The knowledge and cognitive process dimensions of technology teachers' lesson objectives

By

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Abstract

The knowledge and cognitive process dimensions of Technology teachers' lesson objectives

This study employs both quantitative and qualitative enquiry, which seeks to establish the nature and quality of the lesson objectives intended by Technology teachers. Technology teachers are frequently faced with the need to use technological knowledge and its methodological approaches in their development of lesson plans and in their teaching. The methodological aspect and technological knowledge of these teachers should be reflected in the framing of lesson plans containing explicit statements of lesson objectives or learning outcomes. The cognitive levels to which the objectives lead are important because of the demands placed on learners by the subject of technology. Technology inherently requires mastery of some scientific knowledge, and procedures of the technological process from needs establishment to design and fabrication of artefacts. This requires learners to achieve at the upper levels of Bloom's taxonomy. This is the important goal of education.

The purpose of this study was to investigate the knowledge and cognitive process dimensions of the lesson objectives in lesson plans of Technology teachers. These dimensions of Technology teachers' lesson objectives were mapped using the Taxonomy Table adapted from the Revised Bloom's Taxonomy.

This study used a primarily qualitative research approach, with some quantitative analysis of data. A survey research design with limited scope was used to obtain lesson plans from Technology teachers in order to establish the nature and qualities of their lesson objectives. Lesson plans were collected from 19 teachers in three districts of Mpumalanga. These lesson plans were analysed, interpreted and discussed with sampled teachers in a focus group.

With regard to the knowledge and cognitive domains of the Technology teachers' lesson objectives, findings from this study suggest that teachers tend to focus more on factual knowledge and less towards metacognitive knowledge, and operate at low-order level in the cognitive domain. In other words, technology learners are being taught factual knowledge at the low-order level of thinking. Technology teachers tend to have lesson objectives that are known only to them. This might imply that teaching in technology occurs without proper specific objectives.

Measures need to be put in place to intensify support to Technology teachers so that they realise the importance of the formulation of lesson objectives that cover all the levels in the knowledge and cognitive domains. Furthermore, Technology teachers should be encouraged to state their lesson objectives explicitly.

Key words: lesson objectives; knowledge and cognitive process dimension; taxonomy table; explicit lesson objectives; inferred lesson objectives; overt behaviour; covert behaviour; indicator behaviour; original taxonomy; revised taxonomy

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LIST OF ACRONYMS AND ABBREVIATIONS

ACE	Advanced Certificate in Education
C2005	Curriculum 2005
CAPS	Curriculum, Assessment Policy Statement
CI	Curriculum Implementer
DoE	Department of Education
FDE	Further Diploma in Education
FET	Further Education and Training
GET	General Education and Training
IDMEC	Investigate, Design, Make, Evaluate and Communicate
SES	Senior Education Specialist

Note

In this report the capitalised form, ‘Technology’, is used to indicate the school subject that was introduced into the National School Curriculum in 1998. Discussions of the human practice of technology, and the investigation and practice of educational principles that underlie both the practice and teaching of technology are written with a lowercase initial ‘t’, as ‘technology’ and ‘technology education’, respectively

CHAPTER 1 ORIENTATION TO THE STUDY

1.1 Introduction and background

This mini-dissertation reports on an investigation undertaken as a research project of limited scope for the requirements of the degree of Master in Education (Science and Technology).

Since the inception of Technology in the South African school curriculum in 1998, technology education has faced various challenges (Chisholm 2000). For example, teachers from Woodwork, Metalwork, Home Economics and Industrial Arts were generally assigned to teach Technology (Van Niekerk, Ankiewicz & De Swardt, 2010). They were expected to implement and teach Technology without being appropriately trained with regard to the content and methodological approaches of technology education (Van Niekerk et al., 2010).

The lack of proper training meant that those teachers had inadequate knowledge of the technological process (from needs analysis to design and fabrication of artefacts); procedural knowledge (of methods of investigation, techniques of design and fabrication); and scientific content knowledge as required in technological applications and technological concepts (conceptual knowledge) (Van Niekerk et al., 2010). This knowledge inadequacy has had a strong influence on the teachers' approach to content and their methodological approaches in teaching. Furthermore, Moreland and Jones (2000), in their study of assessment practices in Technology, affirmed this knowledge inadequacy, when they found that Technology teachers could give technological tasks to learners that might not be related to a suitable learning outcome. Hence, the cognitive levels of the learning outcomes that the inclusion of Technology in the school curriculum was intended to achieve, in particular the requirements of investigation, analysis, synthesis and creativity in design, might thus be unachievable, if teachers effectively demand of their learners only rote learning of limited concepts and procedures.

Consequently, this study has sought to investigate the cognitive levels of the knowledge and cognitive process dimensions of Technology lesson objectives. These lesson objectives might be explicitly expressed or implied by teachers in their lesson plans.

1.2 Rationale and purpose of the enquiry

A Department of Education report (DoE, 2003:31) stated that Technology teachers generally have a low capacity in terms of content knowledge, cognitive skills and manual skills. Together with Van Niekerk et al.'s (2010) report on the inadequacy of the teachers' Technology knowledge and methodological approaches, this suggested the need for an investigation into the framing of lesson objectives by Technology teachers and the types of cognitive levels of content knowledge, cognitive skills and manual skills technology teachers expect the learners to achieve.

In practical terms, the findings of this study yielded evidence of the degree to which learning objectives are overtly stated or covertly implied within the design of instructional activities, as well as the cognitive levels and knowledge domains that the teachers expected the learners to master as a consequence of the lessons.

This study was conducted with Grade 9 Technology teachers in Mpumalanga in districts other than the one in which the researcher works. Lesson plans of teachers of Technology at schools in three districts of Mpumalanga were sampled and analysed for this purpose.

1.3 Statement of the problem

Technology teachers are frequently faced with the need to use technological knowledge and its methodological approaches in the development of their lesson plans and in their teaching. The technological knowledge and methodological approaches of these teachers should be reflected in the lesson plans that contain explicit or implicit lesson objectives of the learning outcomes.

The cognitive levels to which the objectives lead are important because of the demands placed on learners by the subject. Technology inherently requires mastery of some scientific knowledge, and procedures of the technological process from needs establishment to design and fabrication of artefacts (DoE, 2002). For learners to operate at that mastery of scientific knowledge and technological process level, they are required to achieve at the upper levels of Bloom's Taxonomy, which is the important goal of education (Krathwohl, 2002). It has been reported (Van Niekerk et al, 2010; DoE, 2003) that few Technology teachers have been adequately trained to teach the subject, and in consequence they may be expected to resort to teaching activities that do not achieve the levels of learning required by the subject.

The nature and quality with which teachers of Technology frame the lesson objectives, cognitive levels and knowledge domains that they address need investigation. Addressing this matter was the purpose of this study.

1.4 Objectives

The purpose of this study was to investigate the knowledge and cognitive process dimensions of the lesson objectives in lesson plans of Technology teachers.

The aim was thus to establish how lesson objectives are framed or implied in the lesson plans of Technology teachers, and thus to identify the knowledge and cognitive levels that teachers expected the learners to achieve. These lesson objectives were to be classified in terms of the hierarchy of knowledge domains and cognitive process of the two-dimensional form of Bloom's Taxonomy (Krathwohl, 2002). Classified lesson objectives were to be interpreted and verified through focus group interviews as contextualised to the subject of Technology.

1.5 Research questions

The research was guided by a main research question, and four sub-questions.

1.5.1 Main research question

What are the knowledge and cognitive process dimensions of the lesson objectives framed by Technology teachers in the districts under study?

1.5.2 Sub-questions

(i) What are the lesson objectives chosen by Technology teachers as explicitly stated or implied in their lesson plans?

(ii) What is the proportion of explicit and implicit lesson objectives?

(iii) What is the distribution of the lesson objectives regarding the knowledge and cognitive dimensions on the two-dimensional Taxonomy Table?

(iv) How do the lesson objectives of Technology teachers relate to the intended outcomes of the Technology curriculum as stated by the Department of Education?

1.6 Limitations of the study

This study was conducted in Mpumalanga, in three (of four) districts: Nkangala, Ehlanzeni and Gert Sibande. Lesson plans of Technology teachers were obtained from 19 clustered sampled consenting teachers and used as official private documents (Bryman, 2004:381). The focus of this study was on the lesson objectives of each lesson plan.

The lesson objectives should cover a wide range of Technology content and include the development of higher level cognitive and process skills among learners. These requirements are expressed in the official curriculum documents made available to teachers by the Department of Education (2002). The study, however, did not address other domains that have been developed, such as the affective (Krathwohl, Bloom & Masia, 1964) and psychomotor domains (Simpson, 1966; Dave, 1970; and Harrow, 1972), but was restricted to the extended cognitive domains that emphasise intellectual content (Sharda, Romano Jr, Lucca, Weiser, Scheets, Chung & Sleezer, 2004).

The findings of the study are strictly applicable only to the three districts in which it was conducted, and are further limited to the participating teachers. To enhance its generalisability, the study should be replicated in the remaining district and other provinces.

Clustered schools within one geographical urban, township and rural area in each district were visited by the researcher to request teacher participation in this study. This left out other urban, township and rural areas because of their vast distances, which could be costly to the researcher. For this reason, this study is entirely limited to schools of those urban, township and rural areas that were visited.

1.7 Explanation of key terms

Certain key terms need to be defined in the context of this study. Definitions are given for the terms 'lesson objective', 'Taxonomy Table' (as adapted from Krathwohl, 2002) and 'metacognition'.

1.7.1 Lesson objective

With reference to lesson planning, Lemov (2010) takes a lesson objective to mean what students need to know or be able to do at the end of that lesson. Craft and Bland (2004:89), when listing elements of a lesson plan, refer to a learning objective as an outcome component. This means 'what students will be able to do or show they know at the end of instruction'. In addition, Koepke and Cerbin (2009) describe an instructional objective as a clear explanation of what learners will be able to do after they have been presented with an instruction. Furthermore, in general terms, Mager (1991:5) defines an objective as a 'description of a performance you want learners to be able to exhibit before you consider them competent. An objective describes an intended result of instruction, rather than the process of instruction itself.'

There are certain commonalities in the definitions of learning objective, outcome component, instructional objective and objective in general by these four authors in that they identify what the student should know, be able to do, show or exhibit at the end of instruction. Mager

(1991) added that what learners will exhibit is a performance that might qualify them as competent.

In this study, the behavioural action required by students after receiving an instruction will be termed 'a learning objective'. The collection of learning objectives as grouped in intention in a lesson plan is referred to as the 'lesson objectives'. For the purpose of this study, any terminology used in the collected lesson plans that refers to the intended results of that instruction will be accepted as meaning a lesson objective.

1.7.2 Taxonomy Table

Mager (1991:101) defines the term 'taxonomy' as 'a way of classifying things according to their relationships'. According to Bloom (in Krathwohl, 2002), the Taxonomy Table refers to the classification of the six major categories in the cognitive domain, namely remember, understand, apply, analyse, evaluate and create. These categories range in order from simple to complex and concrete to abstract.

The Taxonomy Table will be supplemented in this study with a knowledge dimension, which consists of factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge. In this two-dimensional Taxonomy Table, the cognitive process dimension is arranged as columns and the knowledge dimension as rows. The Taxonomy Table will be presented in Section 2.7 as Table 2.7.

1.7.3 Metacognition

The concept of 'metacognition' has been defined by a number of researchers. Mbano (2004:106) refers to metacognition as 'one's knowledge of and control of one's cognitive systems'. Pintrich (2002:219) refers to metacognitive knowledge as 'knowledge about cognition in general, as well as awareness of and knowledge about one's own cognition'. In addition, Du Toit and Kotze (2009:58) summarise metacognition as 'knowledge of cognition and the monitoring and regulation of cognitive processes'. Papaleontiou-Louca (2003:10) said metacognition essentially means 'cognition about cognition, that is, it refers to second-order cognition; thoughts about thoughts, knowledge about knowledge or reflections about actions'. The example given by Papaleontiou-Louca (2003), in an attempt to contextualise metacognition knowledge, seems to tell it all. That is, if the activity was about 'perceiving', 'understanding' or 'remembering', then metacognition would involve thinking about how one has perceived, understood or remembered (Papaleontiou-Louca, 2003). This means that during metacognition, students reflect on the activities they have done and how they did those activities.

1.7.4 Curriculum implementer/senior education specialist

Mpumalanga has four districts, namely Bohlabela, Ehlanzeni, Gert Sibande and Nkangala. Within the Department of Education, each district has about 350 schools, both primaries and secondaries. Each district has its organogram with different sub-directorate sections. The curriculum sub-directorate section has a component of departmental officials who visit schools to provide curriculum support to teachers. These department officials in Mpumalanga are referred to as curriculum implementers (CI) or senior education specialists (SES). These officials are well acquainted with schools in their districts; hence they were of a great deal of help in the identification of clustered schools offering Grade 9 in this study.

1.8 Brief chapter overviews

Chapter 1 gives the orientation to the study, and introduces the purpose, scope and intention of the research reported here.

Chapter 2 presents the literature review, reports a purposeful appraisal of literature that leads to the central conceptual framework applicable to the research, namely the cognitive and knowledge domains required by the Technology curriculum and, on analysis, provides the frame for mapping the lesson objectives as formulated by teachers.

Chapter 3 describes the research methodology used in this research, including the nature of the sample. The methodological norms that the study considered to ensure its objectivity and trustworthiness are presented. It concludes by discussing the ethical considerations that were followed in this study.

Chapter 4 focuses on data presentation, analysis and discussion, then presents the results of the research, and discusses the findings.

Chapter 5 gives the conclusions, recommendations and suggestions for further research. It concludes the study by presenting conclusions drawn from both literature and empirical data to answer the questions. Limitations of the study, its significance, and possible suggestions for future research are pointed out as the end of the chapter.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter presents a discussion of topics relevant to this study. The concept of learning objective is discussed in some depth, as are the cognitive and knowledge dimensions that form the analytical framework, that is, an adaptation of Krathwohl's (2002) extension of Bloom's Taxonomy (1956) for analysing the nature and depth of the objective set in lesson plans by teachers of this study. The motivation for undertaking this study as filling a gap in the depth of discussions that are found in the literature is argued.

The chapter culminates in a presentation of the cognitive and knowledge domains required by the technology curriculum and, on analysis, provide the frame for mapping the lesson objectives as actually formulated by teachers in the form of a conceptual framework.

2.2 Importance of objectives

Hofstee (2010) uses the metaphor of players in a game to typify the importance of an objective in every activity. He says that players know why they are playing; they also know their goal; hence they develop a plan to achieve that goal. Hofstee (2010) emphasises that, in general, in every activity, from the outset, players and participants make it clear what they want to achieve at the end of the activity, and hence are able to come up with strategies to execute that activity. Objectives for a curriculum and lessons must be set clearly at the beginning.

In addition, Lemov (2010:58) poses a question that he suggests those who practise teaching should ask themselves, 'Why are you teaching the material you are teaching?' Such a question every practising teacher might redirect to him- or herself prior to teaching. Ricker, Brown, Leeds, Leeds, Bonar, Bouton and Volgstadt (1998) advise that evaluation is more possible if the project's objectives are clearly stated at the beginning of the project. They add that the type of information in the project evaluation could be applied in any discipline, and this need for clarity of purpose also applies during lesson design and presentation.

