Educators' interpretation and implementation of the intended technology education curriculum in the General Education and Training Phase

by

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CHAPTER 1

ORIENTATION AND BACKGROUND

1.1. Introduction

South Africa had no formal subject known as technology education in its schools until the introduction of Curriculum 2005 (Heymans, 2007:37). According to Engelbrecht, Ankiewicz and De Swart (2006:2), it was implemented for the first time as part of the new national Outcomes- based Education (OBE) in 1998. Its aim was to provide developing technological literacy (Department of Education, 2002:4). In essence, the learning area serves as a link to provide for work prospects.

Educators were tasked to implement the technology education curriculum in schools, and educators had to refocus to implement the learning area. This meant a refined understanding of the learning area, new planning methods and assessment, and the general use of resources and materials to support implementation. Ankiewicz (2003:87) indicated that the vision of technology as a new learning area compounded problems for the educators. To attain the vision of the learning area, educators had to be trained or retrained in workshops organised by the Department of Education. Each of the nine provincial departments was responsible for presenting educator-training workshops. Engelbrecht et al. (2006:3) attested to the varying interpretations of the curriculum and its implementation. Engelbrecht et al. (2006:3) who cited Chisholm claimed that the varied interpretations raised issues of quality assurance.

According to Kirikkaya (2009:150), Bjurulf (2007:52) and Stevens (2005:5) there were a variety of challenges facing the implementation of technology. Even though the majority of the educators were not fully equipped through training to present technology education at schools (Heymans, 2007:43) they had to go ahead with the implementation. According to Engelbrecht et al. (2006:2), educators were expected to implement technology in schools without being adequately trained in the content and instructional methodology. While this study was being conceptualised, another version of the curriculum known as the Curriculum and Assessment Policy

Statement (CAPS) was introduced. It was intended to contribute towards the learner's technological literacy Department of Basic Education DBE 1 (n.d). The majority of educators who are still not formally trained and currently teaching technology will also have to implement CAPS. Even with the new CAPS, the challenge of educators not having received formal education in technology remains the same. Successful implementation of any new curriculum relies on the competency of the educators who are the agents practicing and implementing it in the classroom.

To explore and describe how the technology curriculum was implemented by educators for a learning area, two educators were identified – one from a medium resourced context and one from a highly resourced context. Neither of the educators had formal education in technology education.

The two educators who interpreted and implemented the technology education curriculum (essential classroom practices for delivering the curriculum in the learning area) were identified for the study. Reddy, Ankiewicz, De Swart and Gross (2003:28) refer to these curriculum categories as "inescapable features" that were developed by curriculum developers and practitioners. Maphutha (2005:5) called these "essential features". In addition, the Maphutha (2002) study cites an array of scholars who refer to these essential features as "principle dimensions" (Eisenberg 1996), "inescapable features" Glover, 1996 "fundamental (core) characteristics" (Reddy, 2003) "major planning elements" (Van Den Akker, 2004), "key aspects" (Lee 2004) "basic inherent tenets" (Potgieter, 2004) or "key traits" (Spoek, 2005).

The "essential features" this study focuses on are planning for teaching at micro level, where implementation takes place. This study focuses on the teaching approaches and strategies used to direct learning for the curriculum. The assessment that is prescribed for the learning area, which the educators conduct in individual classes, will receive attention. Finally, the materials and resources recommended to deliver implementation for the curriculum will be a focus for this study.

1.2. Background to the research problem

The intended curriculum is to be interpreted and implemented by the educators who work at classroom level. According to Potgieter (1999:84), the introduction of technology as one of the eight learning areas in the educational system, emphasises the notion of technological literacy making education more relevant to South African society. However, the majority of South African educators are not formally educated or trained as technology educators for a specific phase. Where training was done, educators had different types of exposure to training, one of which was the Department of Education (DoE) conducting once off training workshops of orientation and cascading. Training as mentioned by Engelbrecht et al. (2006:7) is important and is a necessary pre-requisite for teaching any (subject) or learning area.

The nine provincial Departments of Education were responsible for executing the national policy by providing training for officials from each province. They in turn cascaded information using advocacy strategies to district officials, and the educators were last in line to receive the information (Engelbrecht, Ankiewicz and de Swart, 2007:580). The cascading model resulted in serious problems of watering down and / or misinterpreting crucial information (Engelbrecht, et al. 2006:9; Ono and Ferraira, 2010:61).

On-site training by the curriculum implementers or subject advisors in the schools was initiated. At times educators from different schools gathered at a central venue for courses or workshops of a day or longer (Engelbrecht, et al. 2007:583). This model was criticised in that the subject advisors themselves were not confident and also did not have an in depth understanding of the technology learning area content knowledge and pedagogy. The author also reported that they did not have an understanding of how to effectively manage the training of prospective technology educators.

Training was provided by the Heads of Department (HODs) in schools. The point of departure in this model is that training is provided within the normal working milieu and managed by the school personnel to fulfil the immediate needs of the school (Engelbrecht, et al. 2007:584). Training provided by the HODs was problematic in being fragmented and of an AD HOC nature. The dilemma of varying interpretations of technology curriculum by different educators resulted.

Non-government organizations (NGOs) also provided training for the educators. The aim of involvement by different NGOs was to establish partnerships with the education department. No direct comments were made on the involvement and appropriateness of NGOs for the learning area.

The educators who were tasked with the implementation of the technology curriculum were often sourced from other subject specialties. Educators were sourced from woodwork, metalwork, and industrial arts craft disciplines, including biblical studies. These educators had to be equipped to make the paradigm shift from their old subjects with their specific methodologies, to technology with its specific methodology. The dilemma was that it implied educators offered content relating to their original specialties. Some educators were unsure of what to teach and taught only those areas in which they felt confident (Benson, 2000:7). Interventions to retrain educators were initiated by the DoE and formal tertiary qualifications were introduced. These included a pre-service four-year BEd degree with technology education being one of the learning specialisations. At in service level, educators could register for an Advanced Certificate in education or a BEd Honours in technology education.

1.3. Rationale for the study

In the South African education context, according to Engelbrecht, et al. (2006:2), technology was implemented as a new learning area for the first time as part of the new national outcomes based Education (OBE) in 1998. There were serious challenges in implementing the technology curriculum. These included different understandings of the envisaged curriculum, unspecified content to support the outcomes and inadequate educator training, and the limited period in which the curriculum had to be implemented, resulted in a limited time to train the technology educators adequately. Educators had levels of training. Where training did happen, educators were exposed to different types of training. The different types of training are explained in (Section 1.2). Various interpretations came about because of the varying forms of educator-trainings. The dilemma was it implied educators practiced varied interpretations during implementation, and this had a direct impact on the vision intended for technology. The situation was a complex that resulted in incongruence in what was intended and what was actually feasible. Rogan and Grayson (2003:1173) explain that for the promises of a new curriculum to work, much work needs to be done on the implementation to make an impact in schools.

South Africa however, is not alone in experiencing problems with the implementation of a new curriculum, and especially of technology education. Adams (2000:8) indicates that the implementation relating to the new curriculum was characteristic of rough features, cycles of trial and error with complaints of day-to-day coping by educators.

The demands of the policy of the learning area could not be met by the educators who were tasked to do the implementation. Consequently, Engelbrecht et al. (2006:2) explain that educators were not sure how to approach planning for lessons and not sure of what to teach. This lent itself to educators teaching by simply using different approaches and neglecting essential features of technology education. These approaches had implications for the curriculum and especially for effective teaching of technology as a new learning area. These implications could be seen as varying ways in which the educators interpreted the technology curriculum.

In an attempt to solve some of these implementation problems in the short term, some schools followed a rotation programme where a team approach was adopted (Engelbrecht, et al. 2006:2). With this method, an educator was responsible for a theme in the technology curriculum and the learners rotated among the educators. The problem with this method was that educators had been accustomed to a single subject responsibility and were now expected to function as a team for teaching the same subject. This resulted is justice not being done in the technology classroom (Engelbrecht, et al. 2007:580). Teaching begins with an understanding of what is to be taught and what is to be learnt, (Reddy, Ankiewicz, de Swart and Gross, 2003:28) and the problem with the educators who taught with limited training or none at all, could not achieve a sense of ownership. This negatively affected the learner tasks and activities during classroom implementation.

The essential features that Reddy et al. (2003:28) identified form the basis for the development and focus of this study. They are: planning to teach technology, strategies with approaches, assessment, and the general use of resources the educator uses for the implementation of the technology learning area curriculum.

1.4. Research questions

The problem statement is that many educators are not formally trained to teach the technology curriculum. The technology curriculum referred to here, includes the Revised National Curriculum Statement (RNCS) (2002). The RNCS is rooted in an OBE philosophy and is still the official document. CAPS was released as a Curriculum Assessment and Policy Statement DBE 1 (n.d), and plans are afoot for CAPS to be phased in and replace the RNCS by 2013.

For the purpose of this study, RNCS is the “curriculum” which educators have to interpret and base their teaching on during implementing. The following research questions will be addressed:

1.4.1. Research question 1

What are educators’ interpretations of the intended technology education curriculum in the General Education Phase?

1.4.2. Research question 2

How do educators implement the intended curriculum at classroom level?

1.5. Statement of purpose

The purpose of this study is to explore and generate an understanding of how educators, who have not received formal training but received a form of informal training, interpret and implement the curriculum in the General Education Phase. Different types of educator-training were alluded to and explained in detail in 1.2 of the study. Next follows key concepts pertinent in this study.

1.6. Explanation of key concepts used in the study

1.6.1. Technology

Etymologically, the concept of techno-logy (as with bio-logy and socio-logy) indicates that it is concerned with knowledge. The definition of technology refers to the systematic study and ordering of knowledge with its basis in theoretical reflections, and more recently, in empirical studies (Ankiewicz, de Swart and De Vries, 2006:120). According to the Department of Education (2003:4) technology means the use of knowledge, skills and resources to meet people's needs and wants by developing practical solutions to problems while taking social and environmental factors into consideration.

1.6.2. Technology education

Technology education is not educational technology but technology education. According to Ankiewicz, Adam, de Swart and Gross (2001:189), technology education refers to a need to promote the capability of learners to use, evaluate and design appropriate technological solutions to problems.

1.6.3. Resource tasks

According to Reddy et al. (2003:34) resource tasks are short, practical activities designed to make learners think and to help them acquire the knowledge and skills they need to engage meaningfully in the complex activities of capability tasks.

1.6.4. Capability tasks

Capability tasks are longer, more open ended tasks that require designing, making and evaluation. These are built on learning experiences derived from the case studies and resource tasks (Reddy, et al. 2003:34)

1.6.5. Case studies

According to Killen (2010:322) case studies refer to narratives which describe an actual or realistic situation in which an individual or a group has to make a decision or solve a problem. Their use is to bring reality into the classrooms with the intention of showing learners that technology as a subject is close to the way the world works DBE 1 (n.d).

1.6.6. Constructivism and social constructivism

Constructivism is a term which evolved from research to fundamental principles of collective learning theories of developmental and cognitive psychology (Cooper, 2007:3). According to de Swart, Ankiewicz and Engelbrecht (2005:5), constructivism from a cognitive model of learning is an approach to learning in which learners are provided the opportunity to construct their own sense of what is being learned by building internal connections or relationships among the ideas and facts being taught.

Constructivism as a learning theory in Roblyer and Doering (2010:35) is explained as the construction of all knowledge by humans in their minds followed by participation in certain experiences.

Cognitive psychologist David Ausubel, in (Cooper, 2007:4) advanced a model on the use of “advance organisers” which strategically positioned the context of learning to connect “prior learning” and target high order thinking skills.

A perspective of learning in the Vygotskian perspective of the constructivist learning theory is social constructivism which is firmly placed in the social and cultural domains (De Swart et al. 2005:6). Social constructivism expands Ausubel’s model of learning based as a principle of learning guided by interaction with significant others and context (Cooper, 2007:5). Social constructivism is a process of “enculturization” with appropriations of meaning from both the social and cultural environments (De Swart et al. 2005:6).

1.7. Curriculum

Definitions for the term curriculum are available but vary in literature. This study takes note of the shortcoming of the absence in the word “outcome” when defined in the South African context. A curriculum, according to Wiggins and McThighe

(2005:340), is an explicit and comprehensive plan developed to honour a frame based on content and performance standards.

Table 1.1 presents research questions guided by research questions, a conceptual framework, and instruments for data collection.

TABLE 1.1: Research questions, conceptual framework and instruments

RESEARCH QUESTIONS		CONCEPTUAL FRAMEWORK	INSTRUMENTS
1.	What are educators' interpretations of the intended technology education curriculum in the General Education Phase?	No specific conceptual framework.	Interviews Implementation evaluation rubric
2.	How do educators implement the intended curriculum at classroom level?	Rogan and Grayson (2003) four levels in the profile of implementation	Interviews Observations Implementation Evaluation rubric

8. Organisation of the study

TABLE 1.2: Organisation of the study

CHAPTER	CAPTION	TARGET
1.	Orientation and background	Provides an overview of the study based on the introduction, the background to the research problem, the rationale for the study, the research questions, the statement of purpose, and the explanations of key concepts and organisation of study.
2.	Literature review	Available literature to provide an understanding of the essential features of the technology learning area.
3.	Conceptual framework	Presents the conceptual framework established for the study, mainly to analyse research question 2.
4.	Research methodology	Presents the design, methodology and instruments used in the study.
5.	Research results	Format of presentation and synthesis.
6.	Research discussions and conclusions	Conclusions and results are presented and analysed where literature is integrated. A reflection on possible limitations is offered, recommendations of the study are discussed.

1.9. Chapter summary

This section of the study presents an orientation and background of the study. It is developed by focusing on the background of the research problem, the rationale for the study and the research questions. Finally, key concepts relevant to the study are explained in detail.

CHAPTER 2

LITERATURE REVIEWS USED FOR DEVELOPING DISCUSSIONS FOR THE SECTION

2.1. Introduction

The purpose of this section of the study is to present a literature review to provide a foundation to develop further discussions. The focus falls on the terms "technology" and "technology education" in the South African curriculum and on the educators' interpretations. In addition, a focus on the curriculum being implemented at classroom is also discussed, which addresses research question 2 of the study.

2.2. An explanation of technology as a discipline

Philosophers and technology educators seek answers to questions about what the realistic concept of technology as a discipline is. Educators face the challenge of finding answers to the question of how the concept of technology is to be taught in classrooms (De Vries and Tamir, 1997:5).

Flowers (2010:18) cautioned that our use of available language choices narrow the definitions for the terms communicated. The concept of technology was associated with significantly different perspectives, and none could be rejected because of those put forward, the meaning in no single definition had been agreed upon.

One explanation previously given is that technology is 'applied science'. This explanation augured well in education when technology was taught in the contexts of science education. However, according to De Vries and Tamir (1997:5), this was one of the misconceptions which were held about the term. The notion that technology is 'applied science' is simplistic, especially as science has also been affected by technology. This notion is often missed Hallstrom and Gyberg (2011:9). In addition, De Vries (2003) noted that as a result of scientific education, elements of technology were found in abstract science education. Learners found it difficult to recognise the relationship between technological products. Proponents of science offered examples of how science and technology was interdependent (Rose 2007:43). The consequence was a paradigm of 'technology is applied science'. De Vries (2003:2) concurred with the notion, but added that several philosophers wrote that technology cannot be described adequately as 'applied science'. Nowadays most technology philosophers accept the idea that technological knowledge differs from scientific knowledge. This discussion is relevant for the study as the educators' interpretations and understanding of the term "technology" is important for the implementation of classroom activities.

Lee (2011:42), suggest: "the term 'technology', although part of every-day language, means different things to different people. The majority of people still identify technology with technological and technical products". In Lee's opinion, "technology education may be seen as an age-old task of innovation and adaptation with a focus towards the process by which products are developed and used (Lee, 2011:42)".

The strong influence of the learners' experiences on their view on the nature of technology would seem to have important implications for teachers of technology (Mawson, 2007:107). Rohaan, Taconis and Jochems (2009:3) confirmed that many learners have a limited concept of technology. As a result technology education needs to be taught in a way that provides learners with a comprehensive conceptual understanding of technology.

Technology education has experienced turbulence as a result of the change that was expected from the educators in relation to what and how to teach, as well as to "translate the new curriculum into implementable classroom activities" (Lee, 2011:43).

This section of the study contextualised changes in terms of how the educators' understanding of the term influenced their implementation practices. A discussion of technology education in the South African curriculum follows.

2.3. Technology education in the South African curriculum

Technology education was introduced as a pilot project to promote and support social constructivism in public schools in 1998. (See section 2.6 on constructivism.) According to Potgieter (2004:208) and Ankiewicz, Adam, de Swart and Gross

(2001:190), Curriculum 2005 was introduced at the same time as technology education was introduced. Its vision according to Ankiewicz, et al. (2001:189), was to produce creative, adaptable, thinking, autonomous, entrepreneurial and employable citizens. Molefe (2007:1) adds that it strives for practical, solution-oriented learning. In addition technology education supports and promotes the social construction of knowledge Ankiewicz, Adam, de Swart and Gross (2001:190).

South African education did not have expert practice or the experience in its history of technology education to reach the intended outcomes (Potgieter, 1999:90). Implementation at micro levels, that is in the classrooms where the majority of South African educators were either under qualified or poorly qualified, was difficult as the educators could not make sense of the complex curriculum that included technology education (Jansen, 2001:212). In their roles of implementing the technology education curriculum, the educators required important key features to understand the nature of the technology curriculum. Two such key features are the integrating action when finding solutions to problems, and new approaches with educators playing different roles. These became important in technology education, and as a result, serious implementation challenges of the curriculum became apparent (Ankievicz et al. 2001:190) and De Vries and Tamir (1997:5) explained that the nature of technology curriculum was not an easy task as many things were loosely referred as technology curriculum.

The technology education curriculum in schools as prescribed in the CAPS document is comprehensive. The foundation phase of the curriculum has no technology. The intermediate and senior phases have technology, but in the intermediate phase it is regarded as natural science and technology. According to the policy document DBE 2 (n.d) the total instructional time for all learning areas in the phase is 27.5 hours per week with 3.5 of those hours allocated to the integrated learning areas of science and technology. But according to the CAPS document, the total number of instructional hours for technology in the senior phase is 2 hours per week.

The Natural Sciences and technology curriculum (intermediate phase) for Grades 4-6, developed six knowledge strands for the curriculum. These are life and living, matter and materials, energy and change, earth and beyond, technology and structures and mechanical and electrical systems and control (DBE 1: n.d). The RNCS is the focus of this study, and the discussion on CAPS is to draw a comparison between the two approaches as they concern technology curriculum.

Three specific aims were developed for the intermediate phase.

Specific aim 1: Knowledge in Science and Technology.

Specific aim 2: Investigations phenomena in natural sciences and designing and making solutions in Technology.

Specific aim 3: Appreciation and understanding the history, importance and applications of science and technology in society DBE 2 (n.d).

A number of skills were envisaged within each strand in the learning area. Specific Aim 1 aims to develop skills of, for example, knowledge acquisition by recalling facts, understanding and making connections through building conceptual framework that link with the science and technology disciplines. Specific Aim 2 aims at developing the skills for learners to follow instructions, to design, to plan and to measure. A number of skills are ideal in Specific Aim 3. Its aim is for learners to understand and appreciate the relevance of scientific discoveries and to value the application of science and technology in industries and in improving the quality of life of people and the environment DBE 2 (n.d).

