the year planner of the topics from the department the teacher also have the work schedule planned in line with the lesson plans.	Project analysis Addresses the theme TPS on structures no evidence of inclusion or linking TSE. Exercise books Addresses the issues of content there is An evidence of linking the themes Test book There are items that addresses the knowledge, skills and attitude &values Task books More related to day to day experiences which bridges along knowledge, skills & values. Technology learning program	Departmental documents Support-letter from the district identifies the topics to be taught as of content (TRU) says nothing about TPS &TSE. Exemplar policy for Grade 4-9 (school and provincial) Highlight each theme's – delivery mode, content & context Teaching strategies – project based and learner centred approach. Learning programme-w/schedule. The three themes appear on the project making activity 6. Integration done on other learning areas but not within Technology itself. The work schedule covers all the Los and Assessment standards. Have two kinds of work schedule when asked why the teacher explained that both produced by the provincial department one original copy and the second one a supplementary copy. Lesson plans The lesson plans are planned in such a way that they cover these themes not at once but step by step until they are all realise at the project level	Documents Main file Contained exemplar programme of assessment for grades 10-12 Work schedule Shows term, week, Los & As, content, core knowledge concepts, integration, resources, assessment, data completed. Integration column does not show anything on Technology. Los & As only shows numbers which might be confusing –teachers find it a challenge to align these numbers with the bullets in the policy document. Lesson plan Lesson plans reflect the los but the activities are not well articulated in terms of showing how they immerged from the very LO.

The work schedule is not planned by the teacher but was supplied by the department in line with the Dinaledi programme. Text books The text books in use are the Technology today Grade 7 and Technology for the new nation Grade 7. The books are not enough for use by the learners. Their contents are in line with the Technology policy. They address the issues of content in all the three themes and demonstrate the links that exist among the themes in Technology. Project portfolios Projects are done in line with the requirements on the work schedule within a specified period. The project aspects indicated in a portfolio are addressing the elements of design process showing the linkage of the three themes in Technology.	Integration column shows the integration with other learning areas nothing on Technology Work schedule Interrelationship of themes is embedded on the project to be produced by learners. Lesson plans LP's are there but the question is whether they are translated to the interrelationship. Activities are general in nature and do not relate well with the objectives. Supporting documents from other agencies Contains all aspects of the themes and are planned in an n interrelated manner.	(one example attached) using the discussion learner approach. Text book Covers most of the activities in all the themes. Portfolios Structures focusing on project aspects of design process, the evidence of LO3 were shown on the context of the project. Exercise books Activities focus more on TKU and address the themes 1 at a time.	Portfolios They follow the technological process to produce a project though they use common materials like a wire top build projects. Text book The teacher uses Technology today Grade 9 text book. This guide shows all the activities that are integrated together. All the three themes are covered in an interrelated manner where projects are planned based on a particular context. Learners' workbooks Exercises books reflect the aspect of content with some knowledge in TPS. Tests Common assessment requires the integrated knowledge of themes however how learners are prepared towards that by the teacher is not convincing.

Appendix D: Samples of a work schedules, Lesson activities and Learners written work

Grade 7 work schedule

WORK SCHEDULE

LEARNING AREA: TECHNOLOGY
CONTENT/KNOWLEDGE: MECHANICAL SYSTEMS AND CONTROL

GRADE: 7
TERM: 3

TERM	WEEK	LO & AS	CONTENT / CORE KNOWLEDGE CONCEPTS	INTEGRATION	RESOURCES	ASSESSMENT	DATE COMPLETED
	1	LO 1 ASS 1.1	**Introduction** • Introduce Technology as a Learning Area. • Discuss the Background Context for Technology challenges. • Discuss safety precautions.	Language	Book and any resource material Worksheets Any simple mechanisms e.g. eggbeater, door handle, pencil sharpener etc.	1 Informal assessment	
	2 & 3	LO 1 ASS 1.2 ASS 1.3 LO 2 ASS 3.1 LO 3 ASS 3.1	**Activity** **Learners investigate the use, functions and operation of:** Mechanism • Mechanisms and movement • Eight classical mechanisms • Wheels – history of the wheel, • eccentric wheels	Language Natural Science		2 Informal assessments	
	4 & 5	LO 1 ASS 1.1 ASS 1.2 ASS 1.3 LO 2 ASS 3.1	**Activity** **Learners investigate the use, functions and operation of:** • Levers • Linkages • Pivot and slider • Direction of movement change	Language Natural Science	Worksheets A 30cm plastic or wooden ruler, 10 X 5c coins, a pencil, a level desk or table top. Thin, stiff card, 15cm long dowel or paper sticks, 3 paper fasteners.	1 Informal assessment **Formal assessment**	

5		6	**LO 1** ASS 1.1 ASS 1.2 ASS 1.3 **LO 2** ASS 3.1	**Activity** **Learners investigate the use, functions and operation of:** • Cams and Cranks • pistons • Direction of movement change	Language Natural Science	Worksheets Corrugated cardboard, wooden dowels, scissors, glue, drawing pins	2 Informal assessments	
6		7 & 8	**LO 1** ASS 1.1 ASS 1.2 ASS 1.3 **LO 2** ASS 3.1 **LO 3** ASS 2.1	**Activity** **Learners investigate the use, functions and operation of:** • Pneumatic and • Hydraulic systems	Language Natural Science	Worksheets Different sizes of syringes, plastic tubing that fit tight over the nozzle of the syringe, balloons, squeeze bottle	1 Informal assessment **Formal assessment**	