In contrast, Gander (2006) regards learning objectives as barriers to learning. She advocates that learning objectives should be discarded in favour of a taxonomy of proficiency. Yet Lee (2006) suggests that without entirely eliminating the learning objectives, they should be improved and simplified.

Clearly, many formats can be used to establish the intended consequence of a lesson, from overt, clear and detailed statements to a table of proficiencies or competencies. In many cases, a description of assessments implies the intended level of achievement.

The following section discusses the qualities of a learning objective.

2.3. The qualities of a learning objective

Table 2.1 juxtaposes the qualities of a learning objective as viewed by various writers.

From this table, certain common aspects emerge from the writers. The objective should be specific, observable or measurable behaviour. Conveniently, the ABCD rule of measurable objectives (Ricker et al., 1998) is noted here:

A: Audience refers to the learner.

B: Behaviour refers to the action expected of the learner and this will be the verb in the formulation of the objective.

C: Conditions refers to circumstances under which the audience is expected to carry out the action.

D: Degree refers to the criteria for determining whether the objective has been met.

Stating objectives with particular emphasis on the action verb has certain benefits, which have been listed by Waller (2007:1):

For the teacher, objectives:

- ‘Define specific outcomes or competencies to be achieved in terms of skills, content mastery (knowledge), attitude, or values’.
- ‘Emphasise major points and reduce non-essential material and prioritise material efficiently’.
- ‘Provide the basis for determining or assessing when the instruction purpose has been accomplished’.

For the student, objectives:

- ‘Simplify note taking by students and assist them in organising and studying content’.

- 'Guide the students to what is expected from them and thus anticipate test items'.

The action verbs used in the formulation of objectives have been categorised into hierarchies by Krathwohl (2002). Originally Bloom, Engelhart, Furst, Hill and Krathwohl (1956), published the cognitive domain of learning, focusing on thinking. Later Krathwohl, Bloom and Masia (1964) published a taxonomy of the affective domain, which focuses on attitudes and feelings. The psychomotor domain, focusing on doing hands-on activities, was published by various writers (Simpson, 1966; Dave, 1970; and Harrow, 1972). In each domain, action verbs have been organised into hierarchical levels.

This study focuses on verbs in the cognitive domain, which might yield results showing teachers' level of technological knowledge. It is not within the scope of this study to explore the other two domains.

Table 2.1. Characteristics of learning objectives as recognised by various authors

Koepke and Cerbin (2009)	**Waller (2007)**	**Ricker, Brown, Leeds, Leeds, Bonar Bouton and Volgstadt (1998)**	**Mager (1991)**	**Spiegel (1992)**
A learning objective describes a specific measurable behaviour that the learner should perform It is narrow, specific and can be validated	Objectives are specific, observable, and measurable. Four components of an objective: the action verb, conditions, standard and the intended audience	A measurable objective should contain four pieces of information: audience, behaviour, conditions and degree	The characteristics of a useful objectives are these: • Performance (what the learner is to be able to do) • Conditions (important conditions under which the performance is expected to occur) • Criterion (the quality or level of performance that will be considered acceptable)	A good objective is one that is measurable and will contain the following four pieces: audience, behaviour, conditions and degree
Indicate what the instructor expects of the learner				
It is learner-centred, and not instructor-centred	Instructional objectives are written for the students			
State an outcome not an activity				
Be appropriate for the level of the course	Objectives are written for individual units of study			

2.4 Taxonomy Table as extended by Krathwohl: from one to two dimensions

Krathwohl (2002) has indicated that the original taxonomy (Bloom, 1956), which was used to classify curricular objectives and test items, has shown that there is an emphasis on objectives that require only recognition or recall of information. Krathwohl (2002) advises that the most important goal of education is to produce learners who show understanding in their learning, and that happens only if learners are exposed to activities that require them to operate within objectives framed in the higher levels of the cognitive domain, those ranging from 'understanding' to 'create'. Table 2.8 shows the verbs in their various hierarchies within the cognitive domain. These verbs assisted in the identification of objectives in teachers' lesson plans in this study.

Another crucial aspect in framing an objective is the subject matter content that the verbs seek to address (Krathwohl, 2002). The knowledge aspect of the Technology teachers that this study seeks to explore is embedded in the subject matter content of the learning objective. Initially, the Taxonomy Table developed by Bloom et al. (1956) and his colleagues was one dimensional, as shown in Table 2.2. The subject matter content was listed in the cognitive taxonomy under the knowledge domain level as three sub-headings, namely knowledge of specifics; knowledge of ways and means of dealing with specifics; and knowledge of universals and abstractions in a field.

During the revision of the taxonomy by Krathwohl (2002), the verb or verb phrase and the subject matter content or the noun (noun phrase) were separated to form discrete dimensions. The content was placed in the column forming the knowledge dimensions and the verb in the rows forming the cognitive process dimensions. Table 2.3 represents the cognitive process dimensions and Table 2.4 represents the knowledge dimensions.

This tells us that the lesson objectives framed by teachers in this study should contain both the verb or verb phrase and the subject matter as the noun or noun phrase in order to be classifiable in the Taxonomy Table.

Table 2.2 Structure of the original taxonomy

Domain level	Characteristics
1.0 Knowledge	1.1. Knowledge of specifics: 1.11 terminology, and 1.12 specific facts 1.2. Knowledge of ways and means of dealing with specifics. 1.21. conventions, 1.22 trends and sequences, 1.23 classifications and categories, 1.24 criteria, and 1.25 methodology 1.3. Knowledge of universals and abstractions in a field 1.31 principles and generalisations, and 1.32 theories and structures
2.0 Comprehension	2.1 Translation 2.2 Interpretation 2.3 Extrapolation
3.0 Application	
4.0 Analysis	Analysis of: 4.1 Elements 4.2 Relationships 4.3 Organisational principles
5.0 Synthesis	5.1 Production of a unique communication 5.2 Production of a plan, or proposed set of operations 5.3 Derivation of a set of abstract relations
6.0 Evaluation	6.1 Evaluation in terms of internal evidence 6.2 Judgements in terms of external criteria

Source: Krathwohl, 2002:213

Table 2.3 Structure of the cognitive process dimensions of the Revised Bloom's Taxonomy

Hierarchical level of the cognitive domain	**Actions**
Remember: Retrieving relevant knowledge from long-term memory	Recognising Recalling
Understand: Determining the meaning of instructional messages, including oral, written, and graphic communication	Interpreting Exemplifying Classifying Summarising Inferring Comparing Explaining
Apply: Carrying out or using a procedure in a given situation	Executing Implementing
Analyse: Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose	Differentiating Organising Attributing
Evaluate: Making judgement based on criteria and standards	Checking Critiquing
Create: Putting elements together to form a novel, coherent whole or make an original product	Generating Planning Producing

Source: Krathwohl, 2002:215

Table 2.4 Structure of the knowledge dimension of the Revised Taxonomy

Knowledge hierarchy	**Subcategories**
Factual knowledge: The basic elements that students must know to be acquainted with a discipline or solve problems in it	Aa. Knowledge of terminology Ab. Knowledge of specific details and elements
Conceptual knowledge: The interrelationships among the basic elements within a larger structure that enable them to function together	Ba. Knowledge of classifications and categories Bb. Knowledge of principles and generalisations. Bc. Knowledge of theories, models, and structures.
Procedural knowledge: How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods	Ca. Knowledge of subject-specific skills and algorithms Cb. Knowledge of subject-specific techniques and methods Cc. Knowledge of criteria for determining when to use appropriate procedures
Metacognitive knowledge: Knowledge of cognition in general as well as awareness and knowledge of one's own cognition	Da. Strategic knowledge Db. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge Dc. Self-knowledge

Source: Krathwohl, 2002:214

Pickard (2007) used the metaphor of a recipe to elucidate the knowledge dimensions. She likens factual knowledge to an ingredient of the recipe, and procedural knowledge to the direction or methods (or steps to follow) in the preparation of the recipe. Conceptual knowledge is present when the cook is able to replace ingredients if the need arises. Lastly, to her, metacognitive knowledge will be applicable when the cook is able to 'understand which recipe to avoid when the humidity is high' (Pickard, 2007:51). This metaphor is useful when populating objectives in the Taxonomy Table.

Technology teachers were the participants of this study. Therefore, the content of the Technology learning area represented by the knowledge dimension will be presented in Section 2.5 and detailed in Table 2.5 in general, but the content's specificity will be presented in Section 2.6.

2.5 Content as an essential feature of technology and technology education

Table 2.5 outlines the content dimension of the essential features of the subject of Technology in which the first three columns have been adapted from Reddy (Reddy et al., 2003). The last column is an adaptation to further clarify the sub-components. These essential features of Technology and Technology education are necessary since the Technology teachers' lesson objectives should be formulated within this content.

Table 2.5 Content as an essential feature of technology and technology education

Dimension	**Components**	**Sub-components**	**Details**
Content	Knowledge	Generalist	Materials, energy, power and information
		Specialist	Structures, processing, systems and control and communication
	Skills	Cognitive	Critical and creative thinking
		Psychomotor	Hands-on activities
		Other related skills	Social skills, Communication skills, Management skills (time & resources) Entrepreneurial skills
	Values and Attitudes		
	Technological capability	Technological process	Investigate, design, make, evaluate and communicate

Source: adapted from Reddy, in Reddy, Ankiewicz, De Swardt & Gross, 2003

The content and the essential features specific to Technology as suggested by Reddy et al (2003) and shown in Table 2.5 are still quite general in nature.

For the purpose of this study, the learning outcomes (LO) for the Grade 9 learner, as stipulated in the Revised National Curriculum Statement (RNCS) Grades (R– 9), Department of Education (2002), are presented in the following section to show the exact content to be covered in Grade 9.

2.6 The three learning outcomes in the technology learning area

Table 2.6 shows the learning outcomes, assessment standards and the verbs under the column labelled 'We know this when the learner ....' These headings provide the framework with which the Technology lesson objectives developed by teachers in their lesson plans can be assessed to see how far they meet the expectations of the intended curriculum.

Table 2.6 Grade 9 Learning outcomes and assessment standards (Department of Education, 2002)

Learning outcome	Assessment standard	We know this when the learner … :
1 The learner will be able to apply technological processes and skills ethically and responsibly using information and communication technology	Investigate	Examines existing products Identifies and explains problem, need or opportunity Analyses existing products Develops and performs practical testing procedures Uses a variety of available technologies and methods to locate and collect information
	Design	Writes a design brief Lists design specifications and constraints Generates a range of possible solutions Chooses a possible solution
	Make	Writes a resource list Draws a formal drawing in orthographic, oblique or isometric views Draws flow charts/diagrams Chooses and uses appropriate tools and materials. Follows safety measures when working with tools and materials
	Evaluate	Evaluates the product according to the design brief, specification and constraints and suggest possible improvements or modification Evaluates the efficiency of the plan and suggest improving future plans
	Communicates	Presents ideas (in a project portfolio) using formal drawing techniques in two-dimensional or three-dimensional sketches
2 The learner will be able to understand and apply relevant technological knowledge ethically and responsibly	Structures	Demonstrates knowledge and understanding of structures – properties of materials that affect their performance in structure Analyses (no calculations) the effect of different loads
	Processing	Demonstrates knowledge and understanding of how materials can be processed to change or improve properties
	Systems and control	Demonstrates knowledge and understanding of interacting mechanical systems and sub-systems. Demonstrates knowledge and understanding of how simple electronic circuits and devices are used to make an output respond to an input signal.
3 The learner will be able to demonstrate an understanding of the interrelationships between science, technology, society and the environment	Indigenous technology and culture	Explains how indigenous cultures in South African history have used specific materials to satisfy needs and the main reasons for the differences
	Impact of technology	Expresses some reasons that products of technology affect the quality of people's lives positively and negatively
	Bias in technology	Expresses an opinion that explains how certain groups of society might be favoured or disadvantaged by given products of technology

2.7 Conceptual framework

Tables 2.3 and 2.4 (as introduced by Krathwohl, 2002) were combined by Krathwohl (2002) to form a two-dimensional taxonomy table, which was adopted and adapted as the conceptual framework of this research and analysis. The knowledge and cognitive process dimensions of Technology teachers' lesson objectives were mapped using the Taxonomy Table adapted from the Revised Bloom's Taxonomy by Krathwohl (2002). The choice of the Taxonomy Table as a framework to this study was aided by its use by Ferguson (2002), who populated objectives of two subjects. Ferguson (2002:243) wrote that 'the Taxonomy Table has given us a new outlook on assessment and has allowed us to create assignments and projects that require students to operate at more complex levels of thinking'. Byrd (2002) has pointed out that the use of the Taxonomy Table has potential benefits. One of these benefits is that it can offer assistance with regard to reflection by the teachers on what truly is known about classroom practice and moreover what could be done to improve classroom practice.

In this study, Technology teachers' lesson objectives are analysed and classified in the two-dimensional Taxonomy Table on the continuum of low-order to high-order cognitive level, and across the knowledge levels.

Criteria to locate the cell for the objective/question/instruction within this Taxonomy Table are based on the descriptions of the cognitive process dimension shown in Table 2.3 and the knowledge dimension shown in Table 2.4, together with the technology-specific knowledge domains shown in Table 2.6 and action verbs of Table 2.8.

Explicitly stated objectives in the teachers' lesson plans that were framed in terms of subject matter content and a description of what was to be done with or to the content (Krathwohl, 2002:213) were dealt in the following manner: the subject matter content was represented by a noun or a noun phrase in the objective, and what was to be done with or to the content subject matter was represented by a verb or verb phrase (Krathwohl, 2002). Within the

Taxonomy Table, the cognitive process dimension in the columns was used to locate the verb or verb phrase, and the knowledge dimension in the rows was used to locate the type of knowledge

Table 2.7 Taxonomy Table

	COGNITIVE PROCESS					
KNOWLEDGE DIMENSION	Remember	Understand	Apply	Analyse	Evaluate	Create
Factual knowledge						
Conceptual knowledge						
Procedural knowledge						
Metacognitive knowledge						

Source: adapted from Krathwohl, 2002:215

Objectives are placed where these rows and columns intersect. Several objectives written by the teacher in the lesson plan were located in their appropriate cells in the Taxonomy Table. If objectives in the teacher's lesson plan were stated implicitly, questions or instructions framed by the teacher for a formative or diagnostic assessment were used to identify the verb or verb phrase and the noun or noun phrase, and were placed in the appropriate cell in the Taxonomy Table.