The instructional time in the senior phase technology (which is the focus of this study), is two hours per week DBE 2 (n.d). Four content areas are applicable in learning and teaching technology in the senior phase technology, and they form the strands which are to be done every year in every grade. They are structures, processing, and mechanical and electrical systems and control DBE 1 (n.d). According to the policy document DBE 2 (n.d), skills of for example, investigating, designing, making and presenting with the aim of teaching design as a core concept for the learners are envisaged and need to be developed through appropriate and relevant tasks across all the four strands of the senior phase.

The table below outlines the main topics and core content in the senior phase curriculum. Core content features of the technology curriculum are in bold.

TABLE 2.1: Topics and core content areas in Senior Phase technology

1	**The design process skills** Investigation Design Make Evaluate Communication
2	**Structures**
3	**Processing of materials**
4	**Mechanical systems and control**
5	**Electrical systems and control**
6	Technology, society and the environment
7	Impact of Technology
8	Bias in Technology

The specific content that was envisaged for technology brought implications for the educators who were tasked to implement technology in the classroom. For some it meant different interpretations of the nature of technology education. In other words, it meant the intended curriculum views about technology education were varied and conflicting. However, the different interpretations posited in literature are worth consideration as they ultimately provide an understanding of the term "technology". Below follow interpretations of technology which were posited to ground this study.

2.4. Interpretations of technology as a learning area

2.4.1. Technology as design

According to Asunda and Hill (2007:2), design is a creative, interactive and open ended process of conceiving and developing components, systems and processes. They cite Friesen, Taylor and Briton (2005) who attest that design is a creative, open ended and experimental component that characterises problem solving.

The concept of "design" was included in the technological process for the technology learning area curriculum in South Africa (Potgieter, 1999:88). By comparison, technology as design is the most common and popular of the processes appropriate to technology in the US Standards for technology education (Williams, 2000:4).

An essential prerequisite for technology to be understood as design includes the four strands which comprise the design process as proposed by the Gauteng Department of Education (GDE) (Reddy, et al. 2003:38). The four strands of the design process are investigating, designing, making and evaluating the product or process. To fulfil the strand "investigating" as one strand of designing, the learners require good researching skills. The acquisition of these research skills depend on the educators' previous real exposure to formal programmes in technology. Reddy et al (2003:39) claimed the research skills required to produce good design solutions appeared to pose problems. According to Eggleston (1997:26), the design process involves problem solving which begins with a detailed preliminary identification of a problem and a diagnosis of needs and wants that have to be met by a solution. Various solutions are conceived, explored and evaluated until an optimum answer is found that appears to satisfy the need. Technology follows a design process approach which integrates thinking and action to solve problems. An attempt to integrate thinking and action by encouraging the hand and mind to work together offered a challenge with the implementation of technology in schools (Ankiewicz et al. 2001:190). Davis (2007:438) named the misuse of design in technology classrooms as "design fixation" where the focus and emphasis was on the artefact or on an end product and this inhibited the actual problem solving. The Ford Partnership for Advanced Studies (PAS) is an example of learners' design activities which are contextualised and application based. Zinser and Poledink (2005:79) and Jones and Moreland (2003:85) who cite Brown, Collins, and Duguid (1998), attest that technological learning is enhanced when learners are engaged with authentic activities. For example, learners learn designing skills and business skills such as designing a new size and shape for a drink bottle. This notion concurs with Potgieter's (1999:89) notion, that to teach the design process effectively, learners themselves should be exposed to their own design experiences and activities and not be shown other people's examples.

However, according to Banks and Barlex (1999:23) South African educators who received informal training in technology education may have been exposed to skewed designing capabilities.

2.4.2. Technology as problem solving

Learning towards problem solving is a well-established enquiry-oriented instructional method used in formal settings in which learners in small groups acquire knowledge through engaging with authentic and challenging real life problems (Walker, Recker, Robertshaw, Osen and Leary, 2011:73). Park and Ertmer (2008:632) added to the understanding of the term problem solving in claiming it to be a constructivist teaching method in which students learn content knowledge and problem solving through investigating and solving problems. Parkinson, (2001) cited in Jones and Moreland (2003:86), states that problem solving to technology is an important approach for developing technological literacy in which task ownership is effected and communication is enhanced.

Technology as fundamentally problem based and problem solving, is a critical thinking skill necessary to address issues related to technology and to develop effective solutions to practical problems (Makgatho, 2011:3) The success in learning towards problem based orientation is to develop generic skills by which learners become more effective problem solvers Adnan, Karomiah, Abdullah and Wang (2011:3). A specific generic skill developed by learners, was improved learner interaction with others in small groups of self-directed learning characterised by independent thinking (Adnan, Karomiah, Abdullah and Wang, 2011:3).

To use problem based learning effectively, cognitive psychologists suggest that learning must be constructed through cognitive processes guided by social and contextual factors during learning (Cheong, 2008:47).

According to Molefe (2007:1), in South Africa, technology education strives for practical, solution-oriented learning that provides opportunities for technological design processes with elements that include investigating, designing, making, and evaluating that is communicate based in real life contexts. It is clear that educators teach using processes but with differences in the curriculum orientations of how and when these processes are to be taught Zuga (1992:53). To address this problem, Zuga (2004:84) suggested that we could take a page from constructivism to create a learning theory with respect to technology education. In this way, Lewis et al., as cited in Zuga (2004:84), suggested a shift and modification of “problem solving” to “problem posing” which relates to constructivism and extends beyond the purview of science. Problem posing according to Zuga (1992:54), takes cognisance of social construction curriculum in technology education where social problems with relevance in technology are chosen and become a means of organising technological processes.

According to Zuga (2004), it is possible to structure each content area of technology to attack social problems towards concerns of “manufacturing”. This relates to the “processing” theme which is the knowledge content area addressed as learning outcome number two of the technology learning area in GET schools. In addition, according to Zuga (2004), “construction” as a social problem relates to the “mechanical systems” theme, and can be addressed as it relates to Learning Outcome 2 of the technology curriculum. An example alluded to in Zuga (1992:56) in relation to this section is for learners to conduct an energy audit of electricity in their homes and in the school.

2.4.3. Technology as activity

Over the years technology as activity has not attained a useful separation by educators and learners as it is represented by a narrow interpretation in its status. This separation is helpful for an understanding that technology as an activity includes the development of manipulative skills and to use tools effectively and safely (Williams, 2000:1).

In comparison to this interpretation with what has been stated about technology, is that technology is “computers”, which relates to the quickness with which people think of the physical objects when technology is mentioned (Ankiewicz, et al. 2006:132). Technology as computers is the predominant answer given to what technology is. This immediately raises an interesting view of technology as an activity to mean some physical, tactile thing with artefacts of particular qualities or features (Reed, Case, Ingerman and Linder, 2000:5). In addition, the traditional focus of technology as an activity is doing and making things which represented a narrow interpretation (Williams 2000:1).

However, according to Ankiewicz et al. (2006:132) technology as activity includes more than material objects such as tools and machines and mental knowledge or cognition of a kind found in the engineering sciences. It is a pivotal event in which knowledge and volition unite to bring artefacts into existence. It is also recognisable in terms of activities of making, designing, maintaining and using. Many significant cognitive skills are important to develop for technology as an activity. Learners must be taught and be given opportunities to practice specific skills and techniques. Therefore varying educator guidance is essential in technology classrooms.

2.5. Constructivism as underpinning learning theory for technology education

According to Killen (2010:6) the basic premise for constructivism is that knowledge is obtained and understanding is expanded through active construction and reconstruction of the mental framework. Diverse models of a curriculum were developed for constructivism. Two examples of models are cognitive and social constructivism. Cognitive constructivism, according to Killen (2010:7), focuses on the cognitive processes that people use to make sense of the world. The development of the RNCS curriculum rested heavily on beliefs of cognition as outlined by a constructivist framework (Kotze, 2002:77). By comparison, New Zealand's curriculum for schools is based on a framework of triads embedded in the curriculum, in pedagogy and in assessment, which were identified for the best practices in classrooms (Cooper 2007:7) and Killen (2000): vii, xiv-xv. This approach states that factual knowledge is not denied but emphasis should rather be placed on the ability of the learners to retain knowledge and to solve problems. Problem solving renders itself as a core component in technology education where needs and wants for learners are addressed during learning.

Killen (2000) and Kotze (2002) agree that social constructivism treats learning as a social process where learners acquire knowledge through interaction with their environment instead of merely relying on educators lecture. Social constructivism as a theory of learning forms the basis of the rationale of this section of the study where learners are able to solve problems in technology education during classroom activities. An example of social constructivism is group work, where they can co-plan, and challenge one another with discussions, which target higher order thinking skills.

Current debates around notions of incorporating constructivist learning in technology and science education are progressing. According to Williams (2000:3), the difference in relation to technology education is in its usefulness for learners to construct knowledge and solutions towards the completion of tasks. For example, capability tasks which were defined earlier in the study require problem solving to address needs and wants for technology and are likely to require a constructivist approach based on the social constructivism model.

In the unique nature of the technology learning area, educators were required to use a variety of instructional approaches and strategies which required learners to become active and self-directed in their learning, which in essence, was a direction towards constructivism (De Swart et al. 2005:4).

2.6. The term curriculum, its design and its use in this study

The intended curriculum is what is planned, whereas the implemented curriculum is what educators actually do in their classroom (Brown, 2009:3) cited in Schugurensky (2002). A variety of contradictory definitions of the term are available in literature. Lovat and Smith (2003:13) state that the main concern is not to arrive at a specific definition but rather to be aware that curriculum means different things to different people as a particular ideology about education, design and context. At the time of conducting this study, the present South African design for curriculum trend was embedded in 'outcomes' which was however absent in the National Policy Van Loggerenberg (2000:4).

Curriculum design is no longer a unique activity, but regarded as second nature to everyday behaviour. Each curriculum design provides an economical basis on which to examine curriculum through the ideas of the purpose, content, method, organisation and evaluation of curriculum (Bennet, 2005:16). As a result each design has to be invented, articulated and implemented. Van Den Akker (2003:3) expressed three levels of curriculum design as intended, implemented and attained. The invention of a curriculum requires careful planning which is planning at meso level. In the context of curriculum invention in South Africa, Outcomes Based Education was used as a point of departure for invention (de Swart, Ankiewicz, and Engelbrecht, 2005:1). The intended curriculum is expanded in different classrooms of different geographical contexts by the educators during implementation. The teaching and learning contexts of classroom settings are appropriately referred to as curriculum at micro levels. Van den Akker (2003) presented a more detailed framework on the typology of curriculum pertinent to curriculum design. The table appears as table 2.3 below.

TABLE 2.2: Typology of curriculum representations

(Van den Akker, 2003:3)

INTENDED	**Ideal**	Vision (rationale or basic philosophy underlying a curriculum)
	Formal / Written	Intentions as specified by in curriculum documents and / or materials
IMPLEMENTED	**Perceived**	Curriculum as interpreted by its users
	Operational	Actual process of teaching and learning (also: curriculum-in- action)
ATTAINED	**Experimental**	Learning experiences as perceived by learners
	Learned	Resulting learning outcomes of learners

2.7. Curriculum implementation at classroom level

2.7.1. Essential features of a curriculum

The essential feature of technology education is the educators' implementation of the curriculum. This comprises planning, teaching strategies, resources available to teach with, and to assess the achievement of the intended curriculum. Discussions on resources in this study are based on physical resources which provide the means required to support the implementation of the technology curriculum.

Research question 2 of the study is addressed in this section. Ways in which educators implement the technology curriculum is important for the development for this section.

2.7.1.1. The effects of planning on implementation in the learning area

According to Ozturk (2011:125), the reformist, discourse states that one of the primary goals of teaching curriculum reform is to introduce a new method of teaching by focusing on the needs, interests and demands of students and considering their diversity. According to Ozturk (2011), the number one condition is to make sure that a broad sphere of power is present in planning for the course content, methods, assessment and materials. Talanquer, Novodvorsky and Tomanek (2010:1391) concur with Ozturk (2010) in that educators' planning decisions influence the content, materials, activities, the learning environment and what students learn; instructional activities function as the basic structural units of planning and action in the classroom.

According to Varbelow (2012:96), the ideal outcome of planning shows a process-oriented activity where learners reflect on learning opportunities by way of building on the previous ones. Planning lessons is a pertinent aspect of teaching as it is central to classroom management (Jacobs, Vakalisa and Gawe, 2004:360). Planning for technology learning activities requires consideration of the outcomes and the content as well as the process used to achieve the outcomes (Killen, 2000: xiv–xv). Kotze (2002:78) asserts that the learning outcomes that learners should demonstrate are articulated at the outset. The focus is on what is important and of value for the learners to succeed in the future. Assessment standards, according to Kotze (2010:77), describe the skills required and the range for each of the learning outcomes for each grade.

Kruger and Muller (1998:76) assert that lesson planning is executed in the interactive phase where presentation takes place. As such policy documents serve as guiding documents to select specific outcomes important for the lesson (DoE, 1997:21).

Like the curriculum, planning as preparation for teaching, occurs at many levels. Instructional strategies, techniques and activities to be used in a particular lesson are important to provide learners with opportunities to achieve the intended outcomes. Van Wyk and Alexander (2010:165) attest to specialised activities utilised in constructivist teaching methodology, which include an emphasis on learners' construction of knowledge and an emphasis on self-directed learning and collaboration with others. According to Talanquer, Novodvorsky and Tomanek (2010:1391) the selection of an instructional activity involves making decisions about the type, structure, sequence, timing and materials.

The process of assessment to be used to achieve outcomes is important, as alluded to by Killen (2000). Assessment is quite possibly the area where the strongest contradictions can occur, especially a constructivist type of assessment (Avenstrup, 2007:6). According to Avenstrup (2007:6) the South African model for assessment differentiates between general and critical outcomes, learning outcomes and assessment standards describing what each learner should know and be able to do.

The DoE (1997:23) recommends that educators plan to include a variety of environments so that what takes place in class relates to the communities. Resources available inside and outside class will determine the level on which educators plan. Planning for the integration of the use of technology in the everyday life of the school, is not easy, as some of these resources require important changes in teaching practice that not all educators are willing to make (Holmes, Vargas, Jennings, Meier and Rubenfeld, 2002:4). Tam (2000:2) confirms that the role of technology, if it is aligned with capabilities, will contribute towards a constructivist learning environment. However, in the South African context, techniques of existence, survival and adaptation in a variety of environments are adapted into action knowledge, which according to De Vries (2003:20), was about performing actions that might lead to the desired outcomes.

Ideally, the section on resources is intended to be achieved with learning outcome 2 of the technology learning area.

This section of the study on planning by educators is grounded by Rogan and Grayson’s (2003:1183) construct of profile implementation framework.

Van den Akker (2003:4) lists levels of planning which ground an understanding to educator planning activities for the learning area. This section of the study is also guided by pertinent components distinguished by Van den Akker (2003) as learning activities, educator roles, grouping, materials and resources and assessment. These basic concepts as expounded by Van den Akker (2003) are in Table 2.3 below.

TABLE 2.3: Van den Akker's (2003) major curriculum components

Major elements	Major elements
Rationale	Why are they learning
Aims and objectives	Toward which goal are they learning?
Content	What are they learning?
Learning activities	How are they learning?
Educator role	How is the educator facilitating learning?
Materials and resources	With what are they learning?
Grouping	With whom are they learning?
Location	Where are they learning?
Time	When are they learning?
Assessment	How far has learning progressed?

This section presented planning for the learning area as expounded in literature. Next follows a section on group work as an instructional strategy meant to deliver the intended curriculum.

2.7.1.2. Group work as an instructional strategy for the intended curriculum

When new strategies, as well as a new learning area in a new national curriculum are implemented, the burdens on educators handicap innovation for strategies (Black and Atkin, 1996:78). The South African technology education requires teaching strategies that facilitate the learning of conceptual and procedural knowledge (De Swart et al. 2006:18). This is where constructivism is pertinent. Constructivism as a learning theory provides a rationale that links with the technology education curriculum. (See section 2.6.) None of the theories in constructivism dictates the use of particular strategies but simply provides a framework within which to develop strategies to facilitate learning (Killen, 2010:10).

De Swart et al. (2006:8) explained instructional strategies as ways of helping learners to learn with an aim of achieving the important learning outcomes with no active roles of the educator during the process of learning. Killen (2000) and De Miranda cited in De Swart et al. (2006:9), stated that the instructional strategies, grounded in cognitive science, transfer self-regulation and monitoring functions from the educator to the learner. As a result, group work augured well as an instructional strategy in this section of the study.

Group work is a methodological tool that differs from the talk and chalk method and encourages learners to work together (Ankiewicz, et al, 2001:194). In addition, group work takes place when two or more learners perform a task together to achieve an outcome de Swart, Ankiewicz and Engelbrecht (2006:8). An important feature of group work is that learners work together without direct intervention by the educator for at least some of the time, and provides greater opportunities for learning that would not be possible in whole class instruction (de Swart et al, 2006:11). Learning for some time without the educator's direct intervention is seen by the authors de Swart et al. (2004) as a way in which the learning environment is structured for productive interaction, achievement of particularised learning outcomes.

Some educators view group work as an advantage as they are able to prepare for five or more group lessons covering the content and course at a pace appropriate to each group (Kelly,1978:96). Technological activities lend themselves amply to learners to interact with one another in a cooperative environment, with implications for learning towards social constructivism for learning and instructing in technology education (De Swart et al, 2006:12).

Wilson (1997), cited in Cey (2001:5), created a list of opportunities for learners to develop a more active construction of knowledge. Collaborative learning is one of the learning opportunities in group work, cited by Cey (2001:5) and de Swart et al. (2006:11). Collaborative learning which is not group work was at the centre of many changes in the technology learning area (Black and Atkin, 1996:14). Collaborative learning is considered to be a practical method of teaching intended for technology educators. Collaborative skills are identified as important during cooperative learning. Collaborative learning is the instructional use of small groups so that learners work together to maximise classroom learning and accomplish important shared goals (Liang and Gabel, 2005:1146).

Research into educators' experiences on co-operative learning in technology education highlighted positive comments. "The division into groups made a big task much easier. I benefitted by understanding that in co-operative learning, learners are able to share work, brainstorm for more ideas and learners generally learning how to learn better with others" (Hattingh and Killen, 2003:42). A learner describes co-operative experience as "It was fun to create stories today when everyone was allowed to participate and I had more fun today than usual. There wasn't one who decided everything" (Druin and Fast, 2002:206). An educator also indicated that pupils worked collaboratively when they were supplied with a range of materials and tools to create a rattle Jarvinen and Twyford (2000:33). McCormick's (2004:29) experience on cooperative learning involved learners dividing their task into segments, each was assigned a task and the segments later joined together.

Group work and the facilitation of learning the technology education curriculum required changed educator roles. During teaching and learning, the educators' area shifted from a dispenser of knowledge to a facilitator of learning. In becoming facilitators of learning meant moving away from what is known as talk-and-chalk methodology (Hattingh and Killen, 2003:44). Rogan and Grayson (2003:1193) identified a type of educator who is able to present content based, well-designed lesson plan guided by problem solving strategies. Some educators needed "scaffolding" in order to build capacity in using the recommended strategies for the technology curriculum (Rogan and Grayson, 2003:1196). In a study by Jones, Harlow and Cowie (2004:117), the use of wide strategies by educators were detailed as successful where topics related to learners' needs.