7

	9 & 10	**LO 1** ASS 1-5 **LO2** ASS 3.1 **LO 3** ASS 1.1	**Project** A big beverage company, promoting PROUDLY SOUTH AFRICAN, *needs* an improved advertisement for their *product.* According to them the *problem* with their adverts is that, they are very static and they need to have movement associated with their products. They need you to *develop* an animated product, which will appeal to *all societies* and taking *environmental factors, biasness* and *cultural diversity* into consideration. This animated advertisement will be *used* in shop windows and or on billboards not bigger than 150 mm length x 750mm height. At least 2 different mechanisms must be used. **Specifications: Product must:** • Have moving parts • Use two different mechanisms • Advertise the product • Be proudly South African • Focused on 2010 soccer • Be 150 mm X 750 mm • Be environmental friendly • Be non bias	Language Natural Sciences Mathematics EMS	Worksheets Waste boxes Dowel sticks Hardboard / Thicker card for levers / cams Corrugated cardboard, wooden dowels, scissors, glue, drawing pins Different sizes of syringes, plastic tubing that fit tight over the nozzle of the syringe,	**Formal test** **Project**	

Nomvula's Documents

Educator and Tagging Information

Learning Area: Technology
Resource Name: Technology
Assessment Exemplar Number: TECHN7.65
Item/s: 1
Phase: Senior Phase
Grade: 7
Tags: Technology, processing, denim, questionnaire, survey, Formative Assessment
Assessment Type: Formative
Assessment Form/s: Survey, questionnaire
Copyright for included material: N/A
Duration: 60 min
Learning Outcome(s) and Assessment Standard(s): **Learning Outcome 1: Technological Processes and Skills** The learner will be able to apply technological processes and skills ethically and responsibly using appropriate information and communication technology. **Assessment Standards** We know this when the learner 1 **Investigates** 1.4 During investigations, plans a strategy for collecting data and information that includes: • Identifying technologies and methods; • Considering the source, resources and copyright laws; • Uses search techniques; • Extracts relevant data for specific purposes; • Produces meaningful summaries. **Learning Outcome 2: Technological Knowledge and Understanding** The learner will be able to understand and apply relevant technological knowledge ethically and responsibly. **Assessment Standards** We know this when the learner 2 **Processing** 2.1 Demonstrate knowledge and understanding of how materials can be processed to change or improve properties (e.g. strength, fire resistance, waterproofing, taste, volume, texture).
Learning Space: Assessment
Hyperlinks: To be completed later.
Rating: **Number of questions for exemplar:** 3
Easy questions: Question 2 Question 3
Medium questions: Question 1

ACTIVITY 2

CAMS AND CRANKS

Technology: 6.1.1.1; 6.1.1.2; 6.1.1.3; 3.2.3.1

Integration

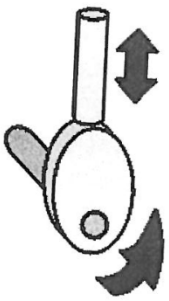
- Language
- Natural Science

Objectives

- Explain what a cam and crank is.
- Find out how cams and cranks are useful in our lives.
- Investigate how cams are used to do work.
- Investigate how cams and cranks can be used create movement
- Explain how a crank-driven wheel is made.
- You will learn that cams convert rotary motion to linear motion.
- Cams can have different shapes to provide a range of movement.
- Followers are used to transmit movement only.

INTRODUCTION

1. CAMS



Cams are wheels with either an off-centre **axis** or they have an irregular shape. They are used where a rotary motion needs to be converted into a linear one.
Usually a device called a **follower** is used, to follow the shape of the outside edge of the cam, which will make it go up and down.

A cam is:

- a specially shaped piece of material,
- usually metal or hard wearing plastic, which is
- fixed to rotating shaft.

The cam **follower slides over the cam surface as the cam rotates**. A follower is a mechanism which is designed to move up and down as it follows the edge of the cam.

WHAT CAN CRANKS DO?

Cranks are used in many different mechanisms and machines. The two main functions of cranks are:

1. To turn a shaft more easily.
2. To change the direction of the movement.

Sometimes energy from a power source is not easy to use, because the type of movement of the power source is different to the movement needed to do the particular job. Cranks can help us change the type of movement.

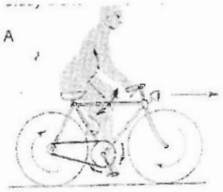
☺ Activity

10min

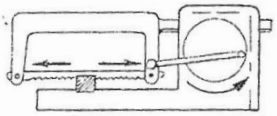
Complete the following worksheet:

Study the following diagrams and answer the questions:

A



B



Some workshops have a power saw like this one, which is driven by an electric motor. It is used to cut large pieces of metal which would be difficult to cut by hand.

1. What type of movement is demonstrated
   The knees of the rider in A?

1.1.1 he pedal crank of the bicycle?