Table 2.8 Key verbs in identifying good objectives and establishing a relative 'taxonomic level' for each objective

REMEMBER	UNDERSTANDING	APPLY	ANALYSE	EVALUATE	CREATE
Cite	Arrange	Adapt	Analyse	Appraise	Arrange
Choose	Associate	Apply	Appraise	Approve	Assemble
Define	Clarify	Catalogue	Audit	Assess	Build
Label	Classify	Chart	Break down	Choose	Combine
List	Convert	Compute	Calculate	Conclude	Compile
Locate	Describe	Consolidate	Categorise	Confirm	Compose
Match	Diagram	Demonstrate	Certify	Criticise	Conceive
Name	Draw	Develop	Compare	Critique	Construct
Recall	Discuss	Employ	Contrast	Diagnose	Create
Recognise	Estimate	Extend	Correlate	Evaluate	Design
Record	Explain	Extrapolate	Criticise	Judge	Devise
Repeat	Express	Generalise	Deduce	Justify	Discover
Select	Identify	Illustrate	Defend	Prioritise	Draft
State	Locate	Infer	Detect	Prove	Formulate
Write	Outline	Interpolate	Diagram	Rank	Generate
	Paraphrase	Interpret	Differentiate	Rate	Integrate
	Report	Manipulate	Discriminate	Recommend	Make
	Restate	Modify	Distinguish	Research	Manage
	Review	Order	Examine	Resolve	Organise
	Sort	Predict	Infer	Revise	Plan
	Summarise	Prepare	Inspect	Rule on	Predict
	Transfer	Produce	Investigate	Select	Prepare
	Translate	Relate	Question	Support	Propose
		Sketch	Reason	Validate	Reorder
		Submit	Separate		Reorganise
		Tabulate	Solve		Set up
		Transcribe	Survey		Structure
		Use	Test		Synthesise
		Utilise	Uncover		
			Verify		

Source: Waller, 2007:3

The placement of these objectives/questions/instructions in the Taxonomy Table assisted in determining whether the delivery of content lay on the continuum of the cognitive process dimension (from 'remember' to 'create').

2.8 Synthesis

This chapter has presented a discussion of immediately relevant topics by various researchers on the subject of the learning objective and its potential to develop the technological knowledge and capacity of learners.

Topics were structured according to the information presented by the literature that shed light on the concept of learning objectives that were to be populated in the conceptual framework adapted from Bloom et al. (1956) by Krathwohl (2002). The importance of an objective has been discussed from the literature. The relevancy of this study has been pointed out after contrasting views of various researchers on the concept of learning objective. Hence, the qualities of a well-written learning objective were presented. The structures of the single dimension of the original Bloom's Taxonomy, and of the cognitive process dimension and knowledge dimension were also presented and discussed. These were useful in the conceptual framework of this study. Furthermore, the content of technology and its learning outcomes as encapsulated in the department's curriculum documents were presented and discussed. The content and learning outcome were important, since the noun or noun phrase, as shown by Krathwohl (2002), reflects content (subject matter) in the lesson objectives. The lesson objectives of this study should address content as contained in the learning outcomes as encapsulated in the department's curriculum documents.

This literature survey culminated in the choice and adoption of the conceptual framework that will be employed in the mapping/classification of the Technology teachers' lesson objectives. Literature has shown that it is possible to use the Taxonomy Table to yield useful results such as reflection by the teacher. The other benefits of the Taxonomy table could be to assist teachers in creating assignments and projects that encourage students to operate at higher levels of thinking.

The chapter to follow will present the design and methodology that was followed in this study.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Research design

This study used a primarily qualitative research approach, with some quantitative analysis of data. A limited survey research design was used to obtain lesson plans from Technology teachers in order to establish the nature and qualities of their lesson objectives. Lesson plans were collected from teachers at schools in three districts that were within a reasonable distance of major roads (McMillan & Schumacher, 2001). After the analysis was completed, the interpretations were discussed with a group of teachers in a focus group, through which explanations of practices and limitations were obtained from teachers.

The lesson objectives – whether explicitly stated in the lesson plans or inferred from activities or assessments described in the plans – were analysed and placed on the cognitive process dimension and along the knowledge dimension in the Taxonomy Table (Table 2.7). Data were acquired from documents in the form of Technology teachers' lesson plans. These lesson plans provided lesson objectives if they were explicitly written. If not, questions or instructions framed by the teacher in the lesson plan to guide learner activities were used to infer lesson objectives.

3.2 Research paradigm

This study was conducted using an interpretative approach, which established a picture in time and place of the kinds and levels of lesson objectives formulated by teachers of Technology in their lesson plans. It used primarily a qualitative research design with some quantitative analysis of responses. A survey research method was used to describe the frequencies of lesson objectives across the knowledge dimension and along the process dimension in the Taxonomy Table from the sampled lesson plans (McMillan & Schumacher, 2001). Data were collected by means of documents in the form of Technology teachers' lesson plans. These lesson plans provided lesson objectives directly if they were explicitly written. If not, questions or instructions framed by the teacher in the lesson plan to guide learner activities were used to infer (through interpretation) lesson objectives. To gain more meaning and understanding the lesson objectives were interpreted and discussed with the participants.

The following assumptions guided this study:

- Ontology: A relativist position was taken. This, according to Ponterotto (2005), means that multiple, constructed realities exist. Reality was assumed to be subjective and constructed by, inter alia, the participant’s experience and the social context (Ponterotto, 2005). For this reason, a variety of data sources were used, including the interpretation of sampled lesson objectives and citations from the participants in an attempt to capture different perspectives.
- Epistemology: Ponterotto (2005) posits that epistemology concerns the relationship that exists beetween the researcher, the participants and the phenomenon under study. For a rich understanding of the phenomenon under study, the researcher had several interactions with the participants. The researcher, negotiated participation and obtain consent from participants. Getting to each participant to collect lesson plans and lastly interacted by calling participants to obtain informed consent for participation in the focus group discussion. The last interaction was during the focus group discussion.

This gave the researcher a better understanding of the participants, which allowed him to better interpret the findings in the correct context.

- Methodology: The methodology refers to the process or procedures that were followed in order to conduct the study (Ponterotto, 2005). Lesson objectives were classified in the Taxonomy Table, which was used as the conceptual framework of this study. Classified lesson objectives, once interpreted, provided themes for focus group discussion. Focus group discussions were recorded, transcribed and interpreted. Using this methodology the 'lived experience', as described by Ponterotto (2005), could be captured and described.

3.3 Sample

This study was of limited scope. Hence, its population and sample were limited, and findings are not necessarily generalisable. The study was conducted in Mpumalanga in the Nkangala, Gert Sibande and Ehlanzeni districts. Technology is offered by all General Education and Training Band (GET) schools in South Africa from Grade R to Grade 9. In Grades 7–9 it is presented as a separate learning area (DoE, 2002). The schools that offer Technology as a subject are spread over urban, township and rural areas. Urban and township schools are more clustered as their catchment areas are concentrated and these are reachable. However, rural schools are scattered as their catchment areas are also scattered and these are difficult to reach.

To overcome the challenge of the large and widely dispersed population of schools in these districts (and often near-inaccessibility of some deep rural schools), cluster sampling was used (Cohen, Manion & Morrison, 2007). Cohen et al. (2007) advised that cluster sampling allows the researcher to select a specific number of schools and limit the excessive amount of time spent travelling. The cluster comprised township, rural and urban schools that were within convenient distance of the researcher. Colleagues who were curriculum implementers (subject advisors) in those districts assisted in the identification of the clustered schools.

From the three districts, 39 schools were targeted: 26 township schools, 8 rural schools, and 5 urban schools. From the clustered schools, Grade 9 Technology lesson plans, covering a wide range of content, were requested from the teachers. A total number of 39 teachers were anticipated. Each teacher was requested to provide a minimum of three lesson plans, which were expected to add up to 117 lesson plans. The researcher was able to reach these districts to deliver letters and collect lesson plans from the educators. Nineteen teachers eventually participated in the study and provided 89 lesson plans. The lesson objectives of these lesson plans were used for the quantitative phase of classification in the Taxonomy Table. For ethical and administrative purposes while classifying objectives in the Taxonomy Table, the collected lesson plans were numbered, and the teachers who supplied them are not identified.

The sample is described below and tabulated in Table 3.1 for better understanding

The clustered schools that formed the planned sample of this study were all visited by the researcher. A total of 11 urban schools were visited, although initially five schools had been intended (220%). However, only 6 of the 11 schools participated for a yield of 55%. A total of 23 township schools were visited from an intended 26 schools. Thus 88% of intended schools were visited, and 11 of the 23 schools participated (48%). Lastly, eight rural schools were targeted, but only two schools could be visited in the allocated time frame, and thus

25% of intended schools were visited and invited to participate. One rural school participated and the other one promised a response that did not actualise.

The overall number of schools that were visited was 36 of the 39 expected, which gave a 92% realisation. Nineteen schools participated, which represents 46% of the schools that were invited. Table 3.1 presents the distribution of the sample members per district and gives the number of lesson plans provided by each participant.

Table 3.1 presents the actualisation of the sample. In the three districts, the total number of schools offering Technology in Grade 9 is 477. The number of schools targeted was 39, but the researcher was able to reach 36. More than twice as many urban schools were visited because of their proximity. More township schools were visited than rural schools and almost half participated. The scattered nature of rural schools limited the researcher's ability to reach them, hence the small number.

Ultimately, 89 lesson plans were provided by 19 participating teachers, though one participant's lesson plans were not included in the analysis as the participant was not available during collecting, but was interested in joining the focus group.

After this phase, which consisted of a limited survey, lesson objectives were classified according to their characteristics in the Taxonomy Table. From these clustered lesson objectives, purposive sampling was conducted for a further qualitative phase. Clustered lesson objectives had different quantities. From these quantities, the researcher purposefully used his judgement (one lesson objective per cell or at most two, if the cell contains more than four objectives) to select a representative sample of lesson objectives for qualitative purposes (Babbie, 2005:189). The framing of the lesson objectives by teachers is interpreted and discussed in Section 4.5

Table 3.1 Distribution of the schools that participated

DISTRICT	**CODES USED FOR THE SCHOOL**			**Number of PARTICI-PANTS**	**Number of LESSON PLANS**
	Urban (U)	Township (T)	Rural (R)		
Nkangala	School UA			1	4
		School TA		1	4
		School TB		1	3
		School TC		1	4
		School TD		1	3
		School TE		1	4
		School TF		1	5
	School UB			1	Book
TOTAL	2	6		8	27 + BOOK
Ehlanzeni			School RA	1	
		School TG		1	15
		School TH		1	3
		School TI		1	4
			School RB	1	3
	School UC			1	3
TOTAL	1	3	2	6	31
Gert Sibande	School UD			1	4
	School UE			1	3
	Scholl UF			1	9
		School TJ		1	4
		School TK		1	16
TOTAL	3	2		5	36
G. TOTAL	6	11	2	19	89
NUMBERS TARGETED	5	26	8	39	135
SCHOOLS VISITED	11	23	2	36	
ACTUAL NUMBERS	6	11	2	19	94
Total number of schools offering Grade 9 Technology in each district:					
Nkangala	172				
Ehlanzeni	165				
Gert Sibande	140				
TOTAL	**477**				

The researcher requested some teachers to participate in a focus group discussion format in which his interpretations of the framing of the lesson objectives were validated, and explanations were obtained from participating teachers.

3.4 Data collection

3.4.1 Document analysis

The researcher carried out a document analysis of the lesson objectives contained in the teachers' lesson plans. Lesson plans were regarded as private official documents that were produced and kept by the teacher (Bryman, 2004). This implied that these documents were not available in the public domain and consequently ethical procedures were required to access them. Permissions were sought from Mpumalanga Department of Education, the schools and the teachers who would provide those lesson plans voluntarily.

3.4.2 Focus group

Cohen et al. (2002:288) write that ‘Focus groups are contrived settings, bringing together a specifically chosen sector of the population to discuss a particular given theme or topic, where the interaction with the group leads to data and outcomes.’ Participants of the focus group for this study were chosen on the basis of availability and proximity of the venue from the population of participants who provided lesson plans. Each participant gave explicit consent to attend the focus group.

3.5 Data analysis

The semi-quantitative phase utilised counted statistics: lesson objectives were analysed and classified in the Taxonomy Table using the criteria in the conceptual framework. The researcher then counted the number of classifications in each row or column to determine their frequency of occurrence. Classified lesson objectives in the Taxonomy Table were also analysed by the manner in which they were distributed and clustered.

Purposefully sampled lesson objectives from the clustered lesson objectives were interpreted for qualitative purposes. Interpretation focused on how Technology teachers frame lesson objectives on knowledge and cognitive process dimensions. The ABCD rule, described in Section 2.3 for measurable objectives, assisted in the interpretation of these lesson objectives.

The last stage of data analysis included a focus group discussion. In this forum the interpretations by the researcher of the purposefully sampled lesson objectives were used as themes or topics to structure the discussion. The researcher audio-recorded the proceedings and transcribed them for further analysis. This was used to validate the researcher's interpretations through comparison with the inputs of the participants.

3.6 Methodological norms

This study used mainly a qualitative and some quantitative research designs. The standards of rigour shown in Table 3.2 were used to ensure the objectivity and trustworthiness of this study.

Table 3.2 Standards of rigour for research

Quantitative research	Qualitative research	Issue addressed
Internal validity	Credibility	Truth value
External validity	Transferability	Generalisability
Reliability	Dependability or trustworthiness	Consistency
Objectivity	Confirmability	Neutrality

Source: Ary, Jacobs & Sorensen, 2010

Internal validity (quantitative research): The conclusion to be drawn from the quantitative phase of this study was to be based only on the frequencies of the lesson objectives as classified in the Taxonomy Table (Bryman, 2004:28). Of the categories of evidence used to establish validity listed by Ary et al. (2010), three were applicable to this study. The Taxonomy Table was content related as it was representative of the knowledge and cognitive dimensions, which were also construct related and it really measured those constructs. The other category was criterion related (concurrent), and the Taxonomy Table used by Krathwohl (2002), Ferguson (2002) and Airasian and Miranda (2002) was employed in this study.

Credibility (qualitative research): 'How congruent are the findings with reality?' (Shenton, 2004:64). Credibility, according to Ary et al. (2010), related to the truthfulness of the findings. These methods, strategies and evidence were employed in this study to enhance the qualitative phase credibility:

- Lesson objectives from different groups of schools were classified in the Taxonomy Table.
- The researcher's status was independent in those districts.
- Discrepancies encountered in this study were acknowledged in the final report.

- Permission from school managers and consent letters from teachers added to the credibility of this study and proved that it was legitimate.
- Structural corroboration was obtained through the use of multiple data sources.
- Referential or interpretive adequacy was catered for through member checks by allowing participants to verify the accuracy of the transcripts of the tape recording.

External validity (quantitative research): The results of this study are not to be generalised beyond Mpumalanga, and will apply strictly to the three districts where samples were selected (Bryman, 2004:29).

Transferability (qualitative research): Ary et al. (2010:501) define transferability as 'the degree to which the findings of a qualitative study can be applied or generalised to another context or to other groups. Shenton (2004:69) indicated that in qualitative terms, transferability of findings lies with practitioners and readers. To achieve this, sufficient contextual information is given about where data were collected. Within this study, three districts participated, the numbers of schools were provided, the numbers of lesson plans and lesson objectives were supplied and data were collected during the period of April 2012–September 2012. This information might assist practitioners and readers to make judgements about similarity and consequently transferability (Ary et al., 2010).

Reliability (quantitative research): This means that 'if the same instrument were given to the same people under the same circumstances, but at a different time, to what extent would they get the same scores' (Punch, 2006:95). It is believed that if the Taxonomy Table employed in this study were to be used on the same sample at a different time, it should yield the same results. Reliability of this study's results was assisted by the descriptions and explanations of reliability by Ary et al. (2010). Ary et al. (2010) advised that the degree of reliability of a measure depends on the extent to which the results will be used. The greater the use, the greater the reliability of the measure is needed. The researcher had to consider some of the factors affecting reliability, as suggested by Ary et al. (2010). The ability level of participants in the focus group with an ACE qualification in Technology was such a factor.