This section of the study is grounded by educator levels as identified by Rogan and Grayson (2003:1184). Level 4 educators are those whose teaching approaches and strategies are designed to facilitate learning, where learners design and undertake long term investigations and projects. These educators assist learners as they weigh the merits of different theories that attempt to explain the same phenomena. The level 3 educator probes for learner prior knowledge, structures learning activities along good practice lines where knowledge is constructed, is relevant and based on problem solving techniques (Rogan and Grayson, 2003:1184). A level 2 educator uses textbooks along with other resources and engages learners with questions that encourage in-depth thinking (Rogan and Grayson, 2003:1183). A level 1 educator presents content in a well organised, correct and sequenced manner based on a well-designed lesson plan. Textbooks are used adequately and efficiently with adequate learner engagement. Ideally, a level four educator is envisaged for the technology curriculum.

To establish the extent to which educators were able to implement the curriculum in this section of the study, an implementation, evaluation rubric with ratings was developed by the researcher.

Next follows a section assessment of learner performance as required for the intended technology curriculum.

2.7.1.3. Assessment of learner performance

The purpose of assessment according to the DoE (2002:54) is to enhance individual growth and development, to monitor the progress of learners and to facilitate learning where a number of tasks are designed to determine the level of each learner’s competence DoE (1998:iii).

Changes in the educational approach in South Africa from the traditional to the new curriculum required educators to make adjustments ─ especially concerning the shift from traditional evaluation to using assessment. This adjustment placed specific demands on the educators (Van Niekerk, Ankiewicz and de Swart, 2006:1).

The important specific feature of assessment was, it was no longer the sole responsibility of the educator and it no longer relied on tests and marks alone. Assessment uses a variety of instruments to indicate the gradual progression of the learner, and uses grading which is the opposite of scoring (Van Niekerk, Ankiewicz, and de Swart, 2006:16).

Learners' competence in technology education should be assessed meaningfully with more than just end-product assessment. Process based assessment augers well in assessing technology education, responsible assessment is essential for high quality assessment to take place during learning. Process based assessment for technology education comprises three aspects. The first aspect deals with outcomes that are divided into specific outcomes and unit outcomes. These are identified with the procedural stages of the technological process, and afford an opportunity to assess the outcomes to be achieved by a learner. The second aspect deals with content, with specific focus on conceptual knowledge (knowing that) as well as procedural knowledge (knowing how). The third aspect deals with assessment methodology that ensures a variety of learner tasks are available during the technological process. Ultimately, the learners can use their knowledge to prove that the stated outcomes were achieved (Van Niekerk et al. 2006:16 and 17).

Process based assessment makes provision for formative assessment that deals with day-to-day assessment; summative assessment deals with the end product and whether learning took place (Van Niekerk et al. 2006:17) and (Ankiewicz and de Swart, 2002:21).

Rogan and Grayson (2003:1183) allude to the ideal levels of educator profiles for the type of assessment an educator undertakes. Level 1 educators' written tests cover the topic adequately with most questions being recall type with some high order thinking. Level 2 educators' written tests cover almost 50% that requires comprehension, application, analysis and practical work. Level 3 educators' written tests include questions based on seen or unseen 'guided discovery' type activities and other forms of assessment that include reports on activities undertaken; creating charts and improvised apparatus and writing reports on extra reading assignments. Level 4 educator's and improvising with the apparatus assessment covers leaner's performances in open investigations and community based projects and the learner's portfolios. The levels 1 - 4 constitute a framework of guiding characteristics to look for during interviews and observations. For interviews these appear with specific ratings guided by themes, which others might term as coding found in literature: insufficient, sufficient and adequately sufficient. The validation of a rubric for the interviews is guided by and grounded in literature. On the other hand, observations, which are a complementary method for data collection in the study, include the essential features of technology as reported in literature and cover the essential components during teaching and learning. The validation of a rubric for observations is also guided and grounded by literature.

Next follows a section on the effects of resources and materials for the intended curriculum.

2.7.1.4. Resources and materials for delivering the intended curriculum

According to the General Education and Training (GET) curriculum, technology as a learning area does not require sophisticated high tech equipment but rather cheap materials which learners could manage at low cost DBE 1 (n.d). Appendices 15: A, B, C and D are included as recommended for the technology curriculum. This is in contrast with the South African Schools Act 84 of 1996 which undertook as a state responsibility, to provide resources to safeguard the right to education for all South African citizens (Department of education 1998:3). Project 7 (School infrastructure) of Programme 2, school effectiveness and educator professionalism of the Department of Education's implementation plan for Tirisano (2000:17), also committed to schools in meeting minimum physical and infrastructural requirements pertinent to conducive teaching and learning environments. The responsibility was accorded to parents (school governing bodies) to provide for additional resources to improve the quality of education in their schools.

If the information stated above is the case, design is the most deeply entrenched practice in technology (Pertina, 2000:207). (See section 2.4.1 in relation to design in technology curriculum.) As design is at the core of the technology education curriculum, resources become the building blocks of learning activities (Recker, Dorward, Dawson, et al, 2005:199). This is important according to the authors because educators adapt and implement resources in ways suitable to their local context. In addition, according to the authors, this view is novel and is aligned with the constructivist philosophy. Particular demands are expounded within the constructivist philosophy. (See section 2.5 on constructivism underpinning as a learning theory in technology curriculum.) According to Macgregor (1997:76), millions of South African children attend schools daily and yet the resources available vary dramatically. However, Tungaraza (2007:218) asserts a people-centred strategy is a solution that maximises learning opportunities as a way forward. In a study which related to a people-related strategy, Hill (1998:213) noted that in the design process for a gardening table (structures knowledge content) a small scale model was made from fibreglass which was not heavy compared to a steel model.

Resources many times served as an instrument for shaping knowledge, attitudes and principles as the presentable physical environment will change the role of promoting students' achievements among learners (Mansor, Badarudin and Mat, 2011:130). Potgieter (2004:212) noted that the use and availability of resources result in differentials during implementing.

In this study, physical environments are encapsulated as high resourced and medium resourced contexts. (See Section 4.3.1 for the definitions of the two contexts.) According to Kardos (2005:10) high tech resources are sophisticated communication and environmental control devices that are electronically based. According to the author, examples of high tech resources are digital voice output for communication, power mobility devices, texts readers, electronic print enlargers and voice activated environmental units. On the other hand, low tech resources are devices that do not require a power source (Kardos, 2005:10). According to the author, examples of low tech resources include pencil grips, raised line paper, non-slip boards, high lighter tapes and picture cards. In a study by Bar, Ford and Gilg (2010:418) on processing content (waste) knowledge for technology curriculum, locals developed local waste knowledge through recycling. In Jones and Moreland's (2004:136) study on the appropriate use of technological vocabulary, a respondent commented that the available materials were affordable and reusable. Hobson's (2010:106) study also noted local waste knowledge from a respondent with a comment that things are over-packed. Packaging and marketing makes products to look bigger and better.

For effective teaching to take place, resources relevant to the learning are indispensable. Technology as design is premised against a notion that the physical context is imperative where thinking is associated with structure of objects and tools (Jones and Moreland, 2004:122). A typical classroom in a low tech resourced context, according to Cuban, Kirkpatrick and Peck (2001:814) and Banks (2009:5), is an environment which is uninspiring, yet safe and warm with generally clean and tidy classrooms, natural light and basic teaching equipment which include chalkboard and chalk. Learning Outcome 3 in technology encourages the use of indigenous solutions to problems (DoE, 2002:9). It is imperative that any learning context should be learner-centred and learners should be creative problem solvers (Jakovljevic, 2009:255). However, according to Motala (2006:90), the school funding has made no significant difference to the overall level of resourcing

A typical classroom in a high-tech context according to Cuban, Kirkpatrick and Peck (2001:814), is characterised by the availability of computers with the Internet, word processing programmes and slide shows for visual presentations.

Regarding these resources Fricke (2008:75) asserted that it is an indication of educator initiative but not actual success with the materials. In a study by Doppelt (2005:20) relating to mechanical systems, learner projects were based on an automated controlled system for lifting a hoister, an automated multiplayer basketball game, a mini football game, an automated system for changing and playing compact discs and a computerised scanner. In Doppelt's (2003:263) study, learners were engaged in building an electrical alarm using modern software as a resource which simulates the electronics content component in the learning area. (See Section 2.2 on core knowledge content in the technology curriculum.)

Next follows a section on chapter summary.

2.8. Chapter summary

The review of literature presented research question 1 of the study grounded by explaining the term technology, technology education in South African curriculum, interpretations of technology as a learning area with specific focus on technology as design and technology as an activity.

Curriculum implementation at classroom level grounded research question 2 of the study with a specific focus on the effects of planning implementation in the learning area; group work as an instructional strategy for the intended curriculum; assessment as a requirement for the intended curriculum and materials and resources for delivering the intended curriculum.

CHAPTER 3

CONCEPTUAL FRAMEWORK UNDERPINNING THE INVESTIGATION

3.1. Introduction

This section presents a framework for the study. Rogan and Grayson's (2003) framework on curriculum implementation in developing contexts augured well for this study in understanding educator practices for the intended technology curriculum.

The framework was able to guide this enquiry as it was developed for the implementation of (science) curricula in developing countries to highlight factors which are able to hinder or support curriculum implementation (Ramnarain, 2011:1356). Two constructs of the profile of implementation and the capacity to support innovation (Rogan and Grayson, 2003:1180) were used from the framework to analyse and communicate my findings at the end of the study.

3.2. Rationale for using the Rogan and Grayson framework

A theory which focuses on implementation as suggested by Rogan and Grayson (2003) was used in this study as it focuses on implementation. It acts as a guide for school based practitioners who in this study were two educators. Within the theory, issues that are relevant to developing countries like South Africa could be addressed. It focuses on developing contexts which is the context in which both the resourced medium and the well resourced schools implement the technology education curriculum. Constructs that emerge could be applied in other subject areas like technology learning area. In developing the theory, the learning environment (classroom) where implementation takes place was selected as a unit of analysis where learners, educators, curriculum and educational resources meet.

The development of any curriculum is a common event in many countries across the globe. In South Africa, in keeping with many developing countries, Curriculum 2005 was no exception (Rogan and Grayson, 2003:1173). These curricula are laudable as they are well designed with clearly defined aims. However, too often the attention and energies focused on the "what", and neglecting the "how" of the curriculum.

Verspoor (1989) is cited in Rogan and Grayson (2003:1171) claims that often policy makers neglect the implementation stage which in nearly all instances results in poor implementation from what was essentially a good idea. South Africa was in danger of falling into this trap. The authors recommend that much work on implementation needed to be done if the promises of the new curriculum could make any impact in schools.

Discussions follow based on two constructs from Rogan and Grayson's (2003) framework of profile of implementation and capacity to support innovation.

3.3. Profile of implementation

This construct is "an attempt to understand and express an extent to which the ideals of a set of curricula are being put into practice (Rogan and Grayson, 2003:1181)". It allows strengths to be identified, and progress to be made by building on these strengths. In addition, the construct recognises that there are as many ways of putting a curriculum into action as there are educators teaching the curriculum. According to the authors the profile assumes that there is at least a vaguely defined notion of what constitutes "good practice" and the overall quality of the teaching and learning in the classroom. Therefore the profile recognises that schools differ in strengths and develop in different directions since the profile is neither linear nor remedial in nature (Rogan and Grayson, 2003:1176).

In the profile of implementation, four sub-constructs exist: classroom interaction, the use and nature of science practical work, incorporation of science in society and assessment (Rogan and Grayson, 2003:1183 and Hattingh, Aldous and Rogan, 2007:76).

Two dimensions in the profile of implementation exist from which I drew and based this section of the study. The two dimensions or sub-constructs were classroom interaction and assessment. According to Rogan and Grayson (2003:1182), with minor changes could apply to any learning area since they are generic.

Each sub-construct comprises four levels of one to four. Levels according to Rogan and Grayson (2003) provide a useful starting point in that they emphasise different degrees of implementation of different degrees of curriculum implementation. A Level 4 is representative of learner centred practices by which in moving through the levels, practices are away from teacher centred ones (Hattingh, Aldous and Rogan, 2007:77). Importantly, the movement within levels is an indication of mastery of teaching and learning practices within the profile as it is not linear. As a result, level 4 practices are not superior to level 1 practices but when situations prescribe, an educator may jump from level 2 practices and back to level 3 (Hattingh, Aldous and Rogan, 2007:77).

Four educator levels within the two dimensions which constitute the profile of implementation are discussed below.

3.3.1. Level 1 in the profile of implementation

Educators operating in this level are typical of being well organised in their planning with learner centred lessons and learner engagement of questions and answers (Rogan and Grayson, 2003:1183). Lesson plans are well designed clearly stated implementation activities. Planned assessment is of pencil and paper type tests which adequately cover topics with questions of recall and high order thinking (Rogan and Grayson, 2003:1182 and 1183).

3.3.2. Level 2 in the profile of implementation

Educators operating in this level plan to use textbooks with other resources. Leaners are engaged with questions which encourage in-depth thinking (Rogan and Grayson (2003:1183). Assessment is planned in the form of tests which cover fifty per cent of comprehension, application and analysis with practical work on topics given (Rogan and Grayson, 2003:1183).

3.3.3. Level 3 in the profile of implementation

Educators' operations are planned to probe learners' prior knowledge learning activities along good practice lines. Relevant knowledge is constructed and based on problem solving techniques by learners Rogan and Grayson (2003:1184). Assessment includes evolving nature of scientific knowledge. Written tests typify questions from more than written tests but guided by discovery type activities (Rogan and Grayson, 2003:1184).

3.3.4. Level 4 in the profile of implementation

Educators in this level plan to facilitate learners as they design and undertake long term investigations and projects. At the same time an educator also assists learners to weigh merits of different theories that explain the same phenomenon (Rogan and Grayson, 2003:1185). The planned assessment is based on open investigations and community projects that are included in final assessment. Learners are also given an opportunity to create portfolios which represent their best work (Rogan and Grayson, 2003:1185).

3.4. Capacity to support innovation

This construct attempts to understand and elaborate on factors that are able to support or hinder the implementation of new ideas and practices in a system such as a school (Rogan and Grayson, 2003:1186) and (Ramnarain, 2011:1356). The construct capacity to support innovation according to Hattingh, Aldous and Rogan (2007:76), consists of four sub-constructs of physical resources, educator factors, learner factors, school ethos and management.

Both physical resources and educator training are pertinent as the physical resources are certainly a major factor that influences capacity (Rogan and Grayson, 2003:1186). Educator background, due to an educator's training and commitment to teaching, are basic factors which relate directly to the extent to which educators implement the curriculum (Rogan and Grayson, 2003:1186). Four levels which directly relate to physical resources will be discussed. In addition, educator training factors will be dealt with in this section of the study. Below follow discussions on the four levels in physical resources and educator factors.

3.4.1 Level 1 in the capacity to support innovation

Buildings are basic with classrooms and toilets but in poor condition with too few available textbooks for all learners (Rogan and Grayson, 2003:1188). In terms of educator factors, educators could be under qualified for teaching in the learning area, but have a professional qualification (Rogan and Grayson, 2003:1188).

3.4.2. Level 2 in the capacity to support innovation

Buildings with electricity are adequate and in good condition with suitable furniture and sufficient textbooks for all learners (Rogan and Grayson, 2003:1188). The educator has minimum qualification for the position, but is motivated, diligent and enjoys his / her work (Rogan and Grayson, 2003:1188).

3.4.3. Level 3 in the capacity to support innovation

Buildings are good and secure with electricity in all rooms, and running water where needed. Textbooks are available for all pupils and educators (Rogan and Grayson, 2003:1189). An educator is well qualified for the position and has a good and sound understanding of the subject matter (Rogan and Grayson, 2003:1189).

3.4.4. Level 4 in the capacity to support innovation

Buildings are excellent in attractive grounds with one or more equipped laboratories, a library and resource centre with adequate materials other than textbooks. Good teaching and learning resources and good copying facilities are available Rogan and Grayson (2003:1190).An educator is well qualified for the position with excellent knowledge of content matter and able to innovate and improvise Rogan and Grayson (2003:1190).

The diagram overleaf represents the four levels in the profile of implementation by Rogan and Grayson (2003).

Figure: 3.1 A figure with Rogan and Grayson (2003) four levels in the profile of implementation

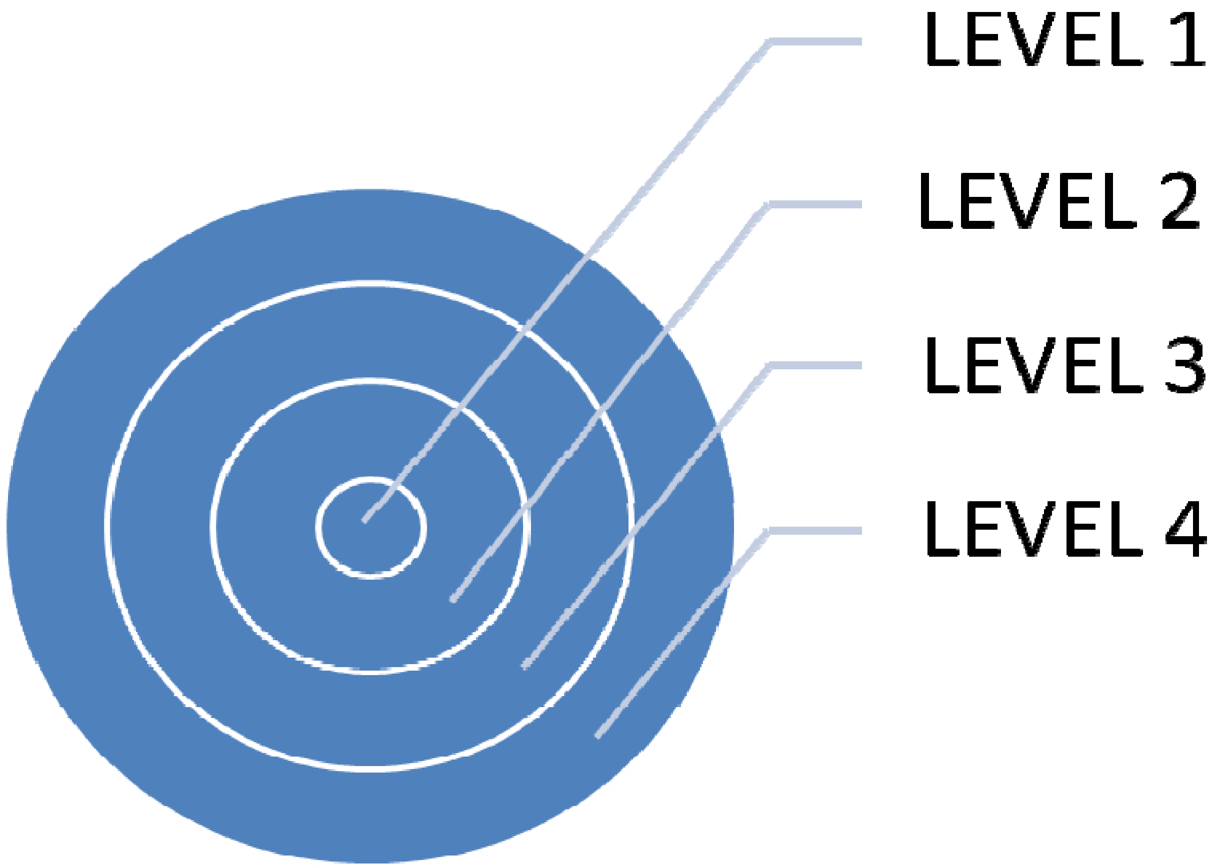

Table 3.1 summarises the research questions to understand educators' implementation practices with the conceptual framework and instruments.