1.1.2 The saw blade in B?

1.1.3 The driving wheel of the electric motor B?

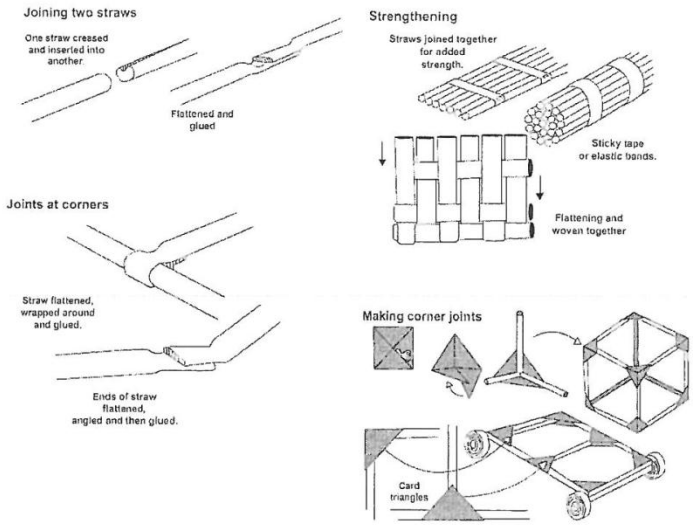
2. Cranks change the type of movement in all motor vehicles. Try to find out the type of movement performed by the following parts of the vehicle.

2.1 Starter motor

2.2 Pistons

2.3 Windscreen wiper blades.

2.4 Driver's seat adjustment lever or driver's seat base.



Use this information to describe how to:

1. Join two straws for maximum strength [5 marks]
2. Strengthen straws [5 marks]
3. Make joints at corners [5 marks]
4. Make corner joints using card triangles [5 marks]

[20 marks]

Suggested Solutions

Question number	Possible mark	Answers
1	5 marks	Learners' answers will vary.
2	5 marks	Learners' answers will vary.
3	5 marks	Learners' answers will vary.
4	5 marks	Learners' answers will vary.
5	5 marks	Learners' answers will vary.

Appendix of Assessment Tools

Suzan's Documents

PRIMARY SCHOOL
LESSON PLAN

Date:	Learning Area: TECHNOLOGY	Record
LO LO 2 LO 3	Assessment Standard: ASS 1 & 2 ASS 1-3	INTERGRATION N.S
DURATION	CONTEXT/ CORE KNOWLEDGE	PRE-KNOWLEDGE
	MATERIALS -managing the material and sustainability of it.	Ask learners to name the different materials that they know.
	TEACHERS ACTIVITIES	LEARNERS ACTIVITIES
	-Explain to the learners that the natural materials that we have should be managed well in order to sustain them for future generation to use. -Explain to them the 3 ways of managing the material which is Reuse, Reduce and Reecycle. - Reuse means to use the material over and over again. - Reduce means to use the material lesser. - Recycle means to buy the material, use it throw it away, collectors, collect it, take it to the factory to make it new again.	-They learn how to manage the material and to sustain it for future generation. -They learn to manage the material by using the 3 R's -Reuse - Reduce - Reecycle. They also learn how to explain them.
	ASSESSMENT ACTIVITIES	ASSESSMENT STRATEGIES
	- Name the products which can be reused. - Name the products that can be reduced - Name the products that can be reecycled.	Classwork.
	EXPANDED OPPORTUNITIES	REFLECTION
	Explain the recycle of bottles.	
RESOURCES:	Learners book page 28	

Grade 7A

Technology

Investigation problem

- learners in grade R are having problem during play time
- They don't have playing equipment to use during that time so they don't go out to play

Investigation report

- The problem is that grade R learners they don't have playing eqipment
- We can help them by making a swing
- I ask grade R learners what kind of game they like, they told me that they like swing and ball that game called nqaka ekina they like that game so much.
- And they tell me that when the are bored they sing and dance.

Generate ideas

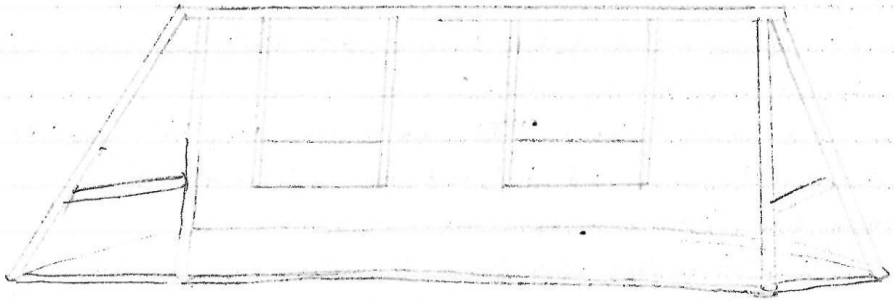
- I can make swing by using poles
- I can make swing by using iron and strings
- I can make swing by using timber and rope

- I can make swing which it have strong poles
- I can make swing which it have big iron and strings
- I can make swing with has bits