Dependability (qualitative research): Most factors discussed under credibility apply here. In qualitative research, dependability is seen as the degree to which variation can be tracked or explained (Ary et al., 2010). This study primarily used documents as sources of data. To ensure dependability on the aspect of audit trails, all raw data are well kept and organised in a retrievable form (Ary et al., 2010). Furthermore, dependability has been ensured by recording all processes and procedures followed in this study.

Objectivity (quantitative research): Lesson objectives have been classified in the Taxonomy Table, an instrument that had only some dependence on the researcher's skill and perception.

Confirmability (qualitative research): The researcher has to guard that his personal values, theoretical inclinations, bias, his own predispositions and his preferences do not sway the conduct of the research and the findings derived from it. Lesson objectives were discussed on the basis of how they were framed by teachers. That was enhanced by triangulation with information derived from the focus group. The main focus here was the neutrality of the researcher.

3.7 Ethical considerations

The ethical process of the University of Pretoria's Faculty of Education requires all its researchers to adhere to ethical procedures of research. The clearance certificate is included on page iii.

McMillan and Schumacher (2001:420) point out certain issues that require ethical consideration in research: 'informed consent, deception, confidentiality, anonymity, harm to subjects and privacy'. Cohen et al. (2007:51) advise that the researcher should plan how to gain access to, and acceptance in, the research setting. Within this study, ethical considerations were observed and followed in the following manner:

Permissions

Protocol in gaining access to the field was followed by seeking permission from Mpumalanga Province and requesting permission from the schools in which the participants were teaching. Only after letters of informed consent had been signed by the participants were lesson plans collected.

Power relations and confidentiality

The issue of power relations, as cautioned by Ferguson (2004), was addressed, since the researcher is a curriculum implementer in the Department of Education. The study was conducted in districts other than the one in which the researcher is known. This was done to avoid the element of coerciveness, which might otherwise cause participants to compromise their voluntary consent because of the status relationship of the researcher. In addition, even in these districts, fellow CIs assisted only in the identification of clustered schools and possible locations. They did not play any further role. The researcher went by himself to those schools to deliver letters of permission and consent and to collect lesson plans.

General ethical principles

Cohen et al. (2007:55) advise the inclusion, description and explanation of the following factors in the informed consent:

- The purpose, contents and procedures of the research
- Foreseeable risks and negative outcomes, discomfort and consequences and how they will be handled
- Benefits that might derive from the research
- Incentives to participate and rewards from participating
- Right to voluntary non-participation, withdrawal and re-joining the project
- Rights and obligations to confidentiality and non-disclosure of the research, participants and outcomes
- Opportunities for participants to ask questions about any aspect of the research
- Signed assents to participation'

The researcher has abided by all factors that were included in the informed consent as listed above. Discussions with prospective participants were carried in a private place for confidentiality, whether they accepted or not. The researcher assured them that the headmaster would be told that the researcher had been well attended. Prospective participants were informed that there were no incentives for participation in this research. However, there could be some snacks and drinks only when focus group discussions were conducted. The right to voluntary non-participation in, withdrawal from, and re-joining the project was assured. One participant's lesson plans were pending until the stage of analysis, but during focus group discussion she brought them and joined the proceedings.

Before getting into the field, a permission letter was obtained from the Mpumalanga Department of Education (refer to Appendix C and D). At school level, a letter to request permission from the school headmaster was submitted (Appendix E). When access was given, the researcher then contacted the Technology teacher. Consent letters from participating teachers were acquired for providing lesson plans (Appendix F) and for participating in the focus group discussion (Appendix G). All these letters are included in the appendices section.

Language of letters of consent

The teachers in Mpumalanga who are teaching in the senior phase are generally required to teach in English, and certainly the lesson plans as official private documents are generally available in English. The teachers were thus able to understand the consent letters and forms. However, the researcher was able to explain the terminology, the research and ethical guidelines to be followed in English, Afrikaans and African languages of the region. The requests for consent were formulated in English.

Confidentiality and anonymity of data

To ensure anonymity, lesson plans did not contain the name of the teacher. Lesson plans were collected by the researcher. These lesson plans and their objectives were numbered for classification in the Taxonomy Table.

3.8 Synthesis

This chapter presented the type of research that was used in this study and its research design. The interpretative research paradigm was discussed. This was followed by the description of the sample that was used in the collection of the lesson plans as the raw data of this study. Cluster sampling was the method used to identify and access the specific schools and teachers that participated in this study.

Document analysis and focus groups as means of data collection have been discussed. This was followed by clarifying how data were analysed, specifically through the classification of lesson objectives in the Taxonomy Table, interpretation of the sampled lesson objectives as placed in the Taxonomy Table, and how inputs from the focus group on those interpreted lesson objectives were conducted.

The methodological norms to ensure the objectivity and trustworthiness of the study were discussed in detail. Lastly, to assure participants of their safety in participation in this study, ethical considerations were spelt out and discussed thoroughly with them.

The next chapter presents the data and its analysis and findings are discussed.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Presentation of data

Airasian and Miranda (2002) used the two-dimensional Taxonomy Table to examine the alignment of the stated objectives, the instructional activities and the assessment of the Parliamentary Acts vignette. In their examination they found instructional activities without stated objectives, explicitly stated objectives with direct assessment, and explicitly stated objectives with instruction, but no assessment. Their experience shows what one could do with the data collected from this study.

Data in this chapter is presented as follows in three ways:

- Objectives obtained from lesson plans with explicitly stated lesson objectives are presented as placed in the Taxonomy Table.
- Inferred objectives from lesson plans where assessment activities were used to infer the lesson objectives are shown as placed in the Taxonomy Table.
- Where there are lesson plans with no lesson objectives and no assessment activities these are accounted for in the quantitative reporting as having no clear objectives.

4.1.1. Breakdown of lesson plans collected from participants

A total of 89 lesson plans were collected. Of this number only 15 (16.9%) lesson plans had explicitly stated lesson objectives. A total of 37 (41.6%) lesson plans included assessment activities from which lesson objectives could be inferred. Finally 37 (41.6%) lesson plans had neither assessment activities nor lesson objectives. In other words, objectives were neither explicit, nor could be inferred.

The 15 lesson plans with explicitly stated objectives yielded 34 lesson objectives, which are presented in Table 4.1 of Section 4.2. The 37 lesson plans without explicit objectives yielded 52 inferred objectives. In total, 67 objectives have been classified.

4.2 Analysis of explicitly stated objectives

In this section the explicitly stated lesson objectives are listed and analysed according to the two-dimensional taxonomy of Section 2.7. Table 4.1 presents the explicitly stated lesson objectives from the 15 lesson plans. The lesson objectives are quoted exactly as written by the teachers and may show language faults of some of the second-language English speakers.

It should be noted that the 15 lesson plans yielded 34 lesson objectives as it can be seen from Table 4.1. One lesson plan could have a number of lesson objectives, depending on the period and content to be covered. Such lesson plans could be taught for a long period.

Table 4.2 shows how these explicitly stated lesson objectives are broken down in preparation for classification in the Taxonomy Table as shown in Table 4.2.

Table 4.1 Explicitly stated lesson objectives from the 15 lesson plans

No.	Lesson objective
1.1	On completion of this lesson learners will be able to make their own hydraulic system + lift model and how to operate a hydraulic system
1.2	On completion of this lesson learners will be able to see how forces in a hydraulic system are transmitted
2	On completion of this lesson learners will be able to identify the control outputs with different kinds of switches • How do they work • Designed for what purpose
3.1	Learners will be able to demonstrate knowledge of indigenous preservation methods
3.2	Learners will be able to appreciate to gain ability and skill to cook, dry and test morogo (wild spinach)
3.3	Learners will be able to indicate the ability to complete a worksheet appropriately
3.4	Learners will be able to evaluate samples in terms of taste, texture and quality
3.5	Learners will be able to recognise the impact of technology development on the quality of peoples' lives
4	Learners will be able to experiment with beam bridges and find out how different lengths and materials affect bridges
5.1	The learners will be able to draw their own beam bridges and label which parts are under compression tension
5.2	Learners learn that certain shapes are stronger than others
5.3	Learners will be able to find out how width changes the load that can be carried
5.4	Learners will be able to find out which shape holds the greatest load
6.1	Learners will find out which side support the greatest the trip laid flat or turned on its side
6.2	Learners will learn different methods of making structures strong stiff and stable
6.3	They learn that certain shapes are stronger than the others
7.1	The learners will be able to answer questions related to bridges
7.2	The learners will be able to identify different kinds of bridges
8	Learners will be able to experiment with beam bridges and find out how different lengths and methods affect the performance and also testing different loads and finding out which shape holds the greatest bad
9	Learners will be able to experience widths and record their results graphically
10.1	Learners will find the strongest design
10.2	Learners will find out which side support the greatest the trip laid flat or turned on its side
10.3	They learn that certain shapes are stronger than the others
11.1	The learners will be able to answer questions related to bridges
11.2	The learners will be able to identify different kinds of bridges
12.1	List all the forces that act on structures
12.2	[List] which things cause the bridges to collapse?
12.3	[List] the functions of the structures
13.1	The learners should be able to answer questions related to bridges
13.2	The learners should be able to draw a rough sketch of different bridges
14.1	Learners must be able to identify the hardest material
14.2	Learners will do some calculations of stress
15.1	Learners will be given the different types of loads; they must be able to differentiate them
15.2	Learners will be given the different pictures and they must identify the types of loads

Table 4.2 Breakdown of the explicitly stated lesson objectives

Number of lesson objectives	Description	Percentage (%)
20	Well-stated lesson objectives populated in the Taxonomy Table	58.9
7	Lesson objectives with non-functional verbs and not populated in the Taxonomy Table	20.6
4	Repeated lesson objectives not populated in the Taxonomy Table	11.8
2	Lesson objectives with no verbs	5.9
1	Lesson objective with no subject matter content	2.9

Table 4.2 presents the breakdown of lesson objectives written by the teachers. This breakdown was necessary to select the lesson objectives (20 of them) that could easily be

populated in the Taxonomy Table, and to leave out those that do not meet the criteria. The criteria can be read in the description column.

Table 4.3 shows how the 20 (or 58.9%) well-stated lesson objectives are populated in the Taxonomy Table. The classifications of these lesson objectives are guided by the verb or verb phrase showing the cognitive level, and the noun or noun phrase showing the knowledge level, as discussed in sections 2.4 and 2.5. The other 14 (41.1%) lesson objectives were left out because of non-functional verbs, repetition of earlier objectives in the same lesson, no verbs at all, or no subject matter. Owing to the small space of the cells in the Taxonomy Table, the numbers of lesson objectives as indicated in Table 4.1 will be used during classification.

Table 4.3 An analysis of the content in technology based on explicitly stated objectives

		COGNITIVE PROCESS DIMENSION (columns)					
		Remember	Understand	Apply	Analyse	Evaluate	Create
KNOWLEDGE DIMENSION (rows)	Factual knowledge	3.5; 5.1; 12.1;	5.1; 7.2; 13.2; 14.1; 15.2		4; 8.1; 10.1		
	Conceptual knowledge		2.1;5.3		5.4;6.1;8.1	3.4	4;
	Procedural knowledge			3.1; 3.2;	14.2		1.1;
	Metacognitive knowledge						

The 20 well-stated lesson objectives during classification total 22 because two lesson objectives had verbs that appeared in two cognitive levels. Therefore, 22 lesson objectives were used in the frequency Table 4.4.

Table 4.4 Frequencies of the explicitly stated lesson objectives within the cognitive process and knowledge dimensions

Knowledge dimension (rows)	Cognitive process dimension						Frequencies of the knowledge dimension
	Remember	Understand	Apply	Analyse	Evaluate	Create	
Factual	3	5		3			11
Conceptual		2		4		1	7
Procedural			2	1		1	4
Meta-cognitive							0
Frequencies of the cognitive dimension	3	7	2	8		2	22

The information presented in Tables 4.1 to 4.4 indicates that only 58.9% of the explicitly stated lesson objectives are sufficiently well structured to be employed to answer the research sub-questions.

From Table 4.4 the frequencies of the knowledge dimension can be summarised as follows:

- Factual knowledge recorded 11 (or 50%) of lesson objectives.
- Conceptual knowledge recorded 7 (or 31.8%) of lesson objectives.
- Only 4 (or 18.2%) are recorded for objectives pertinent to procedural knowledge.
- No frequencies are recorded for the metacognitive level.

Most objectives were formulated to favour factual knowledge; there were no responses for metacognitive knowledge.

The incidence of formulation of lesson objectives by the teachers decreases as the knowledge demand increases, with no objectives requiring metacognition.

Regarding the cognitive process dimension Table 4.4 reveals the following:

- 'Remember' recorded 3 (or 13.6%) of lesson objectives.

- ‘Understand’ recorded 7 (or 31.8%) of lesson objectives.
- ‘Apply’ recorded 2 (or 9%) of lesson objectives.
- ‘Analyse’, the fourth level in the cognitive process hierarchy, recorded 8 (or 36.4%) of lesson objectives.
- No frequencies are recorded for the cognitive level ‘evaluate’.
- ‘Create’ recorded only 2 (or 9%) of lesson objectives.

Again, the low percentage of ‘create’ and the total absence of objectives that address ‘evaluate’, which are the highest levels in the cognitive process, confirm that less is done by technology teachers at these levels.

However, the fairly high percentage (36.4%) of ‘analyse’ is startling. But it was noted that this kind of analysis happened mostly on the factual and conceptual knowledge levels.

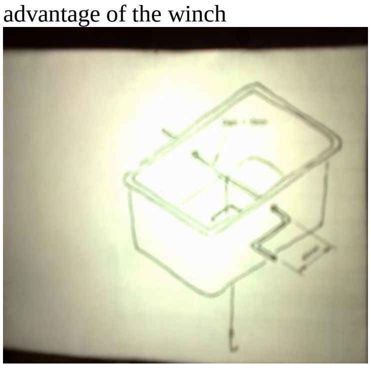
4.3 Lesson plans with assessment activities and inferred lesson objectives

In this section, lesson objectives that were inferred from stated assessment activities are reported and placed on the Taxonomy Table. The assessment activities are quoted exactly as written by the teacher and may show language faults of some of the second-language English speakers. Table 4.5 shows the assessment activities of the teachers’ lesson plans.