TABLE 3.1: Research questions, conceptual framework and instruments

RESEARCH QUESTIONS		CONCEPTUAL FRAMEWORK	INSTRUMENTS
1.	What are the educators' interpretations of the intended curriculum?	• Rogan and Grayson (2003) framework not applicable in this section	• Interviews with rubrics
2.	How do educators implement the intended curriculum at classroom level?	• Rogan and Grayson (2003) four levels in the profile of implementation	• Interviews with rubrics • Observations with rubrics • Implementati on evaluation rubric

3.5. Chapter summary

The preceding section dealt with the conceptual framework for the study. Major discussions were based on the constructs of a theory of curriculum of implementation developed by Rogan and Grayson. The profile of implementation, which included four levels together with the construct on capacity to support innovation with all four levels of implementation were discussed in detail.

Next follows a section on the research methodology of the study.

CHAPTER 4

RESEARCH METHODOLOGY FOLLOWED DURING THE COURSE OF INVESTIGATION

4.1. Introduction

This section of the study presents the research methodology. Two research questions led to the development of this study.

1) What are the educators' interpretations of the intended technology education curriculum in the General Education Phase?

2) How do educators implement the intended curriculum at classroom level?

In this section of the study, the educators' interpretations of the intended curriculum and how they implement it are pertinent. To understand the interpretations and implementations a research design was necessary. A qualitative design augured well for the intended study. Educators became valuable sources of data and two educators were identified as suitable to participate in the study. Interviews and observations predominated as data collection instruments.

4.2. Qualitative approach to research

This study is primarily qualitative and seeks to understand the educators' interpretations and implementation of the intended technology learning area. In the design of this research the researcher acted as a 'human instrument' (Hoeplf, 1997:2).

Contexts of medium resourced and highly resourced schools were chosen in which the two educators implemented the curriculum at classroom level. The two contexts were important to achieve a comparative design that would provide the similarities and differences during implementation using the same intended curriculum for the learning area. As a result, according to Golafshani (2003:58), Winter (2000:7) and Leedy and Ormrod (2005:133) these educators were studied in their real world setting and natural environment which were their specific classrooms in their schools. As seen by Creswell (2005:515), through this kind of research the explanations and descriptions obtained in the classroom helps to extend or explain the general picture and to better understand the complex focus of the study.

4.3. Research population and sample

Educators serve as the major sources in this study by providing the researcher with insights in the research questions. With their responsibilities of implementing lessons in the learning area, they were well suited as respondents in this study Struwig and Stead (2003:342). Their relevance as a sample lies in the opportunities they have to teach the technology education curriculum. As a result they became a sample accessible to the researcher.

4.3.1. Purposive sampling

This section of the study subscribes to the understanding that purposive sampling should contain clearly stated criteria (Johnson and Christensen, 2000:215). Cohen, Manion and Morrison (2000:92) guided the sampling for this section of the study. Two educators were identified from two schools in the same district. Barnes (2005:8) states that in a qualitative enquiry there are no rules for sample size but sample size depends on what will be useful and also what will have credibility.

According to Johnson and Cristensen (2000:215), the two educators met the specific criteria. The two educators must have practiced for at least five years with no formal higher qualifications in the learning area. Potgieter (2000:210) identified these specific educators as those who were not formally trained in technology education but who gained experience implementing the learning area on a daily basis.

The educators' areas of practice had to be from areas of medium and high resource contexts. Medium resourced context in this study is explained as a school in a rural area, the school's classification by the department of education is a no-school-fee paying institution. Learners are provided with transport and meals from a schools feeding scheme by the government. The majority of parents are economically inactive. Rogan and Grayson (2003:1188) describe medium resourced schools as having basic classrooms but in poor condition with not enough textbooks for all learners.

A high resourced context in this study is a school-fee-paying school in a city or town and the majority of parents are economically active and pay school fees. The learners are able to access resources like the internet from home. Rogan and Grayson (2003:1190) describe high resources schools as having excellent buildings with one or more library or resource centre, adequate curriculum materials other than textbooks, good teaching and learning resources, attractive grounds and good copying facilities.

To achieve a comparative study, it is crucial to have contrasting school contexts to explore the research questions of the study and to understand the educators' practices of implementing technology lessons in the two contexts. These contexts help this study to look in many directions at the same time.

The reputation the educators developed through the years of implementing at the school is important for this study. The reputation of the two educators recommended by colleagues and the principal to participate in this study contributed to the school's reputation.

4.4. Data collection instruments

The interview questions in this study were drawn up beforehand. It allowed for the use of an interview schedule to be used through which the observations became the predominant complementary data collection strategy.

According to Bennet (2005:50), these methods are complementary and offer a comprehensiveness that would otherwise not be offered in this research with only one of the two methods. The two methods used together enhance the quality and richness of data and one source was used to corroborate the other.

Rubrics were prepared with ratings for both the interview and observations.

4.4.1. Interviews

The educators in this study are the respondents who provide the situational and contextual knowledge (Mason 2002:63) to the questions, especially with the clearly stated criteria above. The one-on-one interviews were the predominant method for obtaining the data (Cohen, Manion, and Morrison, 2007:271). According to Gray (2009:370), this is a powerful way of helping people to make explicit things that have been hitherto implicit by articulating interpretations which form a major component of the study.

4.4.1.1. Structured interview schedule

A structured interview schedule format was suitable for this study as it allowed for a face-to-face encounter with educators practicing in the learning area. Preliminary personal introductions were made during a pre-visit to the educators, which according to Daugherty (2009:13), are used for purposes of preparations and administrative matters.

Mason (2002:63) claims it is possible to gain a “special kind of information” from the schedule, as the respondents who are practicing educators in the learning area, engage in dialogic interaction. The researcher developed the interview questions with guidance taken from literature. Questions which addressed similar themes were coded so as to capture as much detail about a particular theme. The prepared interview schedule (Appendix 3 of the study) was discussed for refinement with work colleagues in the Department of Science and Technology in the school. A senior educator agreed upon a pilot interview. This was important as a form of pre-testing according to Bennet (2005:53), for testing the clarity of the questions.

The strategies for interviewing differed in the two contexts. The interview in the medium resourced context was conducted during my first day on site. The interview was conducted for thirty minutes in the staff room where I was accommodated during my two-day visit to the site. This was done immediately after observing a technology lesson as the educator was free during that period for the day. The educator also offered another learning area different to technology in the school. The after school hours which I suggested to the school seniors were used for extra-curricular activities for learners.

The interview strategy in the high resourced context was for the interviews to be conducted during my second day on site. It was conducted during the educator's free period in class. This was because of a rotational system used in the school where learners attend periods in different classes with class educators permanently in class. I was permanently in class with the educator during my two days stay on site. According to the time table the educator was free for that period and the interview lasted for thirty minutes.

4.4.2. Observations

Non participatory observation techniques (as explained in Creswell 2003:179) were appropriate for addressing the research questions for the study. According to Gray (2009:401), the advantages of this technique of observing non-verbal behaviour, is immediate as it elicits data on events as they happen and allows for a more natural relationship to develop between the researcher and the respondent.

My observations served as a complementary data collection method for this study. First-hand information was collected with regard to educators' interpretations of implementing the curriculum. During my two days on site to collect the data provided opportunities for observing the two educators. Observations were conducted in order to establish how educators plan their teaching and learning activities, utilise teaching strategies, conduct assessment and use available materials and resources. Observation schedules were developed by the researcher guided by essential features themes table from literature. These appear as Appendix 4 of the study.

The observation strategy in the medium resourced context was a lesson observation for a thirty five minutes period before the interview. It was during my first day on site and with the educator in a grade eight technology class. Prior arrangements were made with an educator which resulted with a set appointment. A period from the timetable was agreed upon for the day. The arrangements were made for a second on-site classroom observation.

The observation strategy from the high resourced context was different. I was in class with the educator during my two days stay. As a result I was able to observe all the lessons presented by the educator for the periods indicated in the time table. This was possible as a result of the rotational strategy followed in the school. This strategy allowed for flexibility. A relationship developed between the educator and the researcher. Matters which needed clarity I could immediately attend to with the educator. After the interviews I observed two formal Grade 8 lessons of forty five minutes.

4.5. The development of a research instrument

This study addresses two main research questions' (1) *what are the educators' interpretations of the intended technology education curriculum in the General Education Phase?* and (2) *how do educators implement the intended curriculum at classroom level?*

An instrument was developed by the researcher to explore different understandings of the educators' concepts of "technology" and "technology education", and to determine the educators' interpretations of their practices. The name of the instrument was called implementation evaluation rubric. The implementation evaluation rubric appears as Appendix 5 of the study.

The purpose of the instrument was to indicate the educators' progress towards the achievement of their pedagogical expectations and to capture details on essential features in the learning area. This was not unique to my study but similar to studies in Aikenhead and Ryan (1992), Bame, Dugger, de Vries and McBee (1993), Van Rensburg, Ankiewicz and Myburgh (1999), Becker and Maunsaiyat (2002), Maphutha (2005), Dorman, Alridge and Fraser (2006), Maxwell, Houston and Berger (2007), Mawson (2007) (PATT USA instrument) and Jita (n.d).

In developing the instrument, some of the steps recommended by Mentzer and Becker (2010:30) were followed. The first step was to identify relevant and essential features for the intended technology curriculum. The next step in the development of the instrument was to code similar themes for technology. I was able to focus on manageable topics at a time. This was necessary in order to capture much detail within the instrument.

In order for the instrument to serve the intended purpose, three ratings were developed. The development of the three ratings was derived from a review of literature as suggested by Kotrlik and Redmann (2009:48) and Mentzer and Becker (2010:30). The three ratings were necessary to capture educator practices within the instrument. Each rating was a descriptor formulated by the researcher. Three varying ratings of insufficient, sufficient and sufficiently adequate were developed.

Rating 1 “insufficient” was developed by writing descriptors which defined features of a particular essential feature for the technology curriculum. The word “inadequate” is used interchangeably with “insufficient” in the rubric and discussions. The actual meaning does not alter.

Rating 2 (sufficient) was developed by writing out descriptors which were selected from an “insufficient” rating. The word “moderately” was used to bring emphasis to a summary of a descriptor which defined a particular essential feature. While this might be criticised, I did not use or bring words or items which could add another understanding or dimension to the original descriptor. I was guided by Almond, Winter and Camento, et al. (2010:34) who claim that the process is valid as long as no new items are added. The word “adequate” will be interchangeably used in the descriptions of the same understanding as with using the word “sufficient”.

Rating 3 “adequately sufficient” was developed by writing out descriptors drawn from the “insufficient” rating. The word “adequate” is used to bring distinction and concise information for particular information from the insufficient descriptor. This was possible because of inference. A criticism levelled at drawing inferences leads to matters of content validity. Content validity was evaluated by my supervisor and co-supervisor. Both are subject experts in the technology curriculum. They are accredited and have extensive publications on the technology curriculum.

4.6. Data analysis and procedures

In data analysis of this study, primarily with the nature of the research being qualitative, was reported in a descriptive manner from both the interviews and observations.

The answers from the interviews and observations were analysed, guided by the rubrics containing ratings as described in section 4.4.2. Mouton (2000:108) explains that the aim of analysing data is to determine developing patterns which could be identified and isolated as dominant themes.

Using the two methods (interviews and observations) to gather the data was to produce trustworthiness by employing triangulation Daugherty (2009:14). Silverman (2010:277) explained triangulation as understanding a situation by combining different ways of looking at a situation. In addition, the instrument developed by the researcher added to the reliability of the results, and added value for the researcher by look at situations in different ways.

4.7. Ethical concerns

While this study was in progress, I was employed by Gauteng Department of Education. I obtained permissions from both Gauteng Department of Education and Tshwane West District (D15) (Appendices 21 and 22) to conduct interviews, observations and to access and use official documents from the two schools. Educator names, school names and leaner names were removed from the official documents which were included as evidence during data collection. In addition, I obtained consent from the two educators for interviews and classroom observations. Consent forms were signed (Appendices 19 and 20) by the two educators with an understanding of withdrawing from the study at any time.

In terms of ensuring for confidentiality, pseudonames were used for the two educators. During data discussions, and presentations, as a researcher I did not also identify verbatim comments with their names.

TABLE 4.1: Framework, data sources and instruments

Research question	Data sources	Instrument
Research question 1	Educators	Educator interview (rubrics with ratings)
Research question 2 2.1. Planning	Educators' file [include assessment tasks] criterion: rubrics	Educator interview [interplay between clarification and validation] (rubrics with ratings)
2.2. Teaching approaches and strategies	Educators in classroom	Educator observations (rubrics with ratings) interviews: [clarification of observations] (rubrics with ratings)
2.3. Assessment	Learner file: Assessment Instruments Tests Assignments Learner portfolio's	Educator interview: (rubrics with ratings)
2.4. Materials and resources	Inventory of list of materials that the school, class teacher has to make teaching technology possible Electricity | Textbooks | Computers | Toolkit | Software |	inventory educator interview (How, What)

4.8. Validity, reliability, credibility, trustworthiness and transferability

Issues of credibility and trustworthiness are crucial for qualitative researchers to make theoretical inferences from the data collected. This is seen in Bryman (2004:543) as reliability which is the degree to which a measure of a concept is stable. Bennet (2005:57) cites Lincoln and Guba (1985) who claim that reliability is not sought for its own sake, but as a pre-condition for validity. According to Gray (2009:582) validity refers to the degree to which data in a research study are accurate and credible.

This study endeavoured to produce credible and trustworthy findings. One strategy used to enhance trustworthiness was to declare the researcher's situation prior explaining the findings. This was declared as a conflict of interest in this study. After ten years of implementing the technology curriculum at classroom level, I was appointed Head of Department in the school which is not the school where I conducted the interviews and observations. This responsibility extended to meeting with other educators from neighbouring schools in the district during technology competitions as a judge. The participants are known to me, but in other contexts. I was appointed as a district cluster leader for the learning area. The main responsibility was to deal with problems of implementation as they arose. My responsibility now is to conduct a study from a researcher's perspective and to ensure a critical reflective distance from my role as an implementer of my technology learning area.

"Robustness, richness, parallel data sets" and "corroborating" were terms explained in Bennet (2005:57) and Bryman (2004:545) to express triangulation so that findings may be cross checked. The terms indicate that as a researcher one is able to check for trustworthiness by using triangulation as Thabang asked me to remove a section of the data collected on the support received from the district subject advisors. Thabo accepted the study in its original form. Full descriptive reports were made available to each participant.

4.9. Chapter summary

This chapter explains the research design of the study. The chapter dealt with the choice of qualitative design. The research population and sampling of the study were discussed. Purposive sampling was discussed in detail. The theory and the actual events during interviewing and observations were explained. The aim was to validate what is available from literature with actual events. The structured interview schedule was also discussed. In terms of the data analysis of the study, a table was developed summarising the data analysis and procedures. Validity, reliability, credibility, trustworthiness and transferability were also discussed in relation to the study.

The next section presents research results from empirical investigation.

CHAPTER 5

RESEARCH RESULTS FROM THE EMPIRICAL INVESTIGATION

5.1. INTRODUCTION

The purpose in this section of the study is to present the research results obtained from the two research questions. This chapter will commence by first presenting the demographic information of each participant, then the analysis based on the interview data, and the observation data completes the section.

Demographic profiles of participants **PROFILE OF PARTICIPANT 1: THABANG**
A pseudonym for this participant was Thabang and teaches in a school with high resources. He is a white male in his early thirties. He teaches in a city school with approximately 700 predominant white students, from Grades 8 to 12 as a post-level one educator. Thabo obtained his BA degree from the University of Pretoria with majors in Mathematics and Science. He has seven years teaching experience. He taught mathematics and biology as subjects in his school for a year and technology for the past six years. The school is in a suburban area and has double storied buildings. It has a main hall and a boardroom for staff meetings. The school buildings are meticulously kept and the gardens are well maintained. Thabang has his own classroom. It is clean, has enough chairs for the learners, and the large enough to manage group work activities. There is a separate room for storing technology projects.

PROFILE OF PARTICIPANT 2: THABO
A pseudonym given to this participant was Thabo who is a black male in his late forties. He teaches in a rural school of approximately 600 black learners. The school is a secondary institution with classes from Grade 8 – 12. He is a post Level 1 educator in the school. He studied for a teaching diploma at a college in the then Bophuthatswana. His majors were in all primary subjects. He has twenty years teaching experience. The subjects he previously taught were general science and history. He has taught technology for ten years in the school. The school is in a rural area with separate buildings in the school grounds. There is no main hall in the school. There were broken windows in a few of the classrooms. The lawn has turned into grass because it is not cut. One class is turned into a staff classroom. The classrooms full to the door with learners. Old paint is peeling from outside and inside classroom walls. Old desks types have two learners sitting in each desk. The desks make it impossible for the learners to group work. There is not enough space to store technology projects.

5.2. General overview of classroom visits

5.2.1. Planned observation in a high resource school

The planned observation periods in the high resourced area were extended as I was permanently in class with the educator because of the rotation system. Learners move to their subject classrooms while the educators stay in theirs. This made it possible to ask questions informally about my queries that arose from our informal discussions.

During my first day of observations at the high resourced context, I arrived after school morning assembly and reported at the school reception. I introduced myself again because I had previously come to the school to introduce myself and to explain the purpose of my visit. I was ushered into the principal's office and found the principal awaiting my arrival. He immediately walked with me to Thabang's classroom.

He introduced me to Thabang who was waiting for me in his grade eight classroom. According to the time table Thabang was free then and had a class only in the third period of the day. This made it possible for me to have informal discussions with Thabang about issues pertinent to the learning area that I would otherwise not have covered during my two-day visit.

At the end of the second period with the bell signalling the third period, Thabang went outside to meet the learners and to explain about my being in their classroom. The learners entered the classroom and remained standing. After formal greetings, Thabang indicated to the learners that I was visiting their class and also explained the purpose of my visit.

During my second day of data collection I met with Thabang after break in the same classroom. He was marking learners' books and was free for the rest of the day. The school day ended and my visit at the school ended. It was on a Friday and Thabang asked if it was possible for me to stay behind for a while as some learners were still in the school grounds. This I did and continued to check an adjacent classroom full of learner's projects. Examples of learner projects are provided as Appendix 13. I went to thank the principal for my two day stay in the school. Thabang and I left the school.

5.2.2. Planned observation in a medium resource school

I arrived during assembly on my first day of interviews and observations in a medium resourced context. The school's assembly was in the school hall. All the educators and learners went to assembly. I sat at the reception until 8:15 when the assembly ended. The principal and the Head of Department (HoD) of the Natural sciences, Mathematics and the technology arrived and I introduced myself again. I had visited the school on a previous occasion to explain the purpose of my visit. The HoD walked with me to the staffroom where we found Thabo who was sitting at a table with learners' books in front of him. I did not see Thabang doing this. Thabo was reading a textbook and preparing for his lesson in the next period. I was introduced to Thabo but he continued making notes from the textbook he was reading. Examples of educator planning are included as Appendices 9 and 10.

During my second day of observations, the educators were all called to an impromptu staff meeting. The school started at 8:00 and there was no assembly that day. The meeting lasted for the whole first period and I was left alone in the staff room. For that day, a whole first period was missed by all learners in the school.