Design specifications

I have choosen to make a swing using poles ✓

Develop the final idea



Meterials

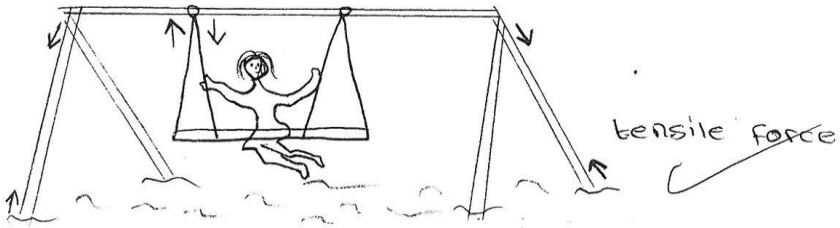
- Coldrink straws ✓
- String of wool ✓

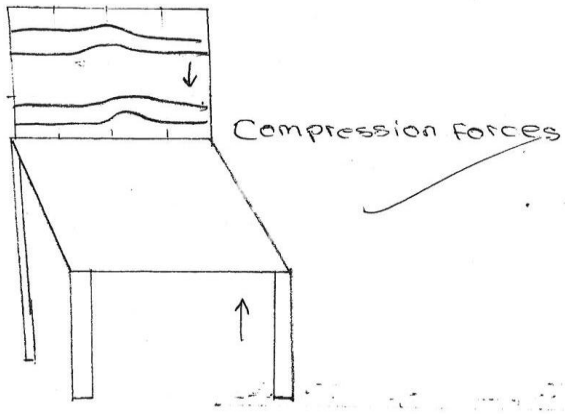
Tools

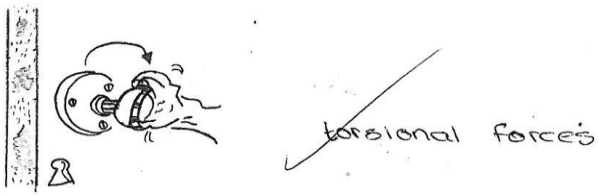
- Scissor ✓
- Glue ✓

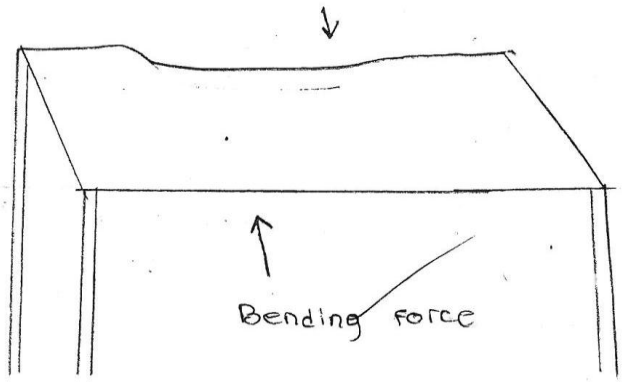
Classwork

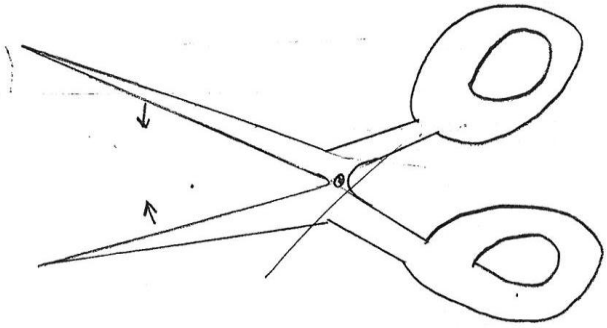
forces that works on a structure





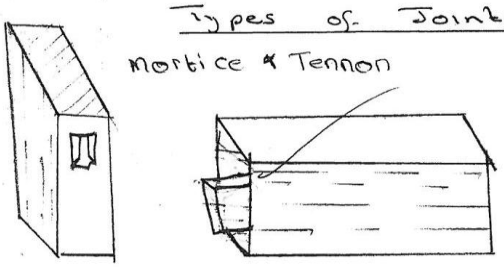


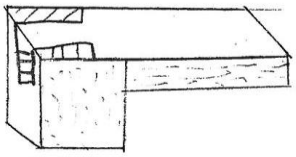




Types of Joints

Mortice & Tennon

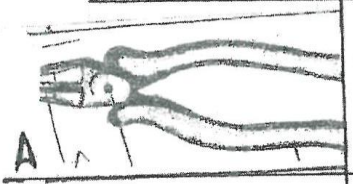
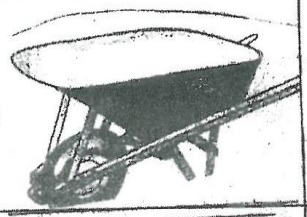
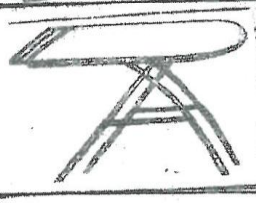
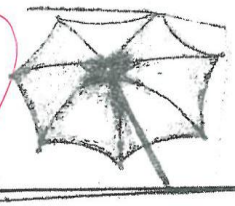
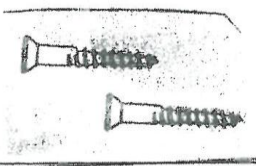




Name: 3J Grade 7B

Assignment Technology 30 August 201

1- Study the levers below and answer the following question

Lever	Name of the lever	class lever no	Uses of the lever
A 	plier ✓	class lever 1 ✓	✗
B 	wheelbarrow ✓	class lever 2 ✓	✓
C 	bead ✗	class lever 2 ✓	✓
D 	Ambureler ✓	class lever 4 ✓	✓
E 	wire ✗	lever 3 ✓	
F 	secise ✓	class lever 1 ✓	✓

Job's Documents

LESSON PLAN DURATION 30min

SUBJECT TECHNOLOGY DATE 02 September 2011

GRADE 7

Context: System and control Core- knowledge: Types of mechanism

Learning Outcomes	Assessment Standards	Integration
LO 1		
LO2 Technological knowledge and understanding.	Demonstrate knowledge and understanding of mechanical system that change the direction of movement e.g. lever system	Maths LO 5 As 1 and 3 1 st add(English) LO 4 as 6.4
LO3		
linking with previous lesson Recapping the following concepts :		
Mechanism ; Mechanical advantage.		
Learning Activities		
_group learners in to a manageable group.		
Activity 1 : In their group let them name six types of basic mechanism ,draw and discussion.		
Activity 2 : Allow learners to respond orally to what they have discussed in their groups.		
Activity 3 :Ask learners to define what a lever is.		
Activity 4 : Paste the pictures on the wall . ask the questions.		
Activity 5 :Calculate mechanical advantage by using the formula mechanical advantage - load /effort		
Activity 6 : learners will be given a class work.		