Table 4.5 Lesson plans with assessment activities and the inferred lesson objectives

No.	ASSESSMENT ACTIVITY	INFERRED LESSON OBJECTIVE
1	Learners should explain what they understand by tensile strength and compression force	At the end of the instruction learners must explain what is tensile strength and compression force
2	Verbally explain the spur gear, meshed, gear train, pinion, wheel, driver gear, driven gear and winch	By the end of the instruction learners must verbally explain the following concepts: spur gear, meshed, gear train, pinion, wheel, driver gear, driven gear and winch
3	What do you understand by the word pulley?	At the end of the instruction learners must define what a pulley is
4	What do you understand by: a) strength; b) stress; c)	At the end of the instruction learners will define the

No.	ASSESSMENT ACTIVITY	INFERRED LESSON OBJECTIVE
	hardness; d) stiffness; e) force?	following: strength, stress, hardness, stiffness and force
5.1	What is rust?	At the end of the lesson learners will define rust
5.2	When does it occur?	At the end of the lesson learners will state when rust occurs
5.3	How do you prevent rusting?	At the end of the instruction learners must explain how to prevent rusting
5.4	What type of materials rust that you know of?	At the end of the lesson learners must name type of materials that can rust
6	What do you understand by the term beam? Where is it usually used and for what reason? What determines the strength of a beam? What is tensile and compressive force? Does a beam is compressive or tensile force? Explain your answer	At the end of the instruction learners must be able to define a beam, mention its qualities and its uses
7	What do you know about mass? What do you understand by weight? What do you think is the difference between mass and weight?	At the end of the instruction learners must be able to define mass and weight and also mention their differences
8	When does food get spoiled? How do you prevent food from being spoiled at home? What happens when the food is spoiled?	The students must be able to tell when does food get spoiled and explain its condition after being spoiled. They should also mention methods of preserving food from being spoiled
9	Which three material do you of have equal tensile and compressive strength? Does wood have more strength in the tension or in the compression?	The students must be able to name three materials which have equal tensile and compressive strength and also tell whether wood is strong in tension or in compression
10	By cutting their structure or drawing their pictures and write their acting force to each structure	Learners must draw a structure where they will be able to show the forces acting on it
11	Find a story in a magazine or a newspaper cut and paste the story with words and identify the problem, design brief, plan and make, evaluate and communicate how you are going to solve the problem	Learners must use the technological process to solve a problem from a story found in a magazine or newspaper
12	Use hand outs given and follow instructions on the hand outs and make a toy of your choice	Following the instructions from the hand outs learners must make a toy of their choice
13.1	Investigate the purpose of packaging and provide examples of the different packages	Learners must investigate the purpose of packaging and provide examples of the different packages
13.2	Visit your local store or supermarket and investigate various packaging products. Paste the pictures of different products on a sheet; define the difference, what they are made of and how each package feels (texture)	Learners must visit local stores or supermarkets to investigate various packaging products and paste their picture on a sheet
13.3	Investigate the information on various packaging products. Select any two packages, list and explain all information found on the selected products	Learners must investigate the information on various packaging products. Select any two packages, list and explain all information found on the selected products
13.4	Look for different materials used in packaging different products. Give two reasons why each of the different products is packaged that way the particular material for packaging is used	Using different materials used in packaging different products, learners must give two reasons why each of the different product is packaged that way the particular material for packaging is used

No.	ASSESSMENT ACTIVITY	INFERRED LESSON OBJECTIVE
13.5	Capability task (project): Read the story below and follow the technological process to work out this task. Problem context: Your school is raising funds and selling different kinds of spices. Spices are delivered in sacks and you have to measure when people buy. However, this is time consuming and affects the health of some of the learners helping in this business project. Much as the community around you is supportive of the initiative, learners involved in the project are unhappy and a number of them have all kinds of excuses so as not to come to the selling station. The project leader, who is your teacher, discussed this issue with other teachers. It was then agreed that packaging these spices will help solve the problem. The suggestion was spread to all learners doing technology as well as those involved in the project. Your class was then asked to design and make packages of various sizes that could be used to pack spices. The package though, must meet the following specifications. The packages must be: cost effective, strong and reusable and have a window to can view the colour of the spice	After reading the problem context, learners must design and make packages of various sizes that could be used to pack spices. Learners must follow the technological process
14.1	What is the relationship between input/process/output. Then what drives the impact of mechanisms	At the end of the instruction learners must explain the relationship between Input/Process/Output and tell what drives mechanisms
14.2	How much cable will be pulled on the drum when the crank turns once? Then, calculate the mechanical advantage of the winch	At the end of the instruction learners must be able to calculate mechanical advantage
14.3	 This diagram shows a simple winch like the one you made at the beginning of this year. Use the systems diagram on answer sheet 2 to describe how this winch causes a difference in the distance moved by the input and output parts. Use the measurements on the diagram to calculate the difference between the distances moved by the input parts. Use these in your systems diagram	At the end of the instruction learners must be able to use systems diagram to describe how a machine works
15	SCENARIO: Read the following carefully. Molefe is a motor car mechanics who wishes to start his own business. He has found a garage with a workshop where he wants to do car service and repairs. Molefe wishes to have a modern garage with a car lift that will allow ground. He has asked you to come up with a proposal and to make a model to show what the lift might look like	Given a scenario. Learners must be able to write a proposal to the problem and make a model of the solution
16	Read the following carefully. People of Sihlangene informal settlement had seen the worst this summer. The heavy rain has flooded their houses. Some had lost their loved ones. People who are studying weather say they should expect more windy and stormy rains for the next few weeks. We need to help the Sihlangene people to protect them from the rain	When given a scenario, learners must follow the design process (Investigate, design, make, evaluate and communicate) to make a real house in order to solve the problem

	MAKES
Ask them to bring along	To mix cement and

<table>
<tr><th>No.</th><th>ASSESSMENT ACTIVITY</th><th>INFERRED LESSON OBJECTIVE</th></tr>
<tr><td></td><td><table><tr><td>cement and sand to make a real wall using the templates.
Tell them to mix cement and pour it into the templates.
Let it left to dry overnight.
Let them put the roof trusses to make a real house.</td><td>sand with water
Pour it into the templates
Let be left to dry
Learners put roof trusses on top the wall.</td></tr></table></td><td></td></tr>
<tr><td>17.</td><td>Jacob and his family live in a farm. On arriving home from school, Jacob found his mother sick in bed. He wants to make her something special. He decides to make her favourite dessert jelly for dinner. He looked in the cupboard and can only find a packet of gelatine, Ultra-Mel custard and a tin of crushed pineapple. We need to make something nice to give to Jacob's mother</td><td>When given a scenario, learners must follow the design process (investigate, design, make, evaluate and communicate) to make a dessert jelly in order to solve the problem</td></tr>
<tr><td>18</td><td>The Motlhabeng villagers have built a strong wall around their village in order to prevent unwanted people from entering the village. A very heavy gate has been installed. There is always a security guard that opens and closes the gate for those leaving and entering the village<table><tr><td>Educator's activities</td><td>Learners' activities</td></tr><tr><td>Write a scenario on the board and read it to the learners
Give them 15 min to read on their own
Give them 10 min to discuss about the scenario
Ask them to identify the problem
Ask them to write down the solution to the problem</td><td>Learners read the scenario and discuss
Ask for clarity where they don't understand
Learners write the problem statement with the design brief</td></tr></table></td><td>After reading the given scenario learners must write the problem statement with the design brief</td></tr>
<tr><td>19.</td><td>They will compare lightweight material structures and their size (mass) with very big or heavy structures. They will define mass as per unit volume</td><td>At the end of the instruction learners must compare light and heavy weight material structures and their sizes (mass) and define mass as per unit volume</td></tr>
<tr><td>20</td><td>A need around the school will be identify e.g. gate. Then the concepts: design brief, specification and constraints will be discussed under the need identified Learners will identify individual needs and follow the design and make process to solve the problem</td><td>By the end of the instruction learners must be able to identify an individual needs and follow the design process to solve the problem/need</td></tr>
<tr><td>21</td><td>Research on increasing the life-span of materials through varnishing and painting</td><td>At the end of the instruction learners must research on increasing the life-span of materials through vanishing and painting</td></tr>
<tr><td>22</td><td>Learners write a recipe they will individually follow to process raw food to processed food</td><td>At the end of the instruction learners must write a recipe they will follow to make processed food</td></tr>
<tr><td>23</td><td>Case study: sewing machine. Analysing combined mechanical systems</td><td>At the end of the instruction learners must analyse the combined mechanical systems of a sewing machine</td></tr>
<tr><td>24</td><td>What is mechanical system? What do machines do?</td><td>At the end of the instruction learners must define mechanical system and explain what machines do</td></tr>
<tr><td>25</td><td>Learners complete the system diagram of manual and electric sewing machine</td><td>After investigating different types of sewing machines, learners must complete the system diagram of manual and electric sewing machine</td></tr>
<tr><td>26</td><td>Project: Good Hope Children's Home is a home that cares for AIDS orphans. Christmas is a very sad time as they would like to give the young children presents, but unfortunately the home has no money to buy gifts for the children. Your Grade 9 Technology class decided that they would like to help the children's home by making toys to give to the children. The class</td><td>At the end of the instruction learners must design and build a toy that has moving parts and must also make a project portfolio to show all the steps they worked through</td></tr>
</table>

No.	ASSESSMENT ACTIVITY	INFERRED LESSON OBJECTIVE
	wants the toys to be interesting and special. They decided that every toy must have moving parts so that the children will enjoy playing with it. Your task: - Design and build a toy that has moving parts. Use any mechanism to change the direction or rotation and the speed of rotation. – Make a project portfolio to show all the steps you worked through. Include your design ideas, your working drawing, your model and your evaluation	
27	Project task: Design and build a structure with different levels for vehicles to park at a sport stadium	At the end of the instruction learners must design and build a structure with different levels for vehicle to park at a sport stadium.
28	Capability task: Design, make and evaluate two wooden spoons, a vanished and an unvarnished spoon that will be able to withstand steering force and be resistant to water and heat	At the end of the instruction learners must design, make and evaluate two wooden spoons, varnished band unvarnished that will be able to withstand steering force and be resistant to water and heat
29	Home activity: project about how to make biltong	At the end of the instruction learners must make biltong
30	Home activity: causes of structural failures	At the end of the instruction learners must name the causes of structural failures
31	Case study: Learners identify different types of system	After reading the case study learners must identify different types of systems
32	Class activity: To investigate the properties of materials focus: elasticity and plasticity	At the end of the instruction learners must investigate the properties of materials with regard to elasticity and plasticity
33	Learners should identify the problem from the given scenario and fill it. They should make a table and table cloth using different kinds of materials and they should follow the specifications	After reading the scenario learners must identify the problem, make a table and a table cloth using different kinds of materials and should follow the specifications
34	Activity: To investigate the properties of materials focus: ductility and malleability	At the end of the instruction learners must investigate the properties of materials with regard to ductility and malleability
35	Class activity: To investigate the properties of materials focus: hardness and toughness	At the end of the instruction learners must investigate the properties of materials with regard to hardness and toughness
36.1	Every day we see various moving objects. What causes them to move?	At the end of the instruction learners must be able to mention what causes objects to move.
36.2	Name four types of simple machines that people use in their daily lives	At the end of the instruction learners must name four types of simple machines that people use in their daily lives
36.3	Which skills are necessary for designing and making machines?	At the end of the instruction learners must name the skills necessary for designing and making machines
36.4	Explain the concept, gears	At the end of the instruction learners must explain the concept, gears
36.5	Explain in your own words what you understand by the concept, pneumatics	At the end of the instruction learners must explain in their own words what do they understand by the concept, pneumatics
36.6	Draw, design and make various types of toys, using drawing techniques and construction methods that you have studied	At the end of the instruction learners must use drawing techniques and construction methods they have studied to draw, design and make various types of toys
37.1	Activity 1: You have learned a little bit about frame, shell and solid structures. Now you have to give 10 example of each = 30 marks. Tip: Write the heading 'frame structures' and underneath it your 10 examples and so on…	By the end of the instruction learners must be able to list 10 examples of each frame, shell and solid structures
37.2	What causes structural failure? What can an architect do to design a proper building?	By the end of the instruction learners must name the causes of structural failure and also describe what an architect can do to design a proper building

The number preceding each assessment activity in table 4.5 represents the inferred lesson objective and will be used to classify these inferred lesson objectives in the Taxonomy Table as shown in Table 4.6.

Table 4.6 Analysis of content in technology based on implicitly stated (inferred) objectives

	COGNITIVE PROCESS					
KNOWLEDGE DIMENSION	**Remember**	**Understand**	**Apply**	**Analyse**	**Evaluate**	**Create**
Factual Knowledge	2;3;4;5.1;5.2 5.4;6;7;8;9; 24;30;36.1; 36.2;36.3; 37.1;37.2	1;2;5.3 13.3; 36.4; 36.5		13.1;32;34; 35	13.3	
Conceptual knowledge	7;8;9;10; 13.4;15;20; 25	31		13.2;13.3; 19;23	21	
Procedural knowledge	8;18;22	14.1; 14.3;		11;14.2;20		12;13.5;15; 16;17;26;27; 28;29;33; 36.6;13.2
Metacognitive knowledge						

A total of 37 lesson plans were used to infer lesson objectives from the assessment activities. These 37 lesson plans with assessment activities yielded 52 inferred lesson objectives. All the inferred lesson objectives were populated in the Taxonomy Table, as shown in Table 4.6. The frequencies of the inferred lesson objectives are shown in Table 4.7. These were used to answer the sub-questions of this study.

Table 4.7 Frequencies of the implicitly stated (inferred) lesson objectives within the cognitive process dimension and the knowledge dimension

Knowledge dimension	Cognitive process dimension						Frequencies of knowledge dimension
	Remember	Understand	Apply	Analyse	Evaluate	Create	
Factual	17	6		4	1		28

Conceptual	8	1		4	1		14
Procedural	3	2		3		12	20
Meta-cognitive							
Frequencies of cognitive dimension	28	9		11	2	12	62

The frequencies of the inferred lesson objectives as populated in Table 4.8 can be summarised as follows for the knowledge dimension:

- Factual knowledge recorded 28 (or 45.1%) where objectives were clustered mostly under ‘remember’
- Conceptual knowledge recorded 14 (or 22.6%) where objectives were clustered mainly under ‘remember’
- Procedural knowledge recorded 20 (or 32.3%) frequencies where objectives clustered predominantly under ‘create’
- Nothing is recorded for metacognitive knowledge

Even with the inferred lesson objectives, it seems that aspects of the metacognitive level are not taught, as was seen in explicitly stated objectives. Procedural knowledge records a substantial percentage of 32.3% and its lesson objectives clustered under ‘create’.

The frequencies of the cognitive process dimension are as follows:

- ‘Remember’ recorded 28 (or 45.2%) under factual knowledge
- ‘Understand’ recorded 9 (or 14.5%) under factual knowledge
- Nothing is recorded under ‘apply’
- ‘Analyse’ recorded 11 (or 17.7%) with objectives evenly distributed from factual to procedural

- 'Evaluate' recorded the least, which is 2 (or 3.2%) with the two objectives under factual
- 'Create' recorded 12 (or 19.4%) with all objectives clustering under procedural

'Remember' recorded the highest percentage, followed by 'create' and 'analyse'. 'Apply' did not record anything. The cognitive process dimension does not flow from low-order to high-order thinking. This might mean assessment activities are given thoughtlessly.

4.4 Interpretation of the sampled lesson objectives

Some representative lesson objectives are presented here, which were interpreted by the researcher for qualitative purposes. Cohen, Manion and Morrison (2007) said that purposive sampling is employed by researchers to choose representative samples which typically conform to certain characteristics of their choice, which will satisfy their need. The representative examples were selected from Table 4.3 on the basis that each cognitive dimension and each knowledge dimension is characterised by an appropriate lesson objective. Table 4.8 presents an example of each lesson objective, followed by a description and a brief interpretation.

Mager (1991) pointed out that the performance of a lesson objective can be overt (observable) or covert (not observable). If covert, an indicator behaviour can be added to make it overt.