I was left on my own while Thabo went to class for a social science period. One of the educators who was in the staff room invited me to go with him to the school's science laboratory. This he did because he had a class attending another learning area in the laboratory as there was not enough space to accommodate the learners in class. I agreed because he told me he thought technology is similar to science. We went to the laboratory and I found unpacked equipment in their boxes. Thabo came looking for me after his period. After the learners had left, I noticed an unused technology kit lying in the laboratory.

We went back to the staff room and I noticed that Thabo had lots of books to mark from learner activities. He was only free for a single that day. The bell rang for after school hours and we packed our belongings for home. I thanked the HoD because the principal was no longer on campus.

5.3 Presentation of data

5.3.1. Introduction

The presentation of data in the next two sections differs. In research question 1 of the study, the presentation focuses only on the interviews I had with the respondents, and research question 2, deals with the essential features of the technology curriculum. The data is obtained through the interviews and the observations. This was necessary in order to achieve an alignment between the data.

The observation schedule (prepared by the researcher) guided this presentation. It was planned according to the particular essential features themes of the technology curriculum. Merriam (2000:179) explained this planning as categories which are important in particular sections of different classrooms. According to Park and Eertmer (2008:635) this is known as a form of coding. (These appear as Appendix 4.)

5.3.2. Interpretations of technology education curriculum: research question 1

In terms of Thabang's understanding of research question 1 of the study, he indicated that technology, as commonly understood, does not only apply to technical drawing. It includes all things connect to technological development and can be advancements in food technology or in biological life, in structures and in mechanical systems.

In terms of "technology education" Thabang indicated that technology education is knowledge about technical knowledge; the knowledge is in technical subjects for example machine design. This knowledge was important to achieve the full use of old machines available in our backyards.

In terms of research question 1 of the study, Thabo explained that technology bridges the gap between the school and the world in which the learners live. In his opinion, it enables learners to understand the relationship between technological development and their natural environment.

About "technology education", Thabo indicated that the term "technology education" involves the ability to use and produce objects from the environment for particular functions, just as traditional people used trees from their environment to carve wooden ploughs for ploughing their fields.

5.3.3. Essential features: research question 2

5.3.3.1. Planning

Thabang's planning for the following year begins in October and November. He starts with macro planning, which involves all the work that has to be covered. He then breaks the work down into semesters, then weekly planning and daily planning. Thabang uses his daily planning for lesson unit planning. As a result of his planning all the learners were involved in the lesson I observed.

According to Thabo planning lessons involves sharing the classroom with colleagues.

Thabo was teaching Grade 8 at the school. He said he did semester planning and not meso planning. Thabo indicated that semester planning leads to weekly and then daily planning. From the daily planning Thabo is able to do individual lesson planning.

Thabo experienced challenges in terms of planning and said that his planning was centred on the available resources. As Thabo puts it "learners in my class are from a poor resource area, which means they use only recycled materials".

Thabang's planning specified the learning outcomes and assessment standards. (An example of learner portfolio activity is included as Appendix 11). These relate to learning outcome two and the topic was on mechanical systems (load, effort and fulcrum). (An example of learner's portfolio is presented as Appendix 14). These were applicable and relevant to the learning task and learning activities. During document analysis, all the tasks for the learners and the educator portfolio indicated the learning outcomes and assessment standards to be achieved. The challenges that Thabang mentioned about his classes were resolved as he was able to engage learners.

Thabang's organisation of the activities was stipulated in his planning. This was evident and available in his planning file.. Observations were conducted during the second term of the year and the learner portfolios for the first term were available for my perusal.

Thabo did not indicate the learning outcomes of the activity as they were not reflected in the textbook he was using. I noticed that he used a Kagiso Dynamic technology learner's book by Clitheroe, Dilley, and Tholo (2005). As a result, the expected competencies were not evident and were not applicable to the learning activities.

Thabo showed constraints in presenting and challenging the learners in his class. Learners were not motivated to continue with the task until Thabo reprimanded the group. He used a textbook and the chalk board to engage learners in class. His organisation of activities was not stipulated in his planning. I was not able to do any perusal of portfolios as Thabo indicated that learners' portfolios were not available as a result of space for storage.

5.3.3.2. Teaching approaches and strategies

Thabang indicated that he likes using a visual approach, like a computer power point presentation for his learners in class. He explained that if the learners were left to read on their own, dictate to them or even use direct instruction, he discovered that he lost touch with the learners. Thabang explained that the types of learners educators were working with in that school enjoyed visual stimulation .He said: "If as an educator, you do not visually stimulate them, you end up losing them during teaching". I observed Thabang using a laptop and a video projector to stimulate his learners visually. He claims that visual stimulation as an approach works best for him in class.

A strategy which did not work well for Thabang was going to class and doing "normal teaching", which involved going to class using a projector with transparencies. This strategy necessitated him to dictate and provide learners mainly with notes on the screen. "Before long half the class was asleep and the rest showed no interest in the lesson."

Thabo explained his teaching as a "simple approach". When asked what he meant, Thabo explained that it involved him as a "leader". I observed that Thabo used more of an educator-centred approach to teaching. According to Thabo, the approach encouraged "clever" learners to come forward with their own understandings. The reason he views himself as a leader in his teaching, makes it possible to "facilitate learners' understandings". From the explanation that Thabo gave, I noticed that he confused the terms "approach" and "strategy". He explained that because technology has difficult terminology, he found it important to lead as an approach to teaching learners the language of technology. He explained that the approach he uses also depended on the type of learners he had in class.

Thabo indicated that he had no experience of approaches being a challenge as he was "able to succeed with other approaches". He also said "there are more ways of killing a cat".

In Thabang's class, learners quickly moved to their groups at different coloured work tables. When I asked about the different coloured tables, his response was that the colours helped to mix the class groups at the end of the week. This prevented friends from remaining members of the same group. In Thabang's class, learners rotate in their groups and meet other learners. The learners work harder at their tasks, which led to a competitive spirit and motivated learners again. Thabang had a variety of group tasks for the learners to use in their groups. I noticed this during the submissions of the tasks at the end of the stipulated time. Only five learners submitted their work to Thabang. The learners went back to their groups and started marking the others' books according to the marks given by the educator. Learners were involved in peer assessment with no complaints or problems from the other learners.

During the second day of my observations, the Grade 8 learners entered Thabang's classroom and found him waiting to present a power point lesson. This was different from the other Grade 8 class, because the learners sat in their groups listening to Thabang's presentation. The topic was on mechanical systems. Images of mechanical systems were projected and the learners were to identify input, output and process. All the learners were able to identify and name the components as instructed. An example of the day's planning is presented as Appendix 8.

Thabo's classroom differed from Thabang's classroom as four tables were placed together. There was no available space to move around the class as in Thabang's classroom.

Thabo was scheduled for the fifth period of technology of the day in the same Grade 8 class where I had previously done the observation. When we arrived in class, he requested learners to submit the projects of the previous period. He continued collecting these projects until the end of the period. Some learners came to the front of the class to present their projects. (Appendix 12 is provided as examples of learners' projects). Those who remained sitting in their groups continued talking while Thabo was busy assigning marks to the learners with projects. I noticed that Thabo had not developed a rubric for the project but concentrated on the completed project. When one of the learners submitted his project, he called to show me the project. According to Thabo it was the most beautiful of all the submissions he had seen in class. Thabo concentrated on the aesthetic part of the project rather than the technological aspect. We left the classroom and went to the staffroom. Thabo was teaching another learning area in the next period. In Thabang's case, he did not have to contend with teaching other learning areas, as the school where he was employed made sure that an educator offers only one learning area.

Thabang showed actions and questioned the learners at varying levels. Some group members were engaged in an activity involving recall questions from the video learners had watched in an earlier class. He did not disturb the other learners who were busy with a challenge in another group. He managed this while interacting and moving between the groups which involved all the learners and kept them interested. Thabang's educator knowledge was evident in the learning activities which were planned for the learners.

By comparison, Thabo did not present actions and did not ask questions on a variety of levels. The activity he presented to the class was taken from the textbook and given to all the groups in class. I did not understand the topic of Thabo's lesson, but only discovered during our interview that he been dealing with structures.

There was a lot of interference from Thabo during his lesson as he continued to explain the task to the learners. I discovered later that Thabo wanted learners to engage in an investigation by using textbooks which were in a box in class. His interactions and movements were limited to the chalkboard and to the learners seated in the front group of the classroom I was unable to establish Thabo's competence knowledge because he read the planned activity from the textbook.

5.3.3.3. Assessment

Thabang believes the assessment depends on the type of activities that were completed in class during the week. Essentially, he does daily assessments and two formal assessments a week. I observed informal assessment in class after the video projections. This assessment involved questions and answers based on the video projection. In the written work, individual assessment activities posed a challenge to the learners. On completion of the video projections, there was a planned written class activity, after which the learners exchanged books and started marking while Thabang provided the correct answers. Thabang explained that he used peer assessment as learners are able to provide correct answers by recalling information based on the video they saw in class. Thabang explained that it was important to develop the learners' "look and listen skills". Thabang said that when planning, he looks through the school videos and if there were none suitable he uses the internet to look for other suitable ones. Thabang checks individual learner books before recording the individual learner marks.

Thabo maintained that the time table allows him only four periods of forty minutes a week. As a result he managed to do only weekly assessment and not daily assessment. He explained that "it is difficult to teach and assess the same day because of the large numbers in class". He stated that he does assessment during the fourth period and begins by collecting all the books to record marks. Thabo did not use actions and questions at varying levels. The informal assessment came from the questions which were given at the end of the activity in the textbook he was using.

Thabo maintained that it is not always easy to comply with the requirements prescribed for the learning area. However, according to Thabo "his interest" for the learning area makes it possible for him to come up with assessment. In terms of the projects which were submitted by the learners, Thabo explained that learners create projects based on their environment as "it is important for the learners to know where they come from".

Informal and formal assessments are planned at Thabang's school. An informal assessment strategy which he used in class involved learners coming to the front of the class indicating from a given picture the input, process and output. (An example of learner activity is presented as Appendix 8.) The instructions, the school name and the educator's name appeared on the first page. To maintain anonymity, the researcher and the educator agreed to remove the learners' names. A formal type assessment involved learners' written activity identifying the parts in a crank. The assessment strategies aligned with the stated outcomes. I noticed that learners submitted a project to the educator based on an activity given prior to my visit. (An example of learners' design process is included as Appendix 7 and Appendix 13 is presented as an example of the learners' projects.)

Peer assessment was also a used in Thabang's class. Only five learners submitted their work to Thabang for marking. In their workbooks, different pictures were given to the learners to identify. The learners went back to their groups and started marking off others learners' books from the marks given by the educator. The conclusion in terms of his assessment strategies can be regarded as trustworthy for this section of the study.

5.3.3.4. Materials and resources

Thabang used the free internet resource (Gauteng on line) available at the school as well as the textbook and posters for planning his lessons. The school has a library which learners use and most learners have access to the internet in their homes. According to Thabang, this makes it possible for the learners to complete their tasks at home. The planning Thabang does for the learners, depends on the materials available for the learners to use. Thabang said he is able to plan with outcomes because of the variety of materials at the learners' disposal. Thabang felt he had all the resources, but that he needed more so he finds them from outside the school.

Support from outside the school provides materials that helped learners. School kits for electricity and electronics were available in the school. Learners were able to build electrical circuit components and appreciated the use of the resources available in the school. During my observation, up-to-date knowledge was evident through the resources the learners were using in class.

The Department of Education (DoE) provides the materials that they use in the school. I enquired about the word "materials" and Thabo indicated that he meant textbooks. However, he indicated that because of the large number of learners in his classes, they have to share textbooks. Not every learner has his or her own textbook that can be taken home for self-study. As a result, he duplicates using the "recycled materials". He says, "Duplicating is always a problem as there is not enough paper in the school for each learner to have a copy". Sometimes Thabo asks the principal to buy wool for "processing" as it is inexpensive. Each learner receives a ball of wool and is then able to continue with projects on weaving. I saw all the projects that learners submitted, but Thabo did not have the design briefs for the projects. All the projects that were developed by the learners were based on Learning Outcome 2 of the technology learning area.

Thabo explained that the support the school received was from an NGO called Lonmin Mine. The mine provided temporary educators of technology to support the curriculum. Thabo said that the educators from Lonmin Mine were trained specialists in technology and brought physical resources to make artefacts in the school.

Thabang used learning resources which were appropriate and relevant to the lessons, such as the video and power point presentations he used in class. I found during document analysis that learners' workbooks met the expected standard. The learning materials he used made learning relevant and appropriate for the task. Thabang had a laptop in class that he used and that included his planning. The success of the outcomes which were achieved was as a result of the available materials and resources.

By comparison, Thabo used a textbook as the only resource for the lesson. There were computers available in Thabo's school centre but he did not use them for his teaching and learning nor for his own planning. As a result, it was difficult to judge the success of the lesson in relation to the available resources in the school.

5.4. Chapter summary

The section presented the results of the empirical investigations of the interviews and the observations. The data collected from the two contexts and the general overview differed in relation to the daily operations in the two schools. The respondents' understanding of research question 1 of the study differed. In terms of essential features which related to research question 2 of the study, some similarities and differences were evident from the respondents' implementations of the technology curriculum.

CHAPTER 6

DISCUSSIONS AND CONCLUSION

6.1. INTRODUCTION

This section presents a synthesised report based on the data presented in the previous chapter. The empirical data and literature of the report are integrated. The theoretical framework by Rogan and Grayson (2003) and the implementation evaluation rubric were used to write a concluding comment on each of the research questions.

To report on the outcomes, a review of the research questions, the orientation and problem statement, and the research methodology is pertinent to ground the understanding of the conclusions drawn in the study.

6.2. A brief review of research questions, orientation and problem statement

TABLE 6.1: Research questions explored in terms conceptual framework and instruments

RESEARCH QUESTION	CONCEPTUAL FRAMEWORK	RUBRIC
What are educators' interpretations of technology and technology education curriculum	Rogan and Grayson (2003) framework not applicable in this research question	Interpretations evaluation rubric: Technology Technology education
How do educators implement the intended curriculum at classroom level	Rogan and Grayson (2003) four levels in the profile of implementation	Implementation evaluation rubric: essential features

6.2.1. Orientation and statement of purpose

The positioning of the technology and technology education in the existing traditional curriculum is likely to yield different understandings in educators. These terms of technology and technology education are susceptible to a large degree of interpretation and to which that clarification is still essential. The technology learning area was introduced as a new learning area in 1998 and had to be implemented by educators. The majority of South African educators were not formally educated or trained as technology education educators (Engelbrecht et al, 2006:2).

6.3. MAIN FINDINGS

6.3.1. Discussion of research question 1

What are the educators' interpretations of the intended technology education curriculum?

This section presents the data structured into a single section. The presentation is based on the data from the interviews, the observations and informed by literature. This was necessary to cross reference, compare and to triangulate. The presentation is done against the research questions. Differences, as well as similarities between the findings from both the participants are highlighted in the discussion. Each section concludes with an interpretation based on the Rogan and Grayson (2003) framework and a rubric rating which was developed for this section of the study. As a researcher, I made judgments based on the ratings from the criteria for implementing features based on benchmarks extracted from literature.

According to Jones (2005:8), educator conceptualisation of technology and technology education is a complex issue which requires understanding of the many factors that influence it. Jones (2005) states that appropriate conceptualisation of the two terms is required to teach effectively in the learning area of technology.

Thabang's understanding of the term "technology" relates to a scientific perspective, which is similar to Rose's (2007:177) whose definition encapsulates "design with intention". The "technological perspective" of the definition also includes using particular tools. This finding is similar to Elshof (2007:177) study of tools to use for design.

Thabang used the word development which indicated solving problems to advance knowledge. In Thabang's class, the learners' workbooks and portfolio's indicated awareness of the stages involved in technology as an activity: investigate, design, make and evaluate. The learners' activities were planned to be submitted at the end of the period, which showed learners' abilities to engage in the processes confidently. These results concur with Reddy, Ankiewicz, De Swart and Gross's (2003:128) notion that practical work is important in technology because it provides opportunities for learners to experience real technological activities.

Thabo understands the term "technology" from a sociocultural perspective as understood in the study by Elshof (2007:179). According to Elshof (2007:177), this perspective is accepted on the basis that it offers "other ways of seeing". According to the author, this notion paves the way to the idea of place based learning, which offers considerations for design locality. Thabo understands technology, as he includes "knowledge of environmental contexts" in his lessons. This idea is similar to Williams and Gumbo's, (2011:2) who cited Cochran, King and deRuiter (1991). During our interviews, Thabo indicated that learners were predominantly from a poor background and as a result their resources were recycled from the environment. Thabo's understanding of technology is in line with Rose's (2010:43) ideas of technology, which alludes to an interdisciplinary understanding of the human and the natural environment. Thabo used the term "technological development and natural development" during our interview.

A similarity which was noted in the two respondents was that both of them had an understanding of the term. Though varied, a common aspect was in their use of the term relating to capability. Wilson and Harris (2004:50) described capability as a combination of skills and knowledge to intervene in the world and improve it. According to the authors, a societal dimension (reflected in Thabo) and the art of designing (reflected in Thabang) are fundamental to capability and to the concept technology.

Thabang's understanding of the concept technology education relates to a technical skills approach with emphasis on automatic control and practical capability (Black. 1998:2,3).

Thabang understands the term 'technology education' "ensures the learners' understanding of how the various devices, equipment, and machines work, how to use them, and that their knowledge and abilities of technology improve". Design is also a concept appropriated to define the term technology education. I observed during my classroom observations that Thabang's learners' actions and thinking showed they were confident. These observations are in line with the recommendations in a study by Vandeleur, Ankiewicz, De Swart and Gross (2001:272). They maintain learners must work in a climate that fosters ideas to generate, as this increases flexibility, fluency and originality of thought. According to Barlex (2005:5) and Barlex (2007:101), Thabang is typical of an educator who has succeeded in developing the learners' ability to conceive that which does not yet exist, to develop a novel system through making technical design decisions, and to make aesthetic decisions which involve how they will make their constructional design.

Thabo's understanding of the concept of technology education gravitates towards a craft approach in which cultural and manual skills and traditional design are used, with much emphasis on problem solving (Black 1998:2, 3); and Kokko and Dillon 2011:500). Thabo's ideas align with the South African curriculum which requires learners to be able to find out about historical contexts when solving a problem in relation to structures, processing or systems and control (Lee 2011:43). Historical and cultural examples provide value to students' cultural capital aimed at a broader understanding of technology education. Thabo uses the term 'bridging the gap' similar to 'close the gap between technology in the real world and technology education in schools' Lee (2011:44). Thabo understands the concept in relation to social engagement which is in agreement with Ingerman and Collier-Reed (2011:142). The authors (2011) contend that technology education is an interaction of people and the application of various tools which have been produced and have a well-defined application. During the interviews Thabo indicated that traditional people (people) carved wood (tool) from the trees for ploughing fields (application). A form of incongruence was evident in the way Thabo explained the concept, and what was actually taking place in his class. He was convincing about his definition of the term "technology", but in his actual technology lessons there was no follow through action of his knowledge, and no evidence of that knowledge helping him during implementation. Serious investigation challenges during classroom observations were evident where learners possessed no prior investigation capabilities. This was similar to findings in Dagan (2007:233), and Barak and Awad (2008:249). In Thabo's classroom activities his aesthetic decisions were based on the final product informed by 'beauty'. This was confirmed during classroom observations when Thabo called me to look at 'how beautiful the project is'. These findings were similar to Bjurulf's (2007:61) results that students meet aspects of technology depending on what the educator focuses on.