22 May 2012

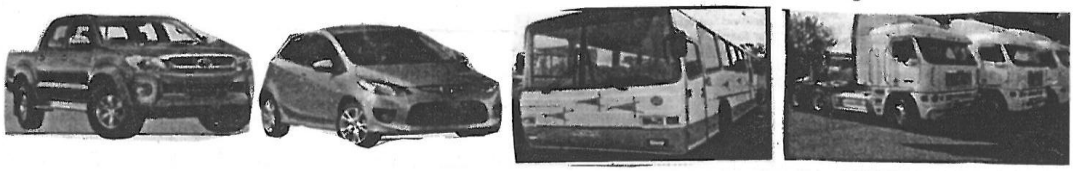
Problem Situation

Children learn a lot about the world by playing with toys. They copy the things that uduits do. They Sametimes injured themselves while playing.

You Task is to design and make a toy that Vehicle that will help children to play with.

You toy Should be 30 cm long, 12 cm wide, 15 cm high we use boxes, glue, generators, betteries

Stage 2 Investigate the problem cut and paste (3) three to four different cars from magazines

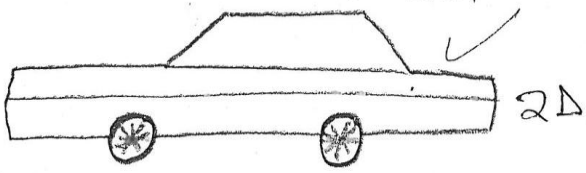


1. People : who is the product? what age?
= Children
= 10 - 13
2. Purpose : what will the product for?
= To play with
= It must be able to move
3. Appearance : what colour ?
= Blue and yellow
what shape ?
Rectangle
what size?
30cm long, 12 cm wide, 15 cm high
4. Materials : what material could use
= Boxes
= Glue
= Generators
= Batteries
5. Cost : How much could people be willing to pay?
= R15,50
6. Environment where is the product is to be made?
= In the School

ACTIVITY 3

1. Developing ideas (stage)
Draw two ideas in 2D, write advantages and disadvantages in each drawing.

1st idea



advantages
- Easy to make
- economicaly
- use for private issues

Disadvantage
- Use/need more materials
- Do not carry too many people.

2nd Idea

Advantages
- Can use for Commecial
- Can carry too many people.

Disavantages
- need more materials
- not economically.

MPUMALANGA DEPARTMENT OF EDUCATION

NAME: MEMO **DATE:** 10 September
TECHNOLOGY
GRADE 7 **TOTAL = (31)**

ACTIVITY 1

Read the problem context below and answer the questions that follow:

Problems context

- Children learn a lot about the world by playing with toys. When they play with dangerous objects they can get injured.
- Design a moving toy transport using boxes, glue, scissors, batteries, generators and junior hacksaw.
- It must be 30cm x 15cm x15cm

QUESTIONS

A.1. Write down a design brief

Children do not have something to play(2) with

2.What is to be designed

a moving toy transport (1)

3.Write down tools and materials that are to be used

Tools	Materials
a) hack saw b) scissors	a) boxes b) glue c) batteries d) generators

(6)

FORMAL ASSESSMENT TASK: PROJECT
SECOND TERM TOTAL: [36]

LO1: Technological process and skills
AS: Investigates
Design
makes
Evaluates
Communicates
LO2: Technological knowledge and understanding

Problem Context

Your younger brother uses dangerous objects and usually injure himself when playing

Your Task is to do the following:

(a) Design and a product that will help him to with.
(b) Design Constraints

- It must mobile
- Use the boxes, glue, batteries, paint and genarator

(c) Specification

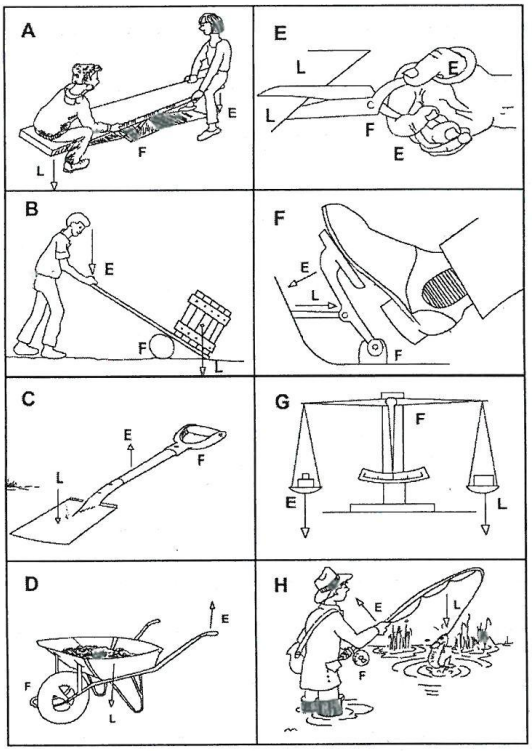
- It must be 30cm long
10cm breadth
15cm high

Assessment Task

Class of levers

The class of levers is dependent on the position of L, E and F.