Table 4.8 Analysis of sampled lesson objectives

LESSON OBJECTIVE	CELL	PERFORMANCE COVERT/OVERT (Mager, 1991)	INDICATOR BEHAVIOUR IF COVERT (Mager, 1991)
3.5 Recognises the impact of technology development on the quality of people's lives	Remember and factual knowledge	Covert	Write the solution
5.1 The learners will be able to draw their own beam bridges and label which parts are under compression and tension	Understand and factual knowledge	Overt	
14.1 Learners must be able to identify the hardest material	Understand and factual knowledge	Covert	Listing
10.1 Learners will find out which side support the greatest, the trip, laid flat or turned on its side	Analyse and factual knowledge	Covert	Showing
2 On completion of this lesson learners will be able to identify the control outputs with different kinds of switches	Understand and conceptual knowledge	Covert	Write the solution
3.4 Evaluate samples in terms of taste, texture and quality	Evaluate and conceptual knowledge	Covert	Describe in writing
4 Learners will be able to experiment with beam bridges and find out how different lengths and materials affect bridges	Analyse and factual knowledge	Covert	Experiment (write results) Find out (describe in writing)
3.1 Learners will be able to demonstrate knowledge of indigenous preservation methods	Apply and procedural knowledge	Covert	Naming
14.2a Learners will do some calculations of stress	Analyse and procedural knowledge	Overt	
14.2b On completion of this lesson learners will be able to make their own hydraulic system + lift model and how to operate a hydraulic system	Create and procedural knowledge	Overt	

Three lesson objectives, 5.1, 14.2a and 14.2b, were well framed, with directly visible behaviour, but the other seven lesson objectives did not have directly observable behaviour, hence an indicator behaviour was added. Although, according to Krathwohl (2002), all the lesson objectives complied with the rule of having a verb or verb phrase and a noun or noun phrase, the lesson objectives needed to be evaluated in terms of observable performance (Mager, 1991). The ABCD rule (audience, behaviour, condition and degree) as suggested by

Ricker et al. (1998) was evident in the lesson objectives. Although it is acceptable sometimes to omit the audience, condition and degree, behaviour should be there.

4.5 Focus group discussion

4.5.1 Demographic profile of participants of the focus group discussion

Participants of the focus group for this study were chosen from the population of the participants (thus those who provided lesson plans) as explained in Chapter 3 Section 3.3. Each participant who was invited to the focus group discussion had given explicit consent to attend the group and consent letters were signed. Pseudonyms are used for each participant because of confidentiality. Four teachers participated in the group discussion and their bio-information is presented in Table 4.9

Table 4.9 Bio-information of focus group participants

Participant	Gender	Age interval	Qualifications and majors	Years teaching technology	Other subjects teaching
Basani	Female	46–50	STD: Biology and Afrikaans ACE: Science and Technology Hons: Natural Science	4	Natural science
Nyeleti	Female	36–40	STD: Maths and Physics	6	Life Orientation
Rirhandzu	Female	46–50	STD: ACE: Technology	4	Life Orientation Arts and Culture
Tintswalo	Female	30–35	HED: Commerce ACE: Technology	5	Business Studies

Three of the participants had a qualification to teach Technology and one was from the Mathematics and Science fields. Participants' years of teaching experience in Technology range from four to six. It is assumed that the participants have at least a basic knowledge of Technology. However, this would be affirmed in the group discussion to follow.

4.5.2 Findings from the focus group discussion

Here are the findings that emerged from the focus group discussion. The full proceedings may be read in Appendix B.

All the participants agreed that a lesson plan does not contain all the details for a lesson. Instead, full details are provided in the lesson preparation notes.

- This means that if the researcher required a true reflection of what was happening in lesson planning, the researcher should have requested lesson preparation notes from the teachers, in addition to the lesson plans.
- In the lesson preparation notes, the researcher would have found lesson objectives and assessment activities.

Responding to the finding that 41.6% lesson plans do not have lesson objectives, both Nyeleti and Tintswalo said "*We don't have time [for] writing it*". Other reasons that teachers don't write lesson objectives include:

- Teachers are stressful because of overcrowded classes.

  Nyeleti: *Actually we are stressful because if you can check getting into a class the classes that I have are overcrowded.*
- Teachers have a heavy workload.

  Tintswalo said, *The workload to the teachers like myself have so many classes they are eight all of them so you know the workload and sitting down and preparing this lessons plans it takes a lot of time*.

The participants, however, did acknowledge that a lesson objective does have value.

Participants agreed that though their lesson objectives and assessment are not indicated in the lesson plan, they know what is wanted:

> Nyeleti: *Ja, we use a policy document; we do have a policy document which indicates the assessment standard and learning outcomes we are used to refer there.'*
>
> *Rirhandzu: We also look at our work schedules that we have; we do have our work schedules that we are using*.

Concerning the clustering of lesson objectives under the classes of 'factual knowledge reproduction' and 'understand', participants agreed that, whatever they claim, that to a minimal extent they do teach learners on the higher level:

> Nyeleti: *I do understand your question; to answer it for me is very difficult because most of the time since I arrived those questions are, like, that say name, give, there is no question which says explain in details, interpret this, evaluate this, no. If you have given a structure, you have to say label the structure*.
>
> Basani: *No, because sometimes [when] we teach we ask them according to factual knowledge, but sometimes we are asking questions that will provoke their thoughts, so by saying so I mean that we are using Bloom's taxonomy*.
>
> Tintswalo: *But sometimes when you are giving this assessment tasks like case study [it, the task] is application.*

To the suspicion that learners are making models without following the technological process, that is, investigate, design, make, evaluate and communicate (IDMEC), participants responded as follows:

> Nyeleti: *No, Ja, if it comes to actual making, actually we do have the project portfolio where learners must follow this technological process … before we start with the model, we must follow the technological process*.

Nyeleti denies the suspicion, but this is still doubtful because the participants cited lack of time, dealing with overcrowded classes, and teaching a number of subjects.

With regard to the minimal engagement of learners on the 'apply' level, as evident from the frequency tables, Basani commented:

> *Like in the module where we have started processing we use most of them to apply their knowledge at home and in this second module which is structures, there is very much practicals there …*

Basani commented at the end of the discussion:

> Basani: *The discussion was an eye-opener to us as educators [because it] was a wakeup call as you have mention something like factual, cognitive all those processes. So it means now as educators we are lucky to have you and discuss such things, because now we are going to rectify our mistakes and to stick on the questions like the learners apply same knowledge which is good which involves the real life.*

4.6 Discussion and findings

This section presents the findings from the explicitly stated objectives, the implied objectives and the focus group discussions. The discussion to follow will attempt to highlight the convergence or divergence of these findings in an effort to triangulate the findings. Consequently, the discussion will marshal the conclusions, recommendations and suggestions for further studies in the chapter to follow.

No frequencies were recorded for the metacognitive level from the explicitly and implied lesson objectives. In the focus group, metacognition was not discussed because of researcher's omission. Factual knowledge recorded a high percentage (45–50%) in the low–order cognitive level in both explicit and implied lesson objectives. From the focus group discussion, Basani admitted that teaching happens mostly at low-order level. This means that the distribution of lesson objectives regarding the knowledge and cognitive dimensions takes place at the lower level.

The conceptual framework as employed in the explicitly stated objectives indicated that the lesson objectives decrease as the knowledge demand increases. This was not so with the implied lesson objectives in which teachers gave assessment activities without lesson objectives. There were some variations in which factual knowledge (at 'remember' and 'understand') was high with 45.1%, followed by procedural knowledge with 32.3%, and conceptual recording 22.6%. From the focus group discussion, certain conflicting sentiments emerged from the participants, which seem to shed light on what was recorded from the implied lesson objectives. On the question of writing lesson objectives, Nyeleti and Tintswalo both confirmed that they do not have time because of overcrowded classes and workload. These sentiments might confirm the suspicion that learners are lucky to be given projects on the 'create' level. Creation of project portfolios requires time and the teachers don't have time because of stress and workload.

The frequency table of explicitly stated objectives shows a low percentage of 'create' and a total absence of 'evaluate'. The fairly high percentage of 'analyse' also happens in factual and conceptual knowledge. 'Apply' recorded a minimal percentage of 9. The frequency table of the implied lesson objectives indicates the same findings. Nothing was recorded under 'apply'. 'Evaluate' recorded 3.2% and the somehow high percentage of 19.4% on the level of 'create' is doubtful, as contested above. Basani acknowledged at the end that the discussion was helpful because they will now start to teach on higher-order level.

It is evident that the cognitive domain utilised by teachers is at low-order level and the middle-order level rarely features in their teaching and learning.

Implications of the findings to the research questions

What are the lesson objectives chosen by the Technology teachers as explicitly stated or implied in their lesson plans?

The Technology teachers' explicitly and implicitly stated objectives addressed most of the factual knowledge: 50% and 45.1%, respectively, on 'remember' and 'understand'. These were the highest in the knowledge dimension. In the focus group discussion, Basani acknowledged that they teach according to factual knowledge. Within the cognitive domain, 'analyse' was the highest at 36.4% (addressing factual and conceptual knowledge) for explicitly stated objectives and 'remember' was the highest at 45.2% (addressing factual and conceptual knowledge) for the implicitly stated objectives.

This implies that Technology teachers' lesson objectives, explicit or implicit, are framed to address mostly factual knowledge and low-order thinking.

The proportion of explicit and implicit lesson objectives:

A total of 22 (26.2%) explicitly stated lesson objectives (Table 4.3) and 62 (73.8%) implicitly stated lesson objectives were classified in the Taxonomy Table (Table 4.6). Participants in the focus group discussion complained about writing lesson plans. Meanwhile, that is where lesson objectives should be found. Participants cited the reasons of not having time because of workload and having to teach a number of subjects. It is clear from the information that in terms of proportionality, explicit lesson objectives are fewer than implicit lesson objectives.

The distribution of the lesson objectives of the knowledge and cognitive dimensions on the two-dimensional Taxonomy Table revealed the following findings:

Table 4.4 shows a frequency of 11 (or 50%) of factual knowledge of explicitly stated objective clustered in 'remember' and 'understand' of the cognitive dimension. Conceptual knowledge followed, with a frequency of 7 (or 31%), and objectives are scattered around 'apply', 'analyse' and 'create'. Frequencies drop until nothing was recorded for metacognitive knowledge. From the focus group discussion, participants acknowledged that they do teach according to factual knowledge, but sometimes on the application level. This means that the distribution of the teachers' lesson objectives is more on factual knowledge which is on 'remember' and 'understand', but scattered on the other cognitive levels, while the knowledge level diminishes. Even the factual knowledge of the implicitly stated objectives was clustered in 'remember' and 'understand'.

The extent to which the lesson objectives of teachers relate to the intended outcomes of the Technology curriculum is now described.

Procedural knowledge in the explicitly stated objectives recorded a frequency of 4 (or 18.2%) and in the implicitly stated objectives it recorded 20 (or 32.3%). Procedural knowledge related to Learning Outcome 1, which is about technological process and skills in which learners are expected to follow the IDMEC process and produce the project portfolio. During focus group discussion, participants dismissed the suspicion that 32.3% of procedural knowledge is not a guarantee that project portfolios are produced by learners during project development. These objectives are the inferred ones; teachers could be giving unplanned assessment activities, since they indicated that they don't have time. This might suggest that teachers' lesson objectives relate more to Learning Outcome 2.

CHAPTER 5 CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 Overview

This chapter summarises the conclusions of the (limited) survey research, which obtained lesson plans from Technology teachers in three of four districts of Mpumalanga and analysed the lesson objectives. Lesson plans were collected in order to establish the nature and qualities of the lesson objectives and the type of content knowledge, cognitive skills and manual or physical skills Technology teachers expect the learners to achieve, as reflected by these lesson objectives. The knowledge and cognitive skill levels addressed by the objectives were analysed, using a two-dimensional form of Bloom's Taxonomy as described by Krathwohl (2002) and adapted for the technology knowledge domain for the purposes of this study.

The chapter first presents arguments drawn from literature with regard to the applicability and structure of a learning objective. Then, the key findings drawn from the analysis and guided by the research questions are presented. The reflections by the researcher on the limitations of the study, because of sampling and methodological limitations, are also set out. This is followed by an appraisal of the usefulness of the study in its limited scope and suggestions for possible extensions to the research are disused.

A short synopsis completes the chapter.

5.2 Conclusions drawn from the literature review

Literature has shown that a well-written lesson objective should contain a verb or verb phrase that shows the performance expected of the learners (Krathwohl, 2002; Mager, 1991). It should also have a noun or noun phrase representing the subject matter content (Krathwohl, 2002). Lesson objectives populated in the two-dimensional Taxonomy Table by the researcher has been shown to favour factual knowledge and the lower level of the cognitive process dimension and some part of the higher level (Ferguson, 2002; Airasian & Miranda, 2002). No evidence of metacognitive knowledge was found, and teachers were encouraged to pursue it with their learners.

Literature has shown that Technology teachers should know the general content of Technology (Reddy et al., 2006). Within the South African context, specific content for Grade 9 and its objectives are stipulated in the department's curriculum documents (DoE, 2002).

Debates are ongoing on the elimination of learning objectives in favour of a taxonomy of proficiency (Gander, 2006). This is contested by Lee (2006), who advocates for improvement and simplification in the formulation of learning objectives. Therefore, learning objectives remain relevant.

5.3 Research study questions and key findings

This section sets out the research questions and the key findings from the empirical data. The research questions were formulated in accordance with the objective of the study, which was to investigate the knowledge and cognitive process dimensions of the technology teachers' lesson objectives. The framed or implied lesson objectives would enable the researcher to identify the knowledge and cognitive level that teachers expected the learners to achieve.

The study was guided by a main research question, namely 'What are the qualities in terms of knowledge and cognitive process dimensions of the lesson objectives framed by technology teachers?' In an attempt to answer this question, the following sub-questions had to be answered by empirical data:

i). What lesson objectives are chosen by teachers of Technology as explicitly stated or implied in their lesson plans?

From the 89 lesson plans collected, only 15 (16.9%) had explicitly stated lesson objectives. These 15 lesson plans yielded 34 lesson objectives. Only 20 (or 58.9%) were well stated; 14 (41.1%) lesson objectives had non-functional verbs, no verbs at all or no subject matter; 37 (41.6%) lesson plans had assessment activities to infer lesson objectives and the last 37 (41.6%) lesson plans had no assessment activities to even infer lesson objectives. On the other hand, from the focus group discussion, Nyeleti and Tintswalo were quick to respond on the question of lesson plans not having lesson objectives, stating that: *We don't have time for writing it* [referring to lesson objectives]. Participants cited reasons of stress because of overcrowded classes and workload. Tintswalo said: *Sometimes we don't put it* [lesson objective] *in writing, but when I go to class I know that at the end of this lesson I want to achieve this to the learners, but the lesson plan we use to write it in short*.

The low percentage (16.9%) of lesson plans with explicitly stated lesson objectives and the 83.1% of lesson plans without objectives mean that Technology teachers favour unstated lesson objectives. Therefore, technology teachers choose to have lesson objectives not explicitly stated, but known only to them.

This might mean that learners simply receive teaching whose objectives they don't know and which might hamper learners' organisation of the content and consequently fail to prepare adequately for tests.

ii) What is the proportion of explicit and implicit lesson objectives?