Below follows a table providing an overview of rubric ratings relating to categories for the research question 1 of the study. Rogan and Grayson's (2003) framework was not relevant to this section of the study.

TABLE 6.2: Rubric rating: interpretation of technology and technology education

CONTEXT	CATEGORIES		
THABANG	**PROBLEM SOLVING**	**DESIGN**	**ACTIVITY**
	RATINGS		
	Sufficient	Sufficient	Sufficient
	Reason: Instructional methods afforded opportunities for authentic learning tasks	**Reason:** Educator provided for various solutions which provided different answers to a single task	**Reason:** Educator provided opportunities for the use of tools which later developed skills manipulation
THABO	**PROBLEM SOLVING**	**DESIGN**	**ACTIVITY**
	RATINGS		
	Inadequate	Inadequate	Adequate
	Reason: Instructional methods do not provide opportunities for authentic learning	**Reason:** Educator tasks did not provide for varying solutions to single task	**Reason:** Projects provided opportunities of tools usage

6.3.2. Discussion of research question 2

The next section presents the empirical findings integrated with literature to ground the discussions.

Research question 2: How do educators implement the intended curriculum at classroom level?

Each respondent's theme is dealt with separately. At the end of the discussion of the second respondent theme, a descriptive comparison of similarities and differences was made so as to conclude a particular essential feature. The discussion was concluded with a summary on each essential feature. It was rated as belonging to a particular level on the Rogan and Grayson (2003) framework with a rating based on the implementation evaluation rubric. In the last section of the section, I made judgments based on the criteria for implementing features based on benchmarks extracted from literature.

6.3.2.1. Respondents 1 and 2: planning as essential feature

Planning in this section of the study refers to unit planning with details of teaching, learning, assessment activities and the resources used and implemented at any period of time (DoE 2003:45). Thabang indicated evidence of knowledge in aspects which relate to planning. These aspects during classroom observations related to his ability to specify the learning outcomes and assessment standards during the activity. These were evident by way of specified activities indicating learning outcomes and assessment standards reflected in his planning. The ability to indicate and also use the learning outcomes was a finding noted in the Milne and Eames (2005:42) study.

During interviews, Thabang said 'my planning makes me think on my feet because I already know the type of assessment activities I will give to the learners'. Thabang showed similarities in relation to adequate educator preparation for a subject which correlates with his practice in class Popoola, Abiodum and Alo (2011:59) and Jones and Moreland (2004:133). During the interviews Thabo indicated that his planning involves planning units. This finding was similar to a finding in Moreland, Jones and Cowie (2007:373). Thabang was also able to identify requirements stipulated for the technology learning area to develop his teaching to include stages of the technological process.

The lesson plans indicated that (during document analysis) emphasis was on the four stages of investigating, design, making and evaluating as stated by Ankiewicz, de Swart, and Stark (2000:128). During classroom observations there was an indication of educator and leaner expectations, and clear links of planning for the technological process. These are similar to the findings in studies by Milne (2012:10) on planning for instruction. Learner sampled books reflected the activities planned in relation to the stages of the technological process.

The planning by Thabang is aligned with the planning in de Swart et al. (2006) who claim that planning should be aimed at using a wide range of activities. During classroom observations a laptop with videos were used by Thabang for varied activities for learners. For Thabang, this kind of planning includes reading instructional technology materials for learner assessment activities. In Thabang's case, the instructional tools comprised the use of a laptop computer, and video apparatus. According to Fadel and Lemke (2006:12) such tools are imperative as a supplementary activity in a technology class to strengthen learning and skills by providing immediate feedback. Thabang called this strategy a visual approach during interviews. The visual approach used by Thabang fits in with one of the learning approaches of Katsioloudis and Fantz (2012:61) cited in Felder-Silverman (1998).

According to the Rogan and Grayson (2003) profile of classroom interaction, Thabang interacts at level 2. Learner activities were specified which was a sign of a well-developed lesson plan.

According to the rubric that was developed for this section of the study, Thabang is rated as adequately sufficient. High planning levels are evident, and his planning covers all the content to be taught. Sufficient educator activities were indicated in his unit planning and the teaching strategies were spelt out in well-written text and kept in his planning file.

Thabo showed little insight into aspects of planning. The absence of documented plans became apparent when he showed an inability to indicate the learning outcomes of the activity which was presented to learners in class. During the interviews, Thabo admitted to challenges he was experiencing in terms of planning. His reason was the heavy workload of his responsibilities of implementation

Glattorn (1997:100) points out that many educators do not want to move away from short term planning. This was typical of Thabo who was reading his class textbook the period before the technology class started. As Thabo puts it “my own teaching can work around this”. Planning for lessons was not important to him and it appeared he had no guide on effective teaching. This is common with findings in the Banks (2009) study. The same textbook and the piece of paper were taken to class and used in the lesson. (An example of educator planning is in Appendix 9 and the section of the textbook as Appendix 10.) Learner activities were given from the same textbook with no alteration or variation of the groups. Should the educator be absent no one could carry on with the teaching as no planning records were available. In terms of planning for lessons, Thabo claimed that he did not have adequate time for planning because his workload was too heavy and because of the demands and responsibilities of the new curriculum.

Thabo’s planning level in relation to Rogan and Grayson (2003) is at level 1. Some form of planning was done however haphazard, and largely dictated by what Thabo wanted to deal with that day. As a result the learner activities were not clearly explained as the activities were taken straight from the textbooks. There was a little interaction in his classroom.

Thabo’s rating as developed for this section of the study, is insufficient. Important levels in technology were not planned for, and there were no planned learner or educator activities. Those available (short term) are not best suited for specifics in content and outcomes.

A similarity which was noted about the two educators was that some form of planning was done by each educator.

In view of the agreement between the findings from the two instruments from the data collected from the two respondents, the levels by Rogan and Grayson (2003) and the rating developed for this sections, my findings can be taken as trustworthy.

A table follows with a summary of the results of planning as an essential of the feature.

TABLE 6.3: The results of planning as an essential feature according to Rogan and Grayson's (2003) framework and interpretations evaluation rubric

PLANNING		
RESPONDENT	**ROGAN AND GRAYSON LEVEL**	**INTERPRETATIONS EVALUATION RUBRIC**
Thabang	**Level 2** **Reason:** Learner activities were specified which was a sign of a well-developed lesson plan	**Adequately sufficient** **Reason:** Evidence of high planning levels by the educator where all content to be taught was covered
Thabo	**Level 1** **Reason:** Haphazard planning by the educator, dictated upon by what the educator wanted to deal with in a specified day	**Insufficient** **Reason:** Important levels of technology were not planned for

6.3.2.2. Respondents 1 and 2: Teaching approaches

Thabang showed insight into aspects relating to teaching approaches and strategies. Thabo used the term visual approach which aligns with Katsioloudis and Fantz's (2012:61) claim that visual learners prefer visual representations of presented materials in the form of pictures and diagrams. This was evident in Thabo's classroom.

During the first day of my classroom observations, the design challenges which were given to the learners were well done. Questions and actions used at varying levels of complexity were evident during classroom observations. As part of the design process, which mainly centred on learning outcome 1 of the learning area, the learners' cognitive abilities were challenged. Group work was used as a strategy for teaching during my observations. Interview findings from Thabang indicated creative brainstorming by learners in a group based on set criteria. These are similar to the findings in Ikonen, Rasinen and Rissanen (2007:42), Doppelt (2008:36) and Hong, Yu and Chen (2008:303).

During the introduction of one of the learning tasks, Thabang gave the learners a current newspaper clipping that reported on a real life problem that related to the intended technology outcomes for the lesson. Moallen (2001:12) noted the kind of educator who approaches learning from a constructivist approach, and puts the learning task in an authentic context relevant to a learner. This finding was similar to the findings in Haarwood (2007:295) and Rutland (2007:316) on the use of case studies shown by a video clip as a strategy to link learners with the outside world. Thabang used this strategy which he calls "look and listen", where clever learners come forward with their own understandings. De Swart et al. (2006:14) suggested that educators use flexible teaching strategies in technology classes. This was typical of Thabang during my observations. His groups of learners were tasked to work on different tasks based on the scenario featuring the learning outcome 1.

The same scenario as reported by Rivero (2010:1), that if properly used, group work can save time which is a precious commodity during learning. This is similar to a study in Ginns et al. (2005), who suggest that scenarios for the design process should be based on open ended but focused teaching approaches. Engelbrecht, Ankiewicz, and De Swart (2007:185) reported on educators similar to Thabang who were empowered through developed instructional approaches and strategies.

Learners were involved in profitable group discussions in dealing with the scenario. Group discussions presented opportunities for learners to focus on aspects of information processing during collaboration and learning (Williams (2007:345). This was noted in a study by Adnan, Karomiah, Abdulla and Awang (2011:8) who found that learners working in a group give positive comments in their groups, and that through discussions they are able to see how friends work.

In Thabang's class, one of the learners' contributions was refused. The reason was the group members did not agree with his contribution in relation to the task they were working on. This finding was similar to those reported on by Khunyakari, Mehrotra, Natarajan and Chunawala (2005:26); Ikonen, Rasinen and Rissanen (2007:42); and as a conclusion in Barak and Zadok (2007:418) who claim discussions and problem solving form an integral part in the concept of "doing" in technology education.

The group's attention was drawn to Thabang. The participation of Thabang with the group members was in the form of leading as opposed to solving the problem. Cowie and Bell (1999), as cited in Stears and Gopal (2010:595), described this kind of strategy as interactive assessment where an educator is able to notice, recognise and the respond. Thabang is typical of an educator recommended for outcomes based education by the DoE (2002:26) and Webb's (2009:328) study as he meets the needs of learners with various teaching strategies. Thabang's intervention required all the group members to revisit the scenario and later carry on with the completion of the task. Learners operating on this level were noted in De Swart et al. (2006) that these types of learners have taken ownership with major thinking roles. This finding was similar to the one in Benson and Lunt (2007:304). This was a classic example of collaborative learning recommended for learning in the learning area. Similar findings were noted in Keirl (2007:311) that this was an example of critiquing which developed in learners as personal tools which shaped a sharper quality of learning. An educator operating within this level is able to allow risk taking as a result of proper unit planning according to Ginns et al. (2005).

According to De Swart et al. (2006:4) and Aldridge, Fraser and Sebela (2004:250), Thabang is a contemporary educator of technology who uses instructional strategies and approaches to complement the unique requirements of the technology curriculum. Design portfolios were also available during document analysis of the learners' portfolios. Learner portfolios reflected a favourable comparison of what was reflected in the educator file and the learner portfolios. The use of integrated technology by Thabang is in line with a study by Hache (2005:10) and Neyland (2011:153). Hache found that if educators succeed in integrating technology (and tools) in class, all the learners benefit from it. Thabang was successful in this approach. In his lessons Thabang used direct instruction, which is a method of teaching other than using technological tools. This teaching strategy is in line with Kramer (1999:99) and Edwards's (2000:120) notion that educators need to use a wide variety of approaches creatively and have the insight of knowing when to use them, sets Thabang at an advantage in the use of approaches during learning. Thabang used a reed whistle to draw the learner's attention. I asked Thabang about the whistle, and he replied "this is one of the learner projects from last year". According to Gawith, O'Sullivan, and Grigg's (2007:120) study, educators similar to Thabang succeed in developing the learners' practical skills, which is fundamental to technology education. It involves selecting materials and basic cutting skills with an action that requires good eye/hand coordination. It requires suitable tools to use, to finish after cutting and to pay regard to potential health and safety issues. Thabang's reply about the reed whistle is important as one of my sampling criteria for choosing an educator for the study was to have practised for at least 5 years in the learning area. According to Rogan and Grayson's (2003) classification of classroom interaction, Thabang operates at level 3. The newspaper clipping he used provided learners opportunities to construct knowledge based on problem solving and his learners engaged in meaningful group discussions.

According to the rating system that was developed for this section of the study, Thabang is rated as sufficient. His teaching approaches relate to constructivism as he met the specific requirements of the learning area. He also used up to date targeted strategies and moderate facilitation to achieve the intended outcomes.

Thabo predominantly used direct instruction coupled with reading the textbook to teach his lessons. This was evident during my classroom observations, as he was not able to present actions and questioning at varying levels to the learners. During our interviews Thabo indicated his preference for using a simple approach to deliver lessons in class. Similar findings were noted in a Banks (2009) study. The danger of direct instruction according to Killen (2000:6) is that learners assume that their educator is always correct. Evidently, learners in Thabo's class were passive and not attentive to learning. This instructional strategy disadvantages learners. What is common in Thabo's class was mentioned in Ankiewicz and De Swart's (2001) study. This notion is also expressed in Jakovljevic, Ankiewicz, De Swart and Gross (2000:2). Thabo's teaching practice did not raise the students' awareness, and he did not provide a variety of strategies for learning to be more defective. The learners seating patterns were tables in groups. My classroom observations of Thabo's lessons indicated a routine use of group work, but the group activities did not target the specific needs for task completion. These particular findings are mirrored in the findings of Ankiewicz, Adam, De Swart and Gross, (2000) and Ginns, Norton, McRobbie and Davis (2005).

During my classroom observations, classroom activities were not planned to include the type of activities recommended for teaching technology. As a result, learner opportunities to engage in the use of resource tasks, capability tasks and focused tasks was absent and not developed, which was noted in De swart et al. (2006:15). I probed Thabo on the fact that he was not using the term "resource tasks" and he replied that he did not use the terms as he did not understand them as he only saw them in the textbooks. For Thabo this notion was true as Williams (2005:5) claimed curriculum programme requirements in the learning area of technology were determined by individual interests and enthusiasm of the educators.

Thabo's profile of classroom interaction operated at level 1. He used direct instruction in his lesson and his presentations were well sequenced. As a result, learners were attentive but only responded to questions posed by Thabo.

According to the rating system developed for this section, Thabo was rated as insufficient. Learner activities were not designed or planned with the aim of promoting constructivism, activities did not meet the requirements specified of the technology education curriculum and were not developed to achieve the expected skills.

The respondents both used direct instruction as a teaching approach which means they have some form of a similar strategy in their teaching. The major difference between the two respondents was the use of other variable strategies to achieve the intended outcomes for the learning area. Each respondent had a particular strategy to use in class, but the strategies differed.

In view of the agreement between the two instruments based on the data collected from the two respondents, using the levels proposed by Grayson and Rogan (2003), and the ratings that were developed for this section of the study, my findings in this section can be regarded as trustworthy.

A table follows below with a summary on teaching approaches.

Table 6.4: Teaching approaches, Rogan and Grayson's (2003) framework and implementation evaluation rubric

TEACHING APPROACHES		
RESPONDENT	**ROGAN AND GRAYSON (2003) LEVEL**	**IMPLEMENTATION EVALUATION RUBRIC**
Thabang	**Level 3** **Reason:** The instructional strategy used by the educator provided learners with opportunities to construct knowledge based on problem solving technique	**Sufficient** **Reason:** The teaching approaches related to constructivism and met specific requirements for the learning area
Thabo	**Level 1** **Reason:** The educator used direct instruction strategy which resulted in a well sequenced presentation	**Insufficient** **Reason:** The teaching approaches did not target for constructivism

6.3.2.3. Respondents 1 and 2: Assessment

Thabang regards assessment as having a variety of purposes. His "thinking on my feet" included planning for assessment. Two main types of assessment were evident during classroom observations. These were day to day assessment (formative) and the end product assessment (summative) DoE (1997:16). My observations of Thabang's class are aligned with the findings of Jones and Moreland (2004:183). For an educator to identify and use both types of assessment, he / she need to provide opportunities of accumulated classroom experience for the learners especially for technology. During classroom observations Thabang provided informal assessment opportunities, which was confirmed during the interviews as varying, depending on the activities in class. Thabang serves as an example of an educator. Rivero (2010:4) suggests that knowledge in relation to vital tools of assessment guarantees a pass into the 21st century with flying colours.

Primarily, the assessment was guided by the prescribed learning outcomes and assessment standards for the learning area. Tasks which were developed for the learners included: case studies: developed for the scenario dealt with in the class; assignments: available for perusal in the learners' portfolios; research: the "ages" activity learners were working at in class and projects: stored in the adjacent room of the technology class.

These are similar to the tasks in Jones, Harlow and Cowie's (2004:106) study on educators using a variety of assessment strategies. During the document analysis, the learner portfolios indicated activities which were developed from case studies grounded by scenarios. The use of learner portfolios by Thabang typified a process type of assessment. In one of the learner activities, an investigation process (Assessment Standard 1 in Learning Outcome 1) was developed from a case study and completed as a project. Thabang's learner portfolios are aligned to Criticos, Long, Moletsane and Mthiyane (2002:108) and Killen's (2003:12) ideas who claim that portfolios provide educators with the opportunity to examine tasks all at once and in one place which learners have completed over time.

Learners started by collecting information on their ages. This was noted in a Bell and Cowie (2001:42) study on an educator who made sense with information the learners collected by turning it into a practical activity. Later they grouped their ages into boys and girls and produced graphs with the information. This is a classic case of skills acquisition converted to knowledge application in Thabang's classroom. Jakovljevic, Ankiewicz and de Swart's (2005) study explained learners similar to Thabang's as typical of learners who had a shift from low–level thinking to complex thinking. This was possible through the research skills which they were able to convert into real-life experiences and problem solving abilities into concrete representations of problems.

According to Rogan and Grayson's (2003) assessment dimension, Thabang fell into level 3. A form of investigation was performed by the learners. A scenario was presented to the learners while in groups. They gathered information about the ages of the learners in the class. Later they represented the information in different formats. Different table formats were drawn by the learners which showed some form of transfer of knowledge through the use of graphs. This was presented as their best work in their portfolios.

According to the ratings developed for this section of the study, Thabang operates at a sufficiently adequate level. The delivery modes are in line with the requirements prescribed in policy documents as Thabang made provision for adequate learner activities. He guided discovery type activities, and arranged written tests. These adequately cover the prescribed learning area requirements.

Thabo regarded assessment as a difficult task. This was confirmed during interviews as he managed only to do weekly and not daily diagnostic types of assessment as recommended for the learning area. Evidently the only form of assessment which he provided for the learners was based on the textbook. This is a common practice according to research conducted by Van Niekerk et al. (2006) and Jones (2005:5). During classroom observations, Thabo was unable to relate outcomes to specific tasks. This was confirmed during interviews. As a result more emphasis was on a finished product Thabo's assessment is typified by his use of product or artefact-type assessment that is characterised by a pen and paper type of test.

Engelbrecht, Ankiewicz and de Swart (2007:588) describe educators (like Thabo) who do not know what is expected of them with regard to assessment, or how to manage or even record the learners' assessments. This is caused by their limited experience in using design instruments. These findings are similar to McLaren, Stables and Bain (2007:143) who claim educators' assessment strategies, if indeed in existence, are more weighted towards the practical outcome and less towards the process. Sutherland's (n.d:7) study recorded similar findings where educators work with a single approach to assessment. But this assessment favours only certain patterns of abilities over others in learners. Penuel and Yarnall (2005:5) give an example of an educator, similar to Thabo, as one who rarely has time to plan assessment activities in a principled manner so as to collect varied forms of data on student assessment without experiencing "information overload".