N.B. Remember:
Class 1 levers
The fulcrum is in the middle, with the effort and load on either side.
Class 2 levers
The load is in the middle, with the fulcrum and effort on either side.
Class 3 levers
The effort is in the middle, with the fulcrum and load on either side.



1.1 Refer to the sketches above and write down the letter of the example next to the correct class of lever. [8 marks]

1.1.1 Class 1 e.g. A B E G

1.1.2 Class 2 e.g. D F

1.1.3 Class 3 e.g. C H

1.2 Choose the correct word or fill in the missing word.
1.2.1 The heavier the load, the (closer/further) it must be to the fulcrum.
1.2.2 The heavier the load, the (longer/shorter) the arm of the lever must be.
1.2.3 When two or more levers are joined together, it is called a ..Linkage..
1.2.4 Give one example of a linkage. [7 marks]

Jane's Documents

WORK SCHEDULE

LEARNING AREA: TECHNOLOGY — GRADE: 9

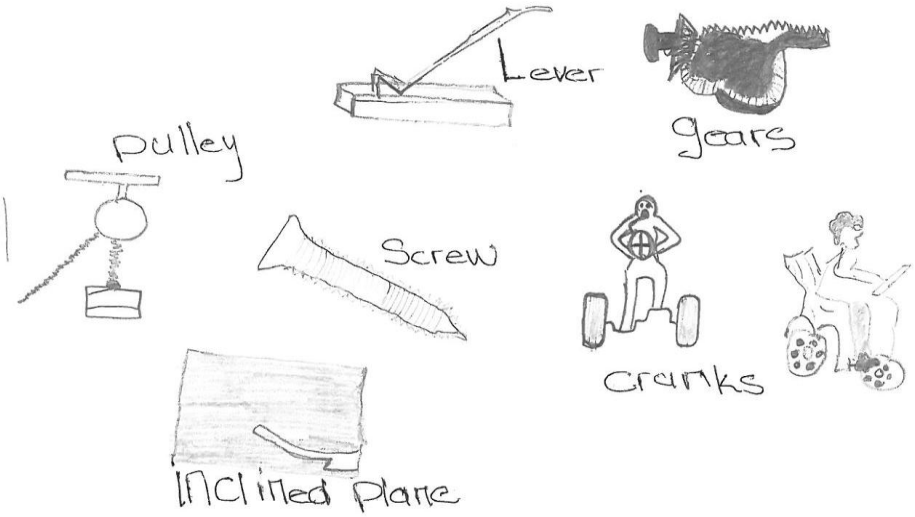
CONTENT/KNOWLEDGE: MECHANICAL SYSTEMS AND CONTROL: — TERM: 3

TERM	WEEK	LO & AS	CONTENT / CORE KNOWLEDGE CONCEPTS	INTEGRATION	RESOURCES	ASSESSMENT	DATE COMPLETED
4	1	9.1.1.1	• General organisation of the classroom. • Discuss rules in the Technology classroom. • Introduce Technology as a Learning Area. • Discuss safety precautions.	Language			
	2	9.1.1.1 9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	**Introduction** Learners investigate: • Mechanical systems • Types of movement	Language Natural Science.	Worksheet	Informal Baseline assessment	
	3	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	**Activity 1** Learners investigate: • Gears • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet, bottle tops, corrugated card, dowel sticks	Informal.	
	4	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	**Activity 2** Learners investigate: • Pulleys • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet, different found materials to make pulley's	Informal.	
	5	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	**Activity 3** Learners investigate: • Mechanical control mechanisms • Mechanical advantage	Language. Natural Science. Mathematics	Worksheet, Stiff card for ratchet and pawl parts and for mounting; craft knife; rubber band; 3 split pins; pawl.	Informal.	
	6	9.1.1.2 9.1.1.3 9.1.1.4 9.2.3.1	**Activity 4** Learners investigate: • Pneumatics • Hydraulics	Language. Natural Science. Mathematics.	Worksheet, 2 x 20 ml syringes (without needles); 10 ml syringe (without a needle); 30 cm plastic tubing; small plastic bath of water, Bicycle pump and connector; needle adaptor used to inflate soccer balls; hand drill; drill bit; 2l plastic bottle; cork to fit neck of the bottle; metal retort stand (to use as a launcher); 500 ml water.	Informal.	

8

	7-10	9.1.2.1 9.1.2.2 9.1.2.3 9.1.2.4 9.1.3.1 9.1.3.2 9.1.3.3 9.1.3.4 9.1.4.1 9.1.4.2 9.1.5.1 9.1.5.2 9.2.3.1 9.3.2.1 9.3.3.1	**Project** Good Hope Children's Home is a home that cares for Aids orphans. Christmas is a very sad time as they would like to give the young children presents, but unfortunately the home has no money to buy gifts for the children. Your Grade 9 Technology class decided that they would like to help the children's home by making toys to give to the children. The class wants the toys to be interesting and special. They decide that every toy must have moving parts so that that the children will enjoy playing with it. Your task: **1.** Design and build a toy that has moving parts. Use any mechanism to change the direction or rotation and the speed of rotation. **2.** Make a project portfolio to show all the steps you worked through. Include your design ideas, your working drawings, your model and your evaluation. Specifications: The toy should: • have moving parts driven by any mechanism. • include any mechanism that changes the speed of rotation. • include a mechanism that changes the direction of rotation. • have at least two different mechanisms. • be attractive to a young child.	Language. Natural Science. EMS.	Different types of waste materials, different tools to suit the need of the learners.	Formal assessment task. Project. Test.	