From the 89 collected lesson plans, 15 (16.9%) had explicitly stated lesson objectives and 37 (41.6%) had assessment activities from which one could infer lesson objectives, that is, implicitly stated lesson objectives. Explicit lesson objectives are fewer in number than implicit lesson objectives. This might suggest that most teaching in technology occurs without properly specified objectives.

iii) What is the distribution of the lesson objectives regarding the knowledge and cognitive dimensions on the two-dimensional Taxonomy Table?

Table 5.1 presents the comparison of the frequencies of explicit and implicit objectives on the knowledge dimension. This comparison has a great deal of bearing on answering the research question (above).

Table 5.1 Comparison of the frequencies of explicit and implicit objectives on the knowledge dimension

Knowledge dimension	Frequencies of explicit objectives	Frequencies of implicit objectives
Factual	11 (or 50%)	28 (or 45.1%)
Conceptual	7 (or 31.8%)	14 (or 22.6%)
Procedural	4 (or 18.2%)	20 (or 32.3%)
Metacognitive	0	0

Table 5.1 shows that factual knowledge is favoured in both explicit and implicit lesson objectives. During the focus group discussion, this was confirmed by Basani when she said: *No, because sometimes we teach them according to factual knowledge but sometimes we are asking questions that will provoke their thoughts, so by saying so, I mean that we are using Bloom's taxonomy*. From this information one could tell that the formulation of explicitly lesson objectives by Technology teachers decreases as the knowledge demand increases. The trend changed in the implicitly stated lesson objectives, where procedural knowledge recorded a better percentage. There was a suspicion that since this involves the technological process, learners were making models without following the design process. However, Nyeleti refuted the suspicion by saying: *No, ja, if it comes to actual making, actually we do have the project portfolio where learners must follow this technological process … before we start with the model, we must follow the technological process*. No evidence of metacognitive knowledge was found.

Table 5.2 Comparison of the frequencies of explicit and implicit objectives on the cognitive process dimension

Cognitive dimension	Frequencies of explicit objectives	Frequencies of implicit objectives
Remember	3 (13.6%)	28 (or 45.2%)
Understand	7 (or 31.8%)	9 (or 14.5%)
Apply	2 (or 9%)	0
Analyse	8 (or 36.4%)	11 (or 17.7%)
Evaluate	0	2 (or 3.2%)
Create	2 (or 9%)	12 (or 19.4%)

The percentage of 'remember' under implicitly stated objectives is higher than under the explicitly stated objectives. This means that teachers are assessing learners naturally at this low cognitive level, particularly where they have not gone to the effort of clearly formulating lesson objectives, and implementing appropriate assessments.

Unexpectedly perhaps, the directive to 'create' appeared more often in implicitly stated objectives than in explicitly stated objectives. The suspicion that learners may just be given projects involving construction without following the technological process may be a justified conclusion, because the participants accepted that they don't have time to write objectives, and acknowledge the further need to explicitly guide learners in the technological process as required in the curriculum. This probably means that Technology teachers don't usually sit down and do thorough planning, in spite claiming that greater details were available in their lesson planning notes – which not a single participant had offered to make available.

iv) To what extent do the lesson objectives of the lessons of Technology teachers relate to the intended outcomes of the technology curriculum as stated by the Department of Education?

The technology curriculum states three learning outcomes as has been presented in Section 2.7, Table 2.6. Learning Outcome 1 deals with the technological process (IDMEC); Learning

Outcome 2 deals with technological knowledge and understanding; and Learning Outcome 3 deals with technology, society and the environment. From the frequency tables, factual knowledge was well catered for, and this deals with Learning Outcome 2. No cognitive dimension was found in which learners were to express their opinion and reasons regarding indigenous technology, the impact of technology and bias in technology, which is Learning Outcome 3. From the focus group discussion, Basani said in her last comment: *The discussion was an eye-opener to us as educators, was a wakeup call, as you have mentioned something like factual, cognitive all those processes, so it means now as educators we are lucky to have you and discuss such things, because now we are going to rectify our mistakes and to stick on the questions like the learners apply same knowledge which is good which involves real life.*

Therefore, this may mean that the lesson objectives of the Technology teachers are related more to Learning Outcome 2 than Learning Outcomes 1 and 3. This may mean that teachers simply deliver content to learners without contextualising it as required by LO3 and also neglect the delivery mode embedded in LO 1.

5.4 Limitations of the study

The limitations of this study are discussed below, terms of sample size, data collection, research methodology and measures used to collect data.

Sample size

The study was a limited survey, conducted only in Mpumalanga, and included merely three districts, namely Nkangala, Gert Sibande and Ehlanzeni. Furthermore, only clustered schools at reachable distance were selected to participate. Rural schools at further distances were not included. This restricts the generalisability of the study. The findings of this study will therefore only be applicable to the sample that participated.

Data collection

Out of 89 lesson plans collected, only 15 had explicitly stated lesson objectives. The researcher had to sample lesson objectives from these lesson plans for interpretation and that yielded a very small number. During focus group discussion, participants advised that it could have been better if lesson preparations had been requested because they write lesson objectives in those documents. Therefore, this implies that all documents said to have been developed by Technology teachers that contain lesson objectives should have been requested.

Research methodology

The research was a limited survey. A survey in general needs a large population for generalisability. The survey was done by the researcher himself, which limited coverage and hence the results of the study could not be generalised, but were confined to the population that participated.

Measure used to collect data

During focus group discussion, the researcher omitted to include questions on metacognitive knowledge under the themes or topics selected. This would have been useful in triangulating the absence of metacognitive knowledge during the classification of explicit and inferred lesson objectives in the Taxonomy Table.

5.5 Usefulness of the study

Curriculum advisors and other teacher-support staff for Technology specifically in the districts that participated can assist teachers in addressing Learning Outcomes 1 and 3.

The findings highlight that teaching (in Technology) is generally not properly planned, but unintentionally done. Technology teachers are not in favour of explicitly stating lesson objectives, but choose to have lesson objectives known only to them. This means it could be difficult to ask someone else to assist in the Technology class if the Technology teacher is absent. Teacher – learner interaction might still be teacher oriented but not learner centred.

Technology teachers should advance their teaching from factual to conceptual, procedural and metacognitive knowledge. Technology teachers should consider teaching their learners not only in low-order thinking ('remember' and 'understand'), but move to middle-order ('apply' and 'analyse') and high-order thinking ('evaluate' and 'create').

The study, though limited, has highlighted that teaching and learning still happen at low level, whether on the knowledge or cognitive dimension. Higher education institutions through the education they provide to teachers can ensure that their pre-service teachers operate at an advanced level of knowledge and cognitive dimensions, specifically when they prepare lesson plans for teaching practice.

It becomes apparent from this study that the notion of an objective as a guiding factor to teaching and learning remains applies only at a trivial level. Teaching and learning without clear specification of objectives makes it difficult for learners to organise their studies and render them unable to prepare for tests. Gander's (2006) suggestion of shifting to the era of a taxonomy of proficiency might be internalised in a slow rate because we do not yet seem to be proficient in mastering lesson objectives.

Technology teachers rarely state explicit lesson objectives, and favour conducting teaching and learning with objectives known only to them. In the South African context, and specifically where the study was conducted, this might be the consequence of inadequate knowledge and lack of methodological approaches, which might be due to a lack of proper training. Self-regulated learning from learners will be impossible to achieve as teachers seem to fail to provide structured teaching and learning. Preparation as part of planning seems to play a major role here. Teacher education institutions should foster preparation during pre-service training, and the education system should monitor this during probation and during in-service. However, research could be done to further diagnose genuine causes of this lack of explicitness in teaching as overcrowding and lack of time, as indicated in the focus group, do not really affect preparation, which is done prior to teaching and learning.

5.6 Suggestions for possible future research

This study looked only at lesson objectives stated within the cognitive domain. Further studies can be carried out that look at lesson objectives that encompass the three domains (cognitive, affective and psychomotor). This could possibly address the concern raised by Gander (2006) that our current objectives are focusing firmly on the learning environment;

meanwhile, 'our workforce in the first decade of the 21st century … requires a complexity of multidomain behaviours across cognitive, affective, and psychomotor'. While attempting to conduct a study that encompasses the three domains, this study has revealed that in practice even the levels of the cognitive domain are still insufficiently addressed.

The study could be replicated in other provinces and use a full survey to cover a wider population in order to be able to generalise.

5.7 Closure

The purpose of this study was to investigate the qualities in terms of the knowledge and cognitive process dimensions of the lesson objectives framed by Technology teachers in the districts under study. It was found that the lesson objectives of Technology teachers focus mostly on factual knowledge and not on metacognitive knowledge. Lesson objectives emphasise low-order thinking more and waver dramatically on middle-order and high-order thinking. Teachers should be encouraged to consider preparing their teaching also at conceptual, procedural and metacognitive knowledge which may foster learners to operate at middle-order and higher-order thinking.

Few Technology teachers' lesson objectives are explicitly stated; teachers favour lesson objectives known only to them. Also, their lesson objectives relate more to Learning Outcome 2 and less to Learning Outcomes 1 and 3.

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APPENDIX A THEMES OR TOPICS FOR FOCUS GROUP DISCUSSION

1. A total of 89 lesson plans were collected. Of these, 15 (or 16.9%) lesson plans had explicitly stated lesson objectives; 37 (or 41.6%) lesson plans had only assessment activities from which lesson objectives were inferred. Finally 37 (or 41.6%) lesson plans did not have lesson objectives or assessment activities.

A total of 41.6% lesson plans had neither lesson objectives nor assessment activities from which to infer lesson objectives. Could this mean that technology teachers just get into the class and teach for the sake of teaching with no specific aim?

2. 41.6% lesson plans had assessment activities but no lesson objectives. A lesson objective seems to be of little value. Comment.

3. The 15 lesson plans yielded 34 lesson objectives. 20 lesson objectives were well stated. 7 lesson objectives had non-functional verbs (e.g. learners will be able to experience…., learners will find out….) 4 lesson objectives repeated. 2 lesson objectives with no verbs and 1 lesson objective with no subject matter. There is a decline in the quality of lesson objectives. Could this mean teachers don't know how to write lesson objectives?

4. From the 10 interpreted lesson objectives said to be well framed, only three were directly observable. Seven lesson objectives needed the addition of indicator behaviour to make them directly observable. This also shows a decline in the importance of lesson objectives. Could this be true? What could be the reason behind this apparent decline?

5. The frequencies of the **explicitly** stated lesson objectives favour factual knowledge reproduction, understand and analysis what does this mean?

6 The frequencies of the **implicitly** stated lesson objectives favour factual knowledge reproduction, remember and **create**, what does this imply?

(Could this mean that the results look better if the assessments and objectives are set only at lower levels. Does ‘create’ mean ‘reproduce’ an item that was made in the class, or shown to the class – that is, lies also at the lower level with no application of knowledge or design principles or procedural skills?)

7. Could my suspicion be right to say that during create level, learners were making models without following the technological process (**IDMEC**)?

8. Why is there so little in the ‘apply’ level of the domain?

9. What else could I as a researcher have requested from the participants which would assist more in this research?

10. Do you have any comment?

APPENDIX B FOCUS GROUP DISCUSSION PROCEEDINGS

NO	QUESTION	NYELETI	TINTSWALO	RIRHANDZU	BASANI
1.	89 lesson plans were collected. 15 (or 16.9%) lesson plans had explicitly stated lesson objectives. 37 (oe 41.6%) lesson plans had only assessment activities from which lesson objectives were inferred. Finally 37 (or 41.6%) lesson plans did not have lesson objectives or assessment activities. 41.6% lesson plans neither did have lesson objectives nor assessment activities to infer lesson objectives. Could this mean that technology teachers just get into the class and teach for the sake of teaching with no specific aim?	2. It is what we normally do and actually even if the activity itself is not there and it not indicated in the lesson plan but I will indicate let's say this textbook is study and master page ten. It does not mean we don't have objectives or what but we now what is wanted.	1. Sometimes we don't put it in writing but when I go to class I know that at the end of this lesson I want to achieve this to the learners but the lesson plan we use to write it in short		
	Follow-up. It means now what you don't want is the issue of writing it down	1.We don't have time 2. But in the lesson plan if not indicated whether if the CI can come they know I'll tell them this is what I did for they will check according to the work schedule.	1.We don't have time of writing		
	Follow-up. Those objectives which are not even written down they are implicit, one cannot see them without you telling him/her, now are they relating to what the curriculum needs how sure that it is well related to what the	1. Yah, we use a policy document, we do have a policy document which indicates the assessment standard and learning outcomes so we are used to refer there.		2. We also look at our work schedules that we have, we do have our work schedule that we are using.	

	curriculum needs?	2. It is not the same as time before, long time ago when I check the syllabus if they give you the textbook you follow the textbook as it is but in this textbook you will find the topic but it is not relevant to what you are supposed to cover according to the work schedule, so we follow the work schedule.		
2.	41.6% lesson plans had assessment activities but no lesson objectives. A lesson objective seems to be of little value. Comment			1.It does have value because you won't just teach without any aim or objective that you want to achieve at the end, so it does have the value.
	By the way you said what is all about writing it, is time factor?	1.actually we are stressful because if you can check getting into the class the classes that I have are overcrowded	2.The workload to the teachers like myself I have got so many class they are eight all of them so you know the workload and sitting down and preparing this lesson plans it takes a lot of time. But the objective does have a value.	
	But you know from what you are saying concerning you are bringing another factor even though it is not the objective of this discussion but also it has got value because it seems as if you are saying the issue of workload is another factor which makes you not to sit down and write everything down. But what about preparation that will cause you that you don't even prepare?	1.That I'm not gonna escape on it, preparation the preparation is number one.		1.I have to prepare.