Morrow (2007:58) describes a typical educator in most South African schools whose assessment is dismal and poor, and Thabo is similar to them. Jones and Moreland's (2005:197) study noted educators (like Thabo) as those with assessment practices that do not provide sufficient feedback, so the obstacles experienced during learning cannot be identified and tackled. It was increasingly difficult at the interview because aspects relating to assessment were not clearly understood even though I asked leading questions.

According to the assessment dimension as described by Rogan and Grayson (2003), Thabo is practicing at level 1. The tests in in his learner's books covered content topics, but there was no indication of learning outcomes. Technology as a process was not addressed, but as body of knowledge it was assessed with pencil and paper. Thabo's assessment was not varied and not planned in advance. He relied on assessment activities given in the textbooks.

According to the rubrics developed for this section of the study, Thabo's rating is insufficient. His approaches are inappropriate in practice, learner opportunities for participation in assessment are inadequate, and written tests do not cover the prescribed technology education curriculum.

In terms of assessment as a theme, the similarity between the two educators for the learning curriculums is that both assessed the learners. The difference however, is in the actual expected prescribed assessment requirements of the learning area in the curriculum.

In view of the agreement of the findings of the two instruments from the data collected from the two respondents, the levels by Rogan and Grayson (2003), and the ratings developed for this section of the study, my findings can be regarded as trustworthy.

Below follows a summary in table from of assessment as an essential feature for the curriculum.

TABLE 6.5: Assessment, respondents, Rogan and Grayson's (2003) level and implementation evaluation rubric

ASSESSMENT		
RESPONDENT	**ROGAN AND GRAYSON LEVEL**	**IMPLEMENTATION EVALUATION RUBRIC**
THABANG	**Level 3** **Reason:** Opportunities for learner investigations were provided the practices of assessment allowed opportunities for varied assessment by the educator	**Sufficiently adequate** **Reason:** Assessment practices in the classroom were credible, reliable and valid with accountability for the technology education
THABO	**Level 1** **Reason:** technology as a process in assessment was not followed by the educator	**Insufficient** **Reason:** No learner opportunities to participate in peer assessment

6.3.2.4. Respondents 1 and 2: Materials and resources

The focus in this section of the study was guided by Dahar and Faize (2011:6) and Ramirez, Clemente, Canedo and Martin (2011:16). These authors maintain that having resources available does not guarantee educators will use them, as sometimes they do not, and this leads to wastage; and not having resources available does not mean they were never available. Divaharan, Lim and Tan (2011:1304) cited the rationale of contexts as important for authentic learning environments to provide meaningful learning.

During classroom observations, Thabang used video cassettes for his lesson. The videos were bought by Thabang for the learners to use in the school. According to Neyland (2011:162), Thabang typifies an educator who located and adapted resources to meet individual needs. During the interviews Thabang indicated that he was able to find more resources for his needs in class. In a study by Ramirez, Clement, Canedo and Martin (2012:1445) “finding for more resources” is understood as the use of resources with meaning for the learners during implementation.

Williams (2005:5,6) claims “when schools purchase instructional materials there is a danger that it will be underutilised and also used either inefficiently or unsafely unless educators are educated in its use”. Evidently Thabang’s use of resources has moved beyond “operational deficits” (Lai 2011:1268). Penuel and Yarnal (2005:7) suggest that usable tools in real classroom contexts that meet the educator’s own perceived need can be implemented successfully. A reed whistle (like the one Thabang used) is a usable tool criticised in a study by, McLellan and Nicholl (2011:80) and McGlashan (2011:247). They claim that using a reed whistle in technology teaching might lead to a fixation or limitation in design ideas and limited thinking in cognitive processes in learners.

The available resources at Thabang’s school were rated by him as high and available for teaching and learning. This was confirmed during my classroom observations where learner activities relied on the available resources (technology kit). Learners’ preferences for hands-on activities are in line with Cardon’s (2000:6) findings. Although not a focus in this study, the computers at the school used by learners were acquired through a DoE initiative. (Gauteng on line) The GoL is an initiative to supply all secondary schools with computers, but they were not used by Thabo for his technology teaching and learning activities. I asked Thabo why he did not use the lab for technology lessons and he said he did have enough time to use the lab. This reason is similar to a study by Jang and Tsai (2012:1456), who claim that educators need more time to prepare when they use innovative technology. Thabang's use of the available resources relates to the study by Ginns et al. (2005) where educators rated the adequacy high and were demanding more and better access to resources of various kinds. Thabang filled in the inventory list the researcher gave to him to complete, confirmed the availability of the resources in the school where he worked. (The inventory appears as section 2.4 in the materials and resources section of table 4.1.)

The basic infrastructure of the school buildings adequately provided for teaching technology. During the technology period, learners quickly moved to the technology classroom where Thabang was waiting. Power point presentations were used to deliver the lesson. My findings in relation to Thabang showed congruency of available resources and their use. During my observations, a video lesson presentation was presented to the learners. Thabang said: "It was important to vary classroom teaching and to stimulate learners visually." Akpinar (2008:291) and Figg and Jamani (2011:1236) claim that to meet the diverse learning needs and to improve student learning, a variety of resources and ways to differentiate and sequence technology would enhances learning. This strategy was efficient in that all the learners were attentive and were able to complete the given task based on the information from the video clip. A study by AiniArifah and Norizan (n.d) proposes that choices in software which transfer skills and stimulate thinking in learners ought to be available.

The capacity to support the innovation which Rogan and Grayson (2003) proposed, points to educators like Thabang who is supported by adequate technology equipment (technology classrooms and computers) to implement their lessons successfully. Thabang was in control of the class using the resources. The school buildings (at level 4) are in excellent condition; they are well equipped and the office has good copying facilities.

In terms of the ratings which were developed for this section of the study, Thabang is rated as sufficiently adequate in this section of the study. He uses resources other than textbooks in his classroom. The learners have sufficient apparatus. He makes optimal use of resources in his lessons. The learners can afford extra lessons outside school.

Thabo used the same classroom for technology as for other learning areas. Textbooks are his predominant resource. Thabo indicated that the school does not have adequate resources (textbooks). Thabo used the textbook as the first instructional material for learning, and his understanding of the term ‘resource’ is similar to a study by Dahar and Faize (2011:9). I asked Thabo for a further explanation of the term ‘resource’, and he again mentioned textbooks. This was not confirmed during observations as learners were using resources such as glue, pairs of scissors and charts. Electricity, textbooks and the technology tool kit were not regarded as resources, even though Thabo indicated in the inventory list that they were available in the school. (The inventory list appears as a section in materials and resources of table 4.1). The immediate school surroundings were not considered resourceful in Thabo’s school. Tins and magazines which are readily available in their school bags and old newspapers (supplied by the DoE in bundles) were left at reception, but they were not used by the educators. Mouton, Tapp, Luthuli and Rogan (1999:40) and Morrison (2005) pointed out that using old newspapers and magazines as resources is a solution to the lack of having any at all. These waste (tins) products are easily available and can be successfully used as resources.

During my second day of data collection in the school, I was asked by another educator who had a class in the science laboratory to accompany him to class. He said that ‘technology is like science’. I discovered an unpacked technology kit in the science laboratory. Upon enquiries, Thabo informed me that it was supplied during one of the workshops and brought to the school by an educator who has since left the school on promotion. A further explanation from Thabo was that he and other educators believed it was for science experiments. These findings concur favourably with the study by Hattingh, Aldous and Rogan (2007) who are of the opinion that the supply of resources must be based on the “need to have, and able to use” principle rather than as a principle suggested by the DoE. Motala (2006) expresses this notion differently saying that the supply of resources to schools is best when with the “adequacy approach” where the starting point is not what resources are available, but what resources different groups of educators and learners in different schools require. Similar findings were noted by Gaotlhobogwe (2008:343) in a Botswana study. So and Kim (2009:110) agree with the notion the authors expressed. Thabo is typical of an educator who needs the technical dimension of scaffolding to use the available tools and resources to help students learn.

According to Williams (2005:5), when schools purchase materials, there is a danger of the materials being underutilised or used inefficiently or unsafely unless educators are educated in their use. Thabo is seen as a typical educator constrained in teaching the learning area even though resources and materials are being supplied. The same findings were noted in the Kirikkaya (2009:150) study which claims that the most important of the problems experienced in implementing are problems of having insufficient materials and equipment. Rohaan, Taconis and Jochems (2009:12) and Chikasanda, Otreal-Cass and Jones (2011:372) noted similar findings in the Netherlands and Malawi studies on the availability of materials.

Rogan and Grayson’s (2003) framework of the “capacity to support innovation” is relevant to Thabo’s opinion on the aspects that support or hinder implementation. Thabo indicated the following aspects on the topic.

The buildings at Thabo’s school were rated at level 1, which Thabo regarded as inadequate. This was not confirmed during my visit in the laboratory as a technology kit was available to use. In addition, the inventory list that Thabo responded to indicated that the required resources were available at the school. Educator factors (though not a focus of this study) hindered Thabo's implementation.

According to the ratings developed for the study, Thabo is rated as adequate. The researcher can draw this conclusion, because over and above the textbooks being available to some learners, other resources were also available – however lacking and poorly managed.

A similarity between the two educators is that both used some form of materials and resources. However, the difference is the extent to which the educators exploited the use of the materials and resource to achieve the intended outcomes in the learning area curriculum. In view of the agreement of the data collected between the two respondents and the levels suggested by Rogan and Grayson (2003) and the ratings, my findings can be regarded as trustworthy.

The table below summarises the materials and resources as essential features of the curriculum.

TABLE 6.6: Materials and resources, respondents, Rogan and Grayson (2003) and implementation evaluation rubric

MATERIALS AND RESOURCES		
RESPONDENT	**ROGAN AND GRAYSON LEVEL**	**IMPLEMENTATION EVALUATION RUBRIC**
THABANG	**Level 4** **Reason:** Buildings were in excellent conditions, well equipped and with good resources in use	**Sufficiently adequate** **Reason:** Optimal use of resources during lessons and equal apparatus for all learners
THABO	**Level 1** **Reason:** Buildings were basic and the textbooks were not available to all learners	**Adequate** **Reason:** Textbooks and some resources available, however poorly managed and non -utilisation of available resources

6.4. THE CONCLUSIONS AND RECOMMENDATIONS

Two research questions guided this study. The results of the interpretations and implementations of the learning area differ widely.

6.4.1. Conclusion and recommendations in terms of research question 1

What are the educators' interpretations of the intended technology education curriculum in the General Education Phase?

In terms of research question 1 of the study, the educator from the medium resourced context adopted a definition of technology that emphasised the human attempt to deploy matter, energy and the environment. Emphasis was placed on understanding technology and its effects in the society in which learners live.

The educator from the high resourced area in relation to research question 1 adopted a “working definition” of technology. The emphasis was on development and the learners using skills for problem solving. The context also provided learners with opportunities to experience using their skills so as to appreciate their transferability in different situations.

The two educators’ interpretations of the concepts differed, which was similar to a study by Rossouw, Hacker and De Vries (2011:423). Thabang and Thabo’s understandings in terms of technology had a varied range of the concept technology. This understanding differed from the notion of technology as applied science. This finding is similar to a study in Rohaan, Tacomis and Jochems (2010:19). From the findings in relation to technology, this finding is important as it raised expectations about technology education. Their understanding impacted on technology education which is important for their implementation practices. A further investigation is recommended for this section of research study.

6.4.2. Conclusions and recommendations on essential features

How do educators implement the intended curriculum at classroom level?

6.4.2.1. Planning: conclusions and recommendations

Thabang’s preparation in planning before going to class contributed greatly to his success as a technology educator. Popoola and Odili (2011:59) support this finding in their study on educator preparation that ensures good delivery of lessons. This finding was critical and needs to be explored further on why highly effective educators who plan for teaching are more reflective and critical of themselves than less effective educators. A similar question on the role and support of the school management in planning for the learning area is important to investigate for this section of the study. Sometimes factors like having no control over the weight and extend of a teaching programme (factor beyond his control), or being unable to use the available resources (created by the educator) to help him with his planning prevent the educator from planning adequately in the medium resourced area. This section of the study provides insight into educator planning, and has created new unanswered questions of why planning for learning was not regarded as pertinent in the school. Another question which arose from this section was what role and support are provided by the school management to assist educators during planning for the learning area.

6.4.2.2. Teaching approaches and strategies: conclusions and recommendations

The educator in the high resourced area showed understanding of the teaching approaches and strategies essential feature theme in the study, as his activities in the classroom revealed maximum engagement with his learners during his lesson. In turn these activities yielded maximum learning opportunities for the learners. The educator from the high resourced area was able to break away from the traditional teaching approaches and strategies. The selected strategies created a classroom environment for learner creativity and skills envisaged for the technology learning area. Brownlee (2003:6) attested that learner creativity in the learning area of technology is affected by an educator initiative by using a variety of strategies to promote constructivism. A future study is recommended for the effects of teaching approaches and strategies on the achievement of the learners. Teaching approaches in relation to medium resourced context reflected minimal educator's engagement with strategies. The classroom environment was that of attentive learners but who did not pay full attention to the classroom activity. As a result, the educator was not able to break away from the traditional approach to teaching. This finding is significant and therefore a further study is recommended for an investigation on the effects of teaching approaches and resources on learners' achievement.

6.4.2.3. Assessment: conclusions and recommendations

The policy guidelines of the assessment essential feature were followed and implemented by the educator teaching in a high resourced area. The educator from the high resourced area showed strong background knowledge in the learning area by providing ample opportunities for learner assessment. This method of assessment in Puente, Van Eijeck and Jochems (2012:9) was seen to enhance group progress in learners. Learners' assessment portfolios and presentations matched and correlated with their understanding of the learning outcomes. As a result, the level of assessment enabled educators to identify their strengths and weaknesses. In a favourable physical environment the educator interactions with learners provided positive results for assessments. A further study is recommended for investigating the effects of assessment in relation to achievement in the learning area. The educator in the medium resourced area did not follow the policy guidelines as they were recommended for the learning area. Learners were not provided with ample opportunities for assessment. The Bassey, Akpama, Ayang, and Obeten, (2012)study recommends educator supervision for assessment, as the educator is still important to facilitate learning to avoid assessment devoid Katsioloudis and Moye (2012:21) that learners receive quality education in technology education. The physical environment was also not conducive to the recommended assessment. It is further recommended that a further study be conducted to investigate the effect of assessment in relation to the learners' achievement.

6.4.2.4. Materials and resources: conclusions and recommendations

Regarding resources and materials for the learning area, the educator from the high resourced context engaged learners with literacy as tools for capability needs. Rohaan, Taconis and Jochems (2010:25) recommend that learners find a connection between functioning, design and the use of materials from their environment. An example of a low tech instrument is a reed whistle used by the educator made from materials from the environment. The potential for learners to use hand-held devices was a construction of experiences for the learning environment essential in technology education. While this finding might be critical, it needs further exploration on the effective use of educators in the high resourced context in the development and use of effective resources and materials for teaching in the learning area. On the other hand, an educator from a medium resourced area was constrained in developing tools-literacy and capabilities in learners. A similar constraint was noted in Rohaan et al. (2010:20) in that a framework for recommended tools in technology is important, and also to specify clearly the type of tools in the curriculum. This finding is critical in this section of the study. However a further study is recommended to establish the impact of the resources on the technology learning area curriculum.

6.5. LIMITATIONS OF THE STUDY

This study's paradigm is qualitative with the aim of providing accounts of both educators' understanding and implementation practices of the technology education curriculum.

To describe the accounts adequately, a limitation on the time spent in classrooms emerged. Longer observation of classroom practices could give in greater detail and insight into classroom practices. However, such prolonged observation is a methodological choice for studies for a full masters' degree or a PhD.

With the limited period of the study, the researcher could not fully address issues, that had the lessons been recorded, help to understand the learners' utilisation of resources' in the two contexts. The use of hand-held high tech resources (a video recording) could have captured the control and use of the resources. This is critical as it could have provided insights into the differences in functionality in terms of cognitive abilities and the differences between boys and girls. The group work dynamics that were established in classes were not captured. The recording would have provided critical information that determined learners' preferences of group compositions during projects. The challenges which were experienced in learning to use tools could also have been recorded.

Functional limitation of software was also not captured. The pragmatic use and the process used in developing knowledge of the internet could have provided insights into groups. The recording could have provided an opportunity to compare the levels of involvement in the two contexts.

A conceptual limitation also resulted from the study. The concern of a theory devoid of a well-established conceptual framework could not be addressed. As a result of not having a well-established conceptual framework for the learning area, the findings of the study could not be mapped against a conceptual framework whose influence had a direct impact for the study.

6.6. Recommendations for future research

Findings from the empirical investigations have shown significant differences and similarities. The literature review was applied in the two contexts. The findings from the contexts indicated that the technology curriculum is different from the learning area. The reason is that each educator focuses on what to teach at a particular time in class. It depends on what the educator is focusing on at the time. This finding is a start and hence a recommendation of a future study in terms of how the two educators' understanding of concepts contributes to being technologically literate. This finding was similar to findings in a study by Bjurulf (2007:52). The dilemma was that learners encountered different kinds of learning in the same learning area. As a result, future research needs to look into the technology education classroom and the educators' actual teaching as recommended by Bjurulf (2007).

A further study is recommended on planning as an essential feature in the curriculum; how it has impacted on the educators and the learners' achievement of technological literacy.

A future separate study is also recommended with a specific focus on the effects of teaching approaches and strategies in the technology curriculum. The same educators would be ideal to follow in their teaching approaches used for implementation. Assessment as an essential feature has made a start in this study.

A future study is recommended with a focus on assessment in the technology curriculum to establish how the policies of the intended curriculum are used in assessment.

Materials and resource utilisation showed limitations in this section of the study. Other factors which contributed to the utilisation of resources were not established in the study. A future investigation is recommended for a specific focus on the utilisation of the materials and resources and the impact they have in the learning area.

6.7. Conclusion of the study

This section of the study presented a review of the research questions, the orientation and the problem statement. The results and findings were presented by comparing the interviews, the observations, the empirical investigation and the findings from the literature. A conclusion to the study was presented with recommendations. The limitations of the study were also discussed. Recommendations were presented in "future research" (6.6). The last section in this dissertation was presented as a summary.

APPENDIX 1

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APPENDIX 2

LIST OF ABBREVIATIONS AND ACRONYMS

DoE Department of Education

GET General Education and Training

OBE Outcomes Based Education

PATT Pupil's Attitude Towards Technology

PAS Partnership for Advanced Studies

PBL Problem based learning

APPENDIX 3

INTERVIEW SCHEDULE: 2 EDUCATORS.

1. What is your understanding of Technology?
2. What is your understanding of technology education?

PLANNING

1. Do you do year planning?
2. Do you do semester / phase planning?

Probe: How?

3. Do you do lesson or learning task planning?

Probe: How?

4. Can you perhaps show me plans that have worked best.

Probe: Why were these plans the best?

5. Show me plans that were challenging.

Probe: Why did you find those plans challenging?

TEACHING APPROACHES AND STRATEGIES

1. Do you use specific approaches for your teaching?

Probe: How?

2. Do you have a specific approach that work best for your lesson implementation?

Probe: Show me the plan if there is any.

3. Which strategy best suits you?

APPENDIX 3

INTERVIEW SCHEDULE: 2 EDUCATORS

Probe: Why?

4. Show me your strategy or approach that was a challenge.

Probe: Why?

ASSESSMENT

1. Do you do weekly or daily assessment?

Probe: How?

2. Do you do informal or formal assessment?

Probe: How?

3. Do you have written activities for your assessment?

Probe: Show me if any the plans that worked well.