H



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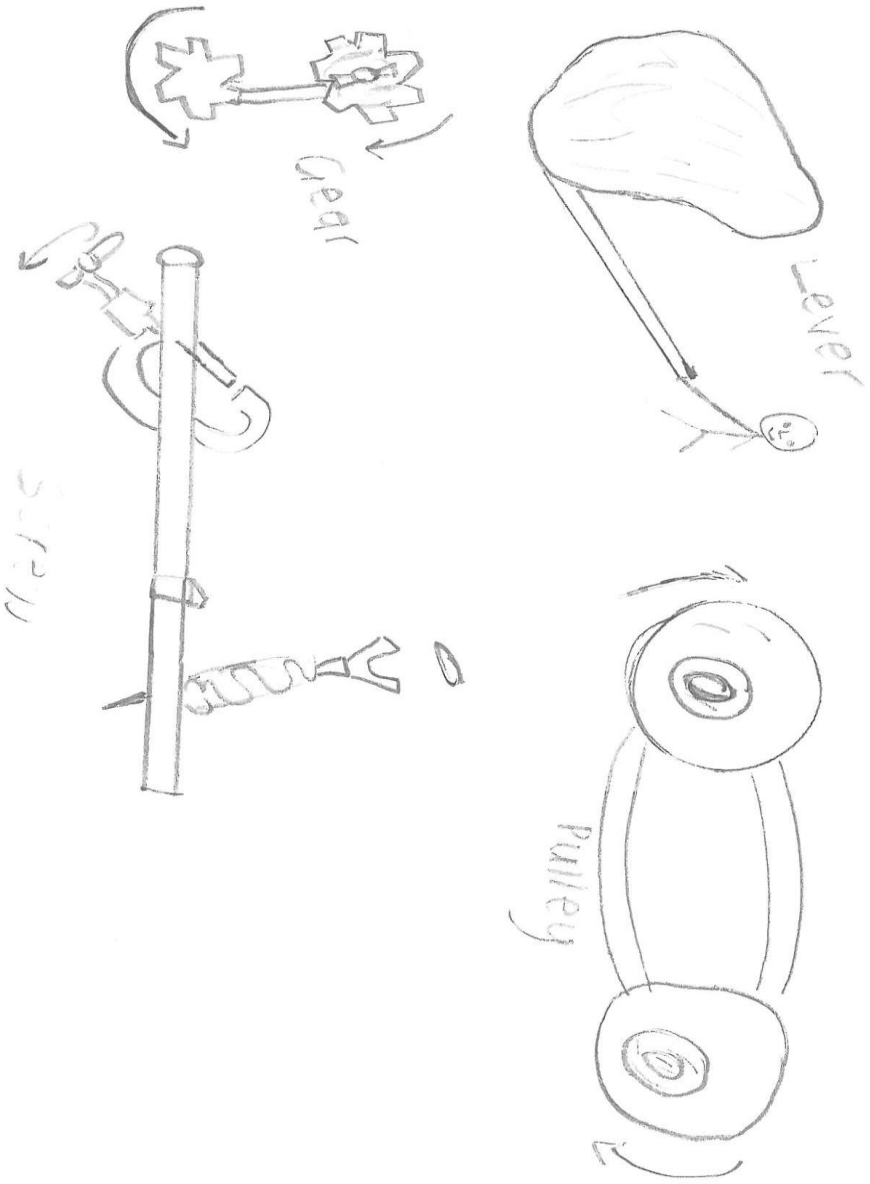

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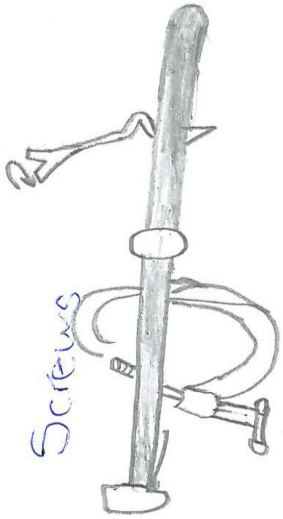

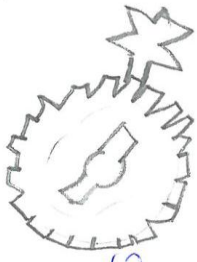

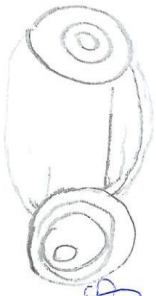

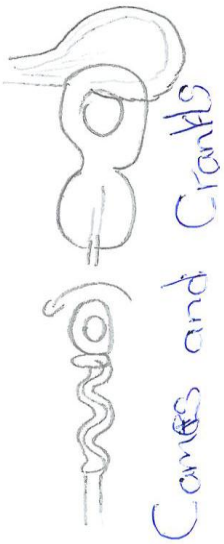

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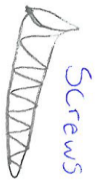
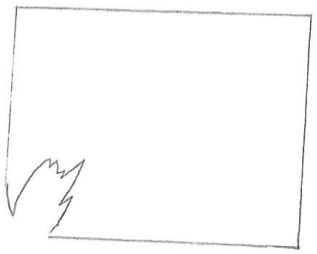