4. Do you do assessment as prescribed for the technology learning area?

Probe: Why?

5. Do you provide learners opportunities to participate in peer assessment?

Probe: How?

MATERIALS AND RESOURCES AND OTHER SUPPORT

1. What resources do you have to teach the technology leaning area?

Probe: Textbooks, audio visual equipments, workshop notes and materials, photocopies?

2. Which resources do you use?

APPENDIX 3

INTERVIEW SCHEDULE: 2 EDUCATORS

Probe: Why?

3. What other resources other than what you already have do you need in order to teach the technology learning area effectively?

Probe: Why?

4. Why do resources influence your planning?

Probe: Why?

5. Do you receive support for the teaching of technology learning area?

Probe: Why?

6. What kind of support do you receive for the learning area?

Probe: From which sources?

APPENDIX 4

OBSERVATION SCHEDULE: 2 EDUCATORS

Planning

Important aspects of the lesson/ learning task	Expected competencies/ Target	Yes/no
1.1 Learning outcomes & assessment standard	Are these applicable & relevant to the learning task & learning activities?	
Researchers comments:		
1.2. Problem/ challenge	Does the educator present to learners a problem that engages and challenges them, and motivate them to solve the problem presented?	
Researcher comments:		
1.3. Organisation	Are the activities for learners stipulated in the planning?	
Researchers comments:		

APPENDIX 4

OBSERVATION SCHEDULE: 2 EDUCATORS

1. Learning approaches and strategies

2.1. Actions and questioning	Does the educator ask questions at varying levels?	
Researchers comments:		
2.2. Interactions & movements	Do all learners appear involved and interested?	
Researchers comments:		
2.3. Knowledge of educator	Is strong learning area matter knowledge of the educator evident?	
Researchers comments:		

APPENDIX 4

OBSERVATION SCHEDULE

1. Assessment

3.1. Assessment strategies	Has formal / informal assessment been planned for?	
Researchers comments:		
3.2. Assessment strategies	Is the assessment aligned with stated outcomes or assessment standards?	
Researchers comments:		
3.3. Assessment strategies	Useful, reliable, transparent, does it obtain information required.	
Researchers comments:		

APPENDIX 4

OBSERVATION SCHEDULE: 2 EDUCATORS

1. Materials & resources and other support

4.1. Learning resources	Are the learning resources relevant & appropriate for tasks? E.g. textbooks, worksheets.	
Researchers comments:		
4.2. Learning materials	Does the educator make relevant & appropriate use of available media?	
Researchers comments:		
4.3. Learning materials + resources	Was there evidence that the success of outcomes were achieved as driven by available learning materials and resources?	
Researchers comments:		

4.4. Educator support	Is the level of educator support evident in planning & executing lessons? From which sources were the support?	
Researchers comments:		

APPENDIX 5

IMPLEMENTATION EVALUATION RUBRIC

3.1 Technology as design

3.1.1 Insufficient

Does not include a curriculum as recommended for the learning area. Potgieter (1999:212). Insufficient provision of various solutions for optimum answers to satisfy needs (Eggleston,1997:26). Does not integrate thinking and action by encouraging hand and mind to work together (Ankiewicz, et al. 2001:190).

3.1.2. Sufficient

Moderately includes the curriculum recommended for the learning area Potgieter (1999:212). Adequate provision of various solutions for optimum answers to satisfy needs (Eggleston,1997:26). Moderately include integrated thinking and action by encouraging hand and mind to work together (Ankiewicz, et al. 2001:190).

3.1.3. Adequately sufficient

Optimally include curriculum as recommended for the learning area Potgieter (2004:212). Adequately sufficient provision of various solutions for optimum answers to satisfy needs (Eggleston, 1997:26). Optimally integrate thinking and action by encouraging hand and mind to work together (Ankiewicz, et al. 2001:190).

3.2. Technology as problem based

3.2.1 Insufficient

Does not offer an opportunity as an instructional method that affords authentic learning tasks (Grant, 2011:38).Does not include carefully selected and sequenced authentic problems (Walker, Recker, Robertshaw, Osen and Leary, 2011:73).

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3.2.2. Sufficient

Moderately improves students interaction with others (Liza, Adnan, Karomiah, Abdullah and Awung, 2011:3). Problem based learning environments focus on content and skills to be learned organised around actual problems (Jonassen, 2011:99).

3.2.3 Adequately sufficient

Highly developed authentic experiences for constructivist teaching practices (Park and Ertmer, 2008:249. Classroom interactions were enhanced by carefully crafted assignments (Cennamo, Brandt, Scott, Douglas and McGrath, 2011:33).

3.3. Technology as activity

3.3.1. Insufficient

Does not develop the manipulation of skills and the use of tools effectively and safely (Williams, 2001:1). Regards a view of technology as some physical, tactile thing with artefacts of particular qualities (Linder, 2000:5). Does not include objects such as tools and machines and mental knowledge or cognition of kind found in engineering sciences (Ankiewicz, et al. 2006:132).

3.3.2. Sufficient

Moderately develops the manipulation of skills and the use of tools effectively and safely (Williams, 2000:1). Moderately includes objects such as tools and machines and mental knowledge or cognition of kind found in engineering sciences (Ankiewicz, et al. 2006:132).

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3.3.3. Adequately sufficient

Adequately develops the manipulation of skills and the use of tools effectively and safely (Williams, 2000:1). Adequately includes objects such as tools and machines

and mental knowledge or cognition of kind found in engineering sciences (Ankiewicz, et al. 2006:132).

3.4. ESSENTIAL FEATURES FOR TECHNOLOGY EDUCATION.

This section of the study addresses research question two of the study.

3.4.1. PLANNING

3.4.1.1. PLANNING: QUESTION 1

The followings ratings appear in subsidiary question 1 on planning for the curriculum

3.4.1.1.1. Insufficient

No important three levels of planning as prescribed for technology indicated (DoE, 2003:1). No possible indication of formal assessment suggested for portfolio.

Year planning: Does not include, teaching, learning, assessment, clearly sequenced and paced for particular grades: number of weeks for teaching and learning, considered for organising learning programmes, learning outcomes, assessment standards and learner opportunities (DoE, 2003:44)

Phase planning: Does not provide educator with previous grade work and does not take into account external and internal factors which contribute to effective teaching (Cohen, Manion and Morrison, 2001:77). No structured, systematic arrangement of activities that promote the attainment of learning outcomes and assessment standards for a phase (DoE, 2003:2).

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3.4.1.1.2. Sufficient

Moderate planning levels with possibility of indicated formal assessment for portfolios (DoE, 2003:1)

Year planning: Includes moderate teaching, assessment, clearly sequenced for particular grades: number of weeks for teaching and learning, considered for organising learning programmes, learning outcomes, assessment standards and learner opportunities (DoE, 2003:45 and (Glatthorn, 1997:94).

Phase planning: Moderately provides educator with previous grade work (Cohen, Manion and Morrison, 2001:77). Adequate, structured, systematic arrangement of activities that promote the attainment of learning outcomes and assessment standards for a phase (DoE, 2003:2).

3.4.1.1.3. Adequately sufficient

High planning levels that include all the technology criteria.Adequate indication of formal assessment for portfolios (DoE, 2003:1).

Year planning: Sufficiently adequate teaching, learning, assessment, clearly sequenced and paced for particular grades: number of weeks for teaching and learning, considered for organising learning programmes, learning outcomes, standards and learner opportunities (DoE, 2003:45).

Phase planning: Adequate provision of educator with previous grade work (Cohen, Manion and Morrison, 2001:77). Sufficiently adequate structured, systematic arrangement of activities that promote the attainment of learning outcomes and assessment standards for a phase (DoE, 2003:2).

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3.4.1.2. PLANNING: QUESTION 2

The following ratings appear in subsidiary question 2 on planning for the curriculum.

3.4.1.2.1. Insufficient

Lesson planning: Inadequate and at times no short term planning available. Does not cover the content of technology that is to be taught: LO's and AS's. No planned educator and learner activities, resources, assessment with tools: memo, checklist and rubrics. No indicated delivery methods: educator, self, peer and group (DoE, 2003: 45).

3.4.1.2.2. Sufficient

Lesson planning: Sufficient short term planning available. Covers moderate technology that is to be taught: LO's and AS'. Moderately planned educator learner activities: resources, assessment with tools: memo, checklist, rubric. Adequate delivery methods indicated: educator, self, peer and group (DoE, 2003:45).

3.4.1.2.3. Adequately sufficient

Lesson planning task: Adequate sufficient short term planning available. Covers the entire content of technology that is to be taught: LO's and AS's. Adequately sufficient planned educator and learner activities: resources, assessment with tools: memo, checklist, rubric. Adequately sufficient delivery methods indicated: self, peer and group (DoE, 2003:45).

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3.4.1.3. PLANNING: QUESTION 3

The following ratings appear in subsidiary question 3 on planning for the curriculum.

3.4.1.3.1. Inadequate

Planned educator activities are not best suited to specifics in content and outcomes. (De Swart, et al. 2006:16).

3.4.1.3.2. Adequate

Moderate planned important educator activities suited for content specifics and outcomes (De Swart, et al. 2006:16).

3.4.1.3.3. Sufficiently adequate

Sufficiently adequate planned educator activities suited for content specifics and outcomes (De Swart, et al. 2006:16).

3.4.1.4 PLANNING: QUESTION 4

The following ratings appear in subsidiary question 4 on planning for the curriculum.

3.4.1.4.1. Insufficient

Planning does not include spelt out teaching strategies which optimally promote learning in technology education (De Swart, et al. 2006:16).

3.4.1.4.2. Sufficient

Planning includes moderate spelt out teaching strategies which optimally promote learning in technology education (De Swart, et al. 2006:16).

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3.4.1.4.3. Adequately sufficient

Adequately sufficient spelt out teaching strategies which optimally promote learning in technology education (De Swart, et al. 2006:16).

3.4.2 TEACHING APPROACHES AND STRATEGIES

3.4.2.1 TEACHING APPROACHES AND STRATEGIES: QUESTION 1

The following ratings appear in subsidiary question 1 for teaching approaches and strategies.

3.4.2.1.1 Insufficient

Not based and does not include constructivism approach as recommended for technology learning area (De Swart, Ankiewicz and Engelbrecht 2006:12). Insufficient for complementing unique requirements of technology (De Swart et al. 2006:16).Inadequate for optimal student learning (De Swart, et al. 2006:4)

3.4.2.1.2. Sufficient

Moderately based on constructivism approach as recommended for the technology learning area (De Swart, et al. 2006:12).Moderate for complementing unique requirements of technology (De Swart, et al. 2006:16). Moderately adequate for student learning (De Swart et al. 2006:4).

3.4.2.1.3. Adequately sufficient

Optimally based on constructivism approach as recommended for the technology learning area (De Swart, et al. 2006:12).Adequately sufficient for complementing unique requirements of technology (De Swart, et al. 2006:16). Adequately sufficient for student learning (De Swart, et al. 2006:4).

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3.4.2.2. TEACHING APPROACHES AND STRATEGIES: QUESTION 2

The following ratings appear in subsidiary question 2 for teaching approaches and strategies.

3.4.2.2.1. Insufficient

Does not meet the specific requirements of technology education, inappropriate modes for delivery of activity based learning: case studies, resource tasks, capability tasks (De Swart, Ankiewicz and Engelbrecht 2006:16). Not based on activities: no practical work (Rogan and Grayson, 2003:1184).

3.4.2.2.2. Sufficient

Meet moderate specific requirements for technology education with moderate modes for delivery: case studies, resource tasks (De Swart, et al. 2006:16).

3.4.2.2.3. Adequately sufficient

Adequate delivery modes: case studies, resource tasks, capability tasks, practical work (De Swart, et al. 2006:16).

3.4.2.3. TEACHING APPROACHES AND STRATEGIES: QUESTION 3

The following ratings appear in subsidiary question 3 for teaching approaches and strategies.

3.4.2.3.1. Insufficient

Talk and chalk method (De Swart, Ankiewicz and Engelbrecht, 2006:9). Do not develop expected skills. Old, no targeted specific teaching strategy. Mostly textbook strategy (Rogan and Grayson, 2003:1183).

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3.4.2.3.2. Sufficient

Moderate chalk and talk method (De Swart, et al. 2006:9). Develop moderate expected skills. Modified, targeted teaching strategy which include both textbook, lecture and demonstrations (Rogan and Grayson, 2003:1183).

3.4.2.3.3. Adequately sufficient

Talk and chalk used minimally for explaining (De Swart, et al. 2006:9). Develop entrepreneurial skills. Up to date, targeted teaching strategies. Strategies include textbook, lecture, demonstrations and effective group work (Rogan and Grayson, 2003:1183).

3.6.2.4 TEACHING APPROACHES AND STRATEGIES: QUESTION 4

The following ratings appear in subsidiary question 4 for teaching approaches and strategies.

3.4.2.4.1. Insufficient

Does not facilitate to the attainment of the intended outcomes (Maphutha, 2007:131).

3.4.2.4.2. Sufficient

Moderate facilitation to achieve the intended outcomes (Maphutha, 2007:131).

3.4.2.4.3. Adequately sufficient

Adequately sufficient facilitation to achieve the intended outcomes (Maphutha, 2007:131).

3.4.3 ASSESSMENT

The following ratings appear in subsidiary question 1 for assessment.

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3.4.3.1. ASSESSMENT: QUESTION 1

3.4.3.1.1. Inadequate

Modes of delivery of the curriculum have inappropriate assessment practices, policies and procedures for internal assessment (Maphutha, 2007:90). Written tests do not adequately cover the topics (Rogan and Grayson, 2003:1183).

3.4.3.1.2. Adequate

Rigorous, valid and reliable measures for assessment practices (Maphutha, 2007:90). Different assessment forms included: improvised apparatus and created charts (Rogan and Grayson, 2003:1184).

3.4.3.1.3. Sufficiently adequate

Modes of delivery of the curriculum have sufficiently adequate assessment policies, practices and procedures for internal assessment (Maphutha, 2007:90). Adequately sufficient forms of assessment include: improvised apparatus and created charts (Rogan and Grayson, 2003:1184).

3.4.3.2. ASSESSMENT: QUESTION 2

The following ratings appear in subsidiary question 2 for assessment

3.4.3.2.1. Inadequate

Inadequate opportunities for learners to relate concepts learned during activities. Learners do not respond and not initiate questions (Rogan and Grayson, 2003:1183).

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3.4.3.2.2. Adequate

Moderate opportunities for learners to relate concepts learned during activities. Learners moderately respond and initiate questions (Rogan and Grayson, 2003:1183).

3.4.3.2.3. Sufficiently adequate

Adequate sufficient learner opportunities which relate to concepts learned during activities (Rogan and Grayson, 2003:1183).

3.4.3.3. ASSESSMENT: QUESTION 3

The following ratings appear in subsidiary question 3 for assessment

3.4.3.3.1. Inadequate

No written activities for assessment. No learner opportunities for participation in planning and performing practical work (Rogan and Grayson, 2003:1183).

3.4.3.3.2. Adequate

Adequate activities with practical work (Rogan and Grayson 2003:1183). Targets basic knowledge and skills pertinent for technology curriculum. Sufficient learner opportunities to plan and perform written activities for practical work (Rogan and Grayson, 2003:1183).

3.4.3.3.3. Sufficiently adequate

Include more than written tests and questions guided by discovery type activities pertinent for technology education curriculum (Rogan and Grayson 2003,:1184), Major learner participation in planning and performing for practical work (Rogan and Grayson 2003,:1184).

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3.4.3.4. ASSESSMENT: SUBSIDIARY QUESTION 4

The following ratings appear in subsidiary question 4 of assessment.

3.4.3.4.1. Insufficient

Written tests that are given do not cover the prescribed technology education curriculum. Tests are not marked and promptly returned to learners (Rogan and Grayson, 2003:1183).

3.4.3.4.2. Sufficient

Written tests moderately cover the prescribed technology education curriculum. Tests are moderately marked and returned to learners (Rogan and Grayson, 2003:1183).

3.4.3.4.3. Adequately sufficient

Written tests sufficiently cover the prescribed technology education curriculum. Tests are sufficiently marked and promptly returned to the learners (Rogan and Grayson, 2003:1183).

3.4.3.5 ASSESSMENT: QUESTION 5

The following ratings appear in subsidiary question 4 of assessment.

3.4.3.5.1. Inadequate

No learner participation in peer assessment (Rogan and Grayson, 2003:1185). Learners do not create portfolios to represent their best work (Rogan and Grayson, 2003:1185

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3.4.3.5.2. Adequate

Moderate learner participation for peer assessment (Rogan and Grayson 2003:1185) Learners moderately create portfolios to represent their best work (Rogan and Grayson, 2003:1185).

3.4.3.5.3. Adequately sufficient

Adequate learner participation for peer assessment (Rogan and Grayson, 2003:1185). Learners adequately work effectively with others to create portfolios to represent their best work (Rogan and Grayson, 2003:1185.

3.4.4. MATERIALS AND OTHER RESOURCES

The following ratings appear with subsidiary questions for materials and resources.

3.4.4.1. MATERIALS AND RESOURCES: QUESTION 1

3.4.4.1.1. Inadequate

Some textbooks but not enough for all (Rogan and Grayson, 2003:1188).Lacking teaching and learning resources: computers, photocopiers.

3.4.4.1.2. Adequate

Sufficient curriculum materials (apparatus) and textbooks for all (Rogan and Grayson, 2003:1188). Sufficient teaching and learning resources: computers and photocopiers.

3.4.4.1.3. Sufficiently adequate

Adequate and available for use materials and resources other than textbooks (Rogan and Grayson, 2003:1190). Adequate teaching and learning resources: computers, photocopiers (Rogan and Grayson, 2003:1190).

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3.4.4.2 MATERIALS AND RESOURCES: SUBSIDIARY QUESTION 2

3.4.4.2.1. Inadequate

Unavailable or lacking textbooks for all the learners and educators. Unavailable or lacking technology apparatus for all the learners (Rogan and Grayson, 2003:1189).

3.4.4.2.2. Adequate

Moderately adequate textbooks for all learners and educators. Sufficient technology apparatus for all learners (Grayson and Rogan, 2003:1189).

3.4.4.2.3. Sufficiently adequate

Varying and more than a single textbook for all the learners and educators. Adequately sufficient technology apparatus for all learners and educators (Rogan and Grayson, 2003:1189).

3.4.4.3. MATERIALS AND RESOURCES: QUESTION 3

The following ratings appear in subsidiary question 3 of materials and resources.

3.4.4.3.1. Inadequate

Poor maintenance and management of resources (Maphutha, 2007:122).

3.4.4.3.2. Adequate

Adequate management and maintenance of resources Maphutha, 2007:122).

3.4.4.3.3. Adequately sufficient

Optimal use of available resources Sufficient and suitable venues for Technology. Apparatus for all learners and educators (Maphutha, 2007:122)

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3.4.4.4. MATERIALS AND RESOURCES: SUBSIDIARY QUESTION 4

The following ratings appear in subsidiary question 4 with materials and resources.

3.4.4.4.1. Inadequate

Learners cannot afford textbooks or extra lessons (Rogan and Grayson, 2003:1189).

3.4.4.4.2. Adequate

Learners moderately afford textbooks or extra lessons (Rogan and Grayson, 2003:1189).

3.4.4.4.3. Sufficiently adequate

Learners sufficiently afford textbooks and extra lessons (Rogan and Grayson).