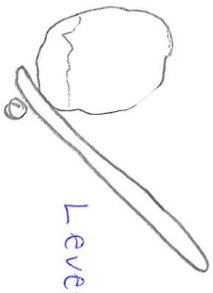
Screws

Gears



In cline plane

Coanks



Lever

pulley

Appendix E

Sampling Details of Teacher Participants and Methods of Data Production

Biographical Details								
Teacher participants	**Number of years teaching Technology**	**Gender**	**Subjects taught**	**Type of schools and their location**	**Qualifications**	**Face to face interview**	**Observations**	**Documents analysis**
Nomvula*(School A)	2009 to date (3)	F	Natural Sciences Technology	Semi-rural	SPTD, ACE	√	√	√
Suzan* (School B)	1998 to date (13)	F	Technology	Rural	JPTD, ACE	√		√
Job* (School C)	1998 to date (13)	M	Technology Natural Sciences English	Semi-rural	SPTD, FDE, ACE ,BEd (Hons) S&T	√	√	√
Jane*(School D)	2004 to date (7)	F	Technology Mathematics literacy	Rural	STD, ACE	√	√	√

Questions	Nomvula*	Suzan*	Job*	Jane*
How old are you?	38	48	47	38
What inspired you to become a teacher?	To improve the standard of education of our country and to work with children is what I need in my life.	I was not inspired by anything I did not like to be a teacher I just found myself in the teaching college.	My secondary school biology teacher style of teaching and his character traits motivated me to become interested in teaching career. I also love to work with children.	Poor family background led me to be a teacher.
How long have you been teaching? Which grades?	Since 2004 to date – NS Gr. 7, Tech Gr. 7 & Maths Gr. 6.	I have been teaching since 1990 to date, I first taught Grade one, Grade three, Grade six and presently Grade seven.	19 yrs (from 1992) in grades 6&7	2004 to date-Gr. 8,9,10 & 11
Which other engagements besides teaching are you involve in?	Feeding schemes, netball sport.	School's Sports and a member of disciplinary committee of the school	HOD, Planning of extra and co-curriculum activities such as school based workshops, mentor for different learning areas, head different sub-committees(exam, music and culture)	Athletics, netball, SGB member, catering committee, SASTE branch secretary.
What challenges are you coming across in your teaching career?	Teaching is a career which needs perseverance because at the same time you must be a parent, teacher, a nurse even a social worker because you need to solve all the learners problems you encounter in your class and at home e.g. poverty.	Though I did not want to be a teacher I found myself being a good teacher who likes to explain things to learners until they understand. I now enjoy my teaching career.	In my teaching career there challenges such as the new approach to teaching i.e. OBE the continuous changes that is taking place in education system teaching learners according to the new approach and assessing them using different forms and tools of assessment. Politics and education it a challenge. Learners value more than responsibilities.	Lack of motivation and lack of resources
What challenges are you experiencing in teaching Technology? (If any)	Technology is a very important subject but there are difficulties on teaching it because of the lack of technological skills and qualifications and also deteriorate the standards of Technology, lack of resources and designing project portfolios.	The challenges I am facing are the learners who cannot read that makes my teaching very difficult.	Technology teachers are facing challenges such as not having enough training to teach Technology as new subject. We are still sceptic in teaching this subject. We are struggling in planning the Technology learning area programme. We also struggle in developing assessment	Lack of resources such as books technological kit and time allocation for the subject.

			instruments. Technology is one of the learning areas, which has lots of practicals and projects which need Technology equipment.	
What do you do to overcome these challenges?	By attending departmental workshops, asking assistance from other teachers and using internet for other information.	I make sure that I treat the problem and come to the bottom fit e.g. make sure that the child is able to read. I like teaching subject with information where I will be giving information and knowledge. I do not like subjects like arts and culture because I am not a skilled person.	To overcome these challenges, the government should by all means avoid taking education to politicians. All stake holders should be involved when planning academic issues. Teachers also be involved and their voice should also be heard. Planning should start from bottom to top. All support systems should be put in place. All teachers who are teaching Technology should be given bursaries to further their studies. The former colleges of education should be reinstated. The government should build Technology centres. Schools should be properly resourced. All these would be the way of capacitating teachers and learners, whereby learners could be able to achieve SKVA which has been perceived by the new approach of teaching and learning.	I sometimes improvise but not always due to lack of proper support.
What is the enrolment of your school?	881	927	954	599
When was the school established?	1966	1985	1970	1990
How many classes does the school have?	20 classrooms	27 classrooms	22 classes	14 classrooms
Describe the school's structural body composition.	Principal (M), deputy principal (F), 3 HODs (2 female &1male), 17 female teachers and 2 male teachers, library assistance (M), 3 general workers (1M&2F),2 admin clerks (F), 2 security guards (M), 5 feeding scheme helpers (F).	Principal (F), 2 Deputy principals (1M) & (1F), 5 HODs, 32 teachers, 2 clerks, 2 general cleaners and 1 security guard.	Principal (F), deputy principal (F), 4 HODs (2 M and 2 F), 33 teachers (7 M & 26 F), 1 clerk (F), 3 cleaners (1 M & 2 F), 3 security guards (all M)	Acting principal (M), Deputy principal (acting) (f), 3 HODs (2F & 1M), 11 female teachers & 7 male teachers, 3 cleaners (2F & 1M), 2 clerical staff (1F &1M)
What learning centres does the school	Computer centre & school library.	Computer centre and library	Computer centre	None

have?				
What is the school's starting and knocking off time?	07h30 – 13h50	07h15 – 14h00	07h20-14h30	07h20-14h30
Is there any educational intervention projects the school involved in?	Yes-the school is the feeder to Dinaledi school.			