Can you show it? Please tell me, what is the difference between preparation and a lesson plan?	1.Yes, we do have preparation 2.If I prepare I jot down everything what I want to say in class. 3.In a preparation book if I prepare, jot down everything what I want to say in class. It will also assist me even if I may have forgotten something if I can check on the preparation I will see everything rather than writing in a lesson plan everything, that is why I say I just refer you on this page or I will say I will cover LO number 1 Assessment Standard number 4. I don't even indicate which one in the lesson planI cannot sayI want to investigate and evaluate and do this and this but I will tell you LO number 1 you must know what is LO number 1.	1.Mm	1.Mm
Now, does it mean because you are bringing something to me If I wanted a true reflection of what is happening I should have requested preparations not lesson plans from you	1.Yes 3.Actually in terms of a lesson plan if you don't know the subject you won't interpret it but the one who is doing this subject if I can give him/her the lesson he will be able to interpret it	1.Yes 2.We are having have different resources, then you have to prepare, like myself I have a notebook for Grade 8 and 9 so when I'm going to class I'm leaving my notebook and then in the lesson plan I just summarise by giving facts I'm going to cover	1.Yes
In short you are telling me that the lesso plan is not in details what is in details is the lesson preparation. In the preparation I	1.Exactly	1.Yes	1.Yes

	can even get the activities which will be given to the learners and possibly even the lesson objective I will get it in the preparation.				
3.	The 15 lesson plans yielded 34 lesson objectives. 20 lesson objectives were well stated. 7 lesson objective had non-fuctional verbs (e.g. learners will be able to experience…, learners will find…). 4 lesson objectives repeated. 2 lesson objectives with no verbs and 1 lesson objective with no subject matter. There is a decline in the quality of lesson objective. Could this mean teachers don't know how to write lesson objectivs? (The fourth partricipant, Basani joined us and she was briefed about the decision of the other three that I should have requested lesson preparation if I wanted to get a lot of information) This decline it means with that answer is caused by what you told me that I would have got a lot of information in the preparation. (we had to skip this question)				1.Yes (she confirmed)
4	From the 10 interpreted lesson objectives said to be well framed; only 3 were directly observable. 7 lesson objectives needed an addition of indicator behaviour to make them directly observable. This also shows a decline in the importance of lesson objectives. Could this be true? What could be the reason behind this apparent	1.mm	1.mm	1.mm	1.mm

	decline? (No response from the participants until I reminded them that may be it is still the same reason that lesson preparation should have been requested – they all agreed)		
5.	The frequencies of the explicitly stated lesson objectives favoured the factual knowledge reproduction, understand and analysis, what does this mean?		1.No, because sometimes we teach we ask them according to factual knowledge but sometimes we are asking questions that will provoke their thoughts, so by saying so I mean that we are using Bloom's taxonomy
	Probing: The problem is that the lesson plans and lesson objectives collocted are clustered under factual knowledge and that tells us that what ever teachers are doing in class technology teachers what they are doing they focus more especially on factual knowledge there is no evidedence of the problem you are telling now. but what can you tell us is it happening like that because the evidence tells it like that. So earlier you said unto me you could be asking a question based on factual knowledge the other staff where these learner might show an understanding, application you are only asking it without having stated it because there will be no proof that's where lies the problem. The recent proof tells that most of the teachers are asking questions	1.I do understand your question to answer it for me is very difficult because most of the time since I arrived those questions are like that say name, give there is no question which say explain in details. Interpret this, evaluate this no. If you have given a structure you have to say label the structure	

	based on part of factual knowledge and that factual knowledge means where learners are only listing, naming there is no questions saying can you explain, can you draw				
	In short you agree with the information that it is like that	1.It is like that 2. I don't know what happened	1.Mm 3. But sometimes when you are giving this assessment tasks like case ctudy is application	1.Mm	1.Mm
6.	The frequencies of the implicitly stated lesson objectives favoured the factual knowledge reproduction, remember and create. When teachers frame objective they lie under factual knowledge but if they only give assessment activities it goes even to the '**create**' level. Why this difference				
7.	Could my suspicion be right to sat that during create level, learners were making models without following the technological process (IDMEC)?	1.No.Yah, if it comes to actual making actually we do have the project portfolio where learners must follow this technological process. They must design, they must make, they must evaluate and communicate bring different ideas and they must choose better one because if they don't use the technological precess they won't make it. Before if we give them before we start with the model we must follow the technological process.			
8.	Why is there so little in the 'apply' level of the domain?				

	Could this mean that when we are teaching learners we don't relate what we are teaching with what is happening in their real life, could I be right to suspect that?	1.As we have said before, in the lesson plan we are not indicating everything there but in a really class situation we relate this in our real life			2.Like in the module where we have started processing we use most of them to apply their knowledge at home and in this second module which is structures, there is very much practicals there because that is where we encourage them even how they going to choose their careers like electrical and mechanical work careers so it was very much practical. Is that we don't indicate in our lesson plans
9.	What else could I as a researcher have requested from the participants which would have assisted in this research?	1.As I have said that in the lesson plan you cannot get everything written down not stated clearly if you don't know the technology you cannot interpret it or you are doing another learning area it will be difficult for you to interpret that one. If maybe you have asked the preparation to answer most of the questions it would be easy.			
	We are looking at CAPS it it seems as if the Department is not talking much about lesson plans could this solve the problem of educators?	1.The lesson plan is there is that we have to prepare follow the work schedule but as we said the lesson plan is not detailled. 3. we have to plan	2.The document for CAPS is stated that this week we do this from week 1 or 2 we are doing this topic 3 and we have to prepare according to those topics. But in CAPS is always there the lesson plan.		
	My problem now is what you are telling me from the information that are discussing about a lesson plan to somebody who is not the subject cannot tell him/her anything we have come to a	2.One other thing in the lesson plan now as it is in the CAPS you can prepare a lesson plan for the whole month one lesson plan other than planning everyday other	3.To add on that a person who did not do technology cannot use my lesson plan to teach but if I give it to mam she can be able to use my lesson plan		1.It seems like that because I as educator I dwell too much on a preparation which is my work. Which thw departmental official don't need it when they come they always need

conclusion that in a lesson plan most of things are not written it is in a summary form. Now what is the importance of a lesson plan if it is like that are you writing it to satisfy because now could read that you are writing it to satisfy the systemic part of it.	writing every day for the topic and at the end of the day I have got hope of lesson plans but it would be short and omitted a lot of information			lesson plan so that is why it is in a summary form that we are doing for the sake of to comply but the work that I'm using is there in the preparation.
If somebody wants a lot of information he/she must go to a lesson preparation.		1.To add on that a person who is not doing technology cannot use my lesson to teach but if I give it to mam she can be able to use it, is that she understands everything.		
But when you say is not details will she be able to see what will be the objective here and what will be the assessment to give to learners the way you wanted it.	2.Actually we can relate this one as a MAXIT language, if you don't know how to communicate in MAXIT language you won't be able to communicate. You cannot read anything you cannot understand even a single sentence there. Technology if you define it makes our lives easy		1.I know the aims and objectives even isn'did we follow the work schedule and the policy documents and if you follow it and I know what it is that she is talking about maybe when he said mechanical system or levers I know what levers is I will be able to do even the activities based on the levers	
Now colleagues you are also telling me this I take myself as a technology teache I'm from that perspective and now you want to tell me that myself I was unable to read those lesson plan that is why I couldn't even infer just to see one thing that the objective could be like this.	1,When did you last time teach technology?			
No I ended teaching it in 2006 and at the department I'm assisting on that	1.Ok may be that we have upgraded it. We understand better than before			

But colleagues this thing should be clear there is some where, where we are doing some submission where we account as educators and now if we write lesson plans to somebody who is not familiar with the subject that person cannot interpret anything are we not liable to labelled as actually saying that what we are doing nobody can understand it except ourselves. We are technology educators we fall to certain department and find that in that the HOD in that department is not that much familiar with technology and the person request your lesson plan to see that what is it that you have prepare to teach, the person cannot see the objective and even the assessment there. What are we saying concerning that or maybe are saying let us do away with lesson plan and we submit lesson preparation because no matter how we say we are complying to the system it does not tell them anything about us, that is the problem I want us to discuss	2.To add on that in that lesson plan format comes from the department if I have to state LO I cannot state LO1 in full I will so if you don’t know what is LO1 in technology you won’t know. But the department if they can come now taking that lesson plan they will be able to interpret it very well. Like the CIs if they can come now that format we find them those CIs.		1.I think the problem lies with the department because I think in all subjects the lesson plan format come from the department and some format are from the textbook like the format in Natural Science is from the curriculum document. So I think we should blame the department there because the format are not structured by the educators
But at school level it will be difficult to a person who is not familiar with the subject	1.That is why it is not good to employ somebody who is not familiar with the subject as an HOD if may be I’m lacking somewhere who is going to help me		
In summary I could hear that the format as mam Basani puts it comes from the department and			

	we have to follow it just like that and you are saying mam Nyeleti that when the departmental officials come and see the way you have fill the format the person will understand it and now at school level the people who are heading that section they are the ones who are having problems because they don't know the language	
10	In conclusion do you have anything concerning our discussion or any contribution.	1.I think e- I was late but the discussion was an eye-opener to us as educators was a wakeup call as you have mention something like factual, cognitive all those processes, so it means now as educators we are lucky to have you and discuss such things because now we are going to rectify our mistakes and to stick on the question like the learners apply some knowledge which is good which envolves the real life.

APPENDIX C LETTER OF REQUEST TO MPUMALANGA DEPARTMENT OF EDUCATION

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

Department of Science, Mathematics and Technology Education
Tel: +27 (0)12 420 5659 Fax: +27 (0)12 420 5621

30th March 2012

The Head of Department:
Mpumalanga Department of Education,
Nelspruit

Dear Sir/Madam

Request for permission to conduct research in schools within districts Gert Sibande, Nkangangala and Ehlanzeni.

I am a student studying through the University of Pretoria. I am currently enrolled for my M.Ed in the Faculty of Education. I have to complete a research module and one of the requirements is that I conduct and write a research report about my work.

The project is titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives.** Since the introduction of Technology as a subject or learning area in the South African school curriculum, teachers have been expected to use methodological approaches and appropriate content and activities to achieve factual, conceptual and procedural knowledge objectives. The research seeks to investigate what knowledge and cognitive process dimensions of technology are actually present in teachers' lesson objectives.

I hereby request permission to conduct research based on a survey and with some discussion groups of teachers in the schools of these districts.

If you grant me permission to do the research at schools in these districts, I will request senior phase grade 9 technology teachers to provide me with some of their lesson plans. The objectives of these lesson plans are the subject of my analysis.

The results from this study will be used to establish the status of knowledge and process dimensions of technology teachers' lesson objectives. The research might inform teacher development programmes and curriculum support by district staff. Reports will be made available in academic articles and conference reports. If requested, copies or urls (web addresses) of these articles will be made available to the district.

Schools and teacher participants are free to refuse to participate. Participation can be withdrawn at any time.

1

The identities of the district, schools and all participants will be protected. Only my supervisors and I will know which schools were used in the research and this information will be treated as confidential. Only where discussions are held with groups of teachers will I or the supervisor know names of teachers. Pseudonyms or codes will be used for teachers during data collection, analysis and reporting. The information that is collected will be used for academic purposes only. In my research report and in any other academic communication, pseudonyms will be used for the school and teachers and no other identifying information will be given.

If you agree to allow me to conduct this research in schools of these districts, please fill in the attached consent form. If you have any questions, do not hesitate to contact my supervisor or me at the numbers given below, or via E-mail.

Yours faithfully

Mathumbu D. (Researcher)
Cell: 082 851 1628
E-mail: zalabantu@gmail.com

Prof. MWH Braun (Supervisor)
Science, Mathematics &Technology Education
012 420 5659
Max.braun@up.ac.za

PROF M W H BRAUN
Head of Department

Department of Science,
Mathematics &
Technology Education
University of Pretoria

2

CONSENT FORM

I, ____ (your name),

Head of Department, Department of Education, Mpumalanga

agree / do not agree (delete what is not applicable)

to allow the research project titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives** to be performed in the districts Gert Simbande, Nkangangala and Ehlanzeni. I understand that in the identified schools senior phase grade 9 technology teachers will provide the researcher with some of their lesson plans. A teacher will not be identified as the author of any lesson plans submitted.

I understand that teachers may be asked to be part of a discussion group to validate interpretations. In that case teachers will sign a separate consent form and understand that any personal information will remain confidential.

I understand that the researcher subscribes to the principles of:

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

Signature:________________________ Date:_________________

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APPENDIX D. APPROVAL LETTER FROM MPUMALANGA DEPARTMENT OF EDUCATION

education
DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

Private Bag X 11341
Nelspruit 1200
Government Boulevard
Riverside Park
Building 5
Mpumalanga Province
Republic of South Africa

Litiko leTemfundvo Umnyango weFundo Departement van Onderwys Umnyango wezeMfundo

Enquiries: A.H Baloyi (013) 766 5476

MR. D. MATHUMBU
UNIVERSITY OF PRETORIA
DEPT OF SCIENCE, MATHEMATICS & TECHNOLOGY EDUCATION
PRETORIA
0001

RE: APPLICATION TO CONDUCT RESEARCH IN GERT SIBANDE, NKANGALA AND EHLAZENI DISTRICTS.

Your application (dated 30 March 2012) to conduct research on "The knowledge and cognitive process dimensions of technology teachers' lesson objectives" was received on the 11 April 2012.

The background of your study gives an impression that the outcome of your study will assist teachers in curriculum management and implementation and therefore improve the teaching and learning in the classroom which is what the department promotes. Given the motivation and the anticipated report of the study, I approve your application to conduct your research study in the specific districts.

You are further requested to read and observe the guidelines as spelt out in the research manual which was forwarded to you. It will be appreciated if you can present and share your findings in electronic form and make formal presentation to the strategic planning's research unit.

For more information kindly liaise with the department's research unit @ 013 766 5476 or a.baloyi@education.mpu.gov.za.

The department wishes you well in this important study and pledge to give you the necessary support you may need.

RECOMMENDED/~~NOT RECOMMENDED~~.

The study is recommended.

18/04/2012

MR. A.H. BALOYI **DATE**

RESEARCH SUBDIRECTORATE

APPROVED/NOT~~APPROVED~~:

18/04/12

MRS MOC MHLABANE **DATE**

HEAD OF DEPARTMENT

APPENDIX E. LETTER TO REQUEST PERMISSION FROM THE HEAD MASTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

Department of Science, Mathematics and Technology Education
Tel: +27 (0)12 420 5659 Fax: +27 (0)12 420 5621

30th March 2012

The Headmaster:

Dear Sir/Madam

Request for permission to conduct research in your school

I am a student studying through the University of Pretoria. I am currently enrolled for my M.Ed in the Faculty of Education. I have to complete a research module and one of the requirements is that I conduct and write a research report about my work. I would like to ask you whether you will be willing to allow me to conduct a part of this research in your school.

The project is titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives**. Since the introduction of Technology as a subject or learning area in the South African school curriculum, teachers have been expected to use methodological approaches and appropriate content and activities to achieve factual, conceptual and procedural knowledge objectives. The research seeks to investigate what knowledge and cognitive process dimensions of technology are actually present in teachers' lesson objectives.

If you grant me permission to do the research in your school, I will request senior phase grade 9 technology teachers to provide me with some of their lesson plans. The objectives of these lesson plans are the subject of my analysis.

In order to confirm interpretations of lesson objectives I may request some teachers to form part of a discussion group. Their identities and the schools from which they come will be kept confidential, and will be known only to myself as the researcher and my supervisors.

The schools and teacher participants are free to refuse to participate. Participation can be withdrawn at any time.

The identities of the schools and all participants will be protected. Only my supervisor and I will know which schools were used in the research and this information will be treated as confidential. Pseudonyms will be used for teachers during data collection and analysis. The information that is collected will be used for academic purposes only. In my research report

1

and in any other academic communication, pseudonyms will be used for the school and teachers and no other identifying information will be given.

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

Yours faithfully

Mathumbu D. (Researcher)
Cell: 082 851 1628
E-mail: zalabantu@gmail.com

Prof. MHW Braun (Supervisor)
Science, Mathematics &Technology Education
012 420 5659
Max.braun@up.ac.za

PROF M W H BRAUN
Head of Department
Department of Science,
Mathematics &
Technology Education
University of Pretoria

2

CONSENT FORM

I, ____ (your name),

Headmaster of the school ___________________________________ (name of school)

agree / do not agree (delete what is not applicable) to allow the research project titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives** to be performed in this school. I understand that senior phase grade 9 technology teachers are to provide the researcher with some lesson plans and may be asked to form part of a discussion group to validate interpretations. Teacher and school identities will be kept confidential by the researcher and supervisors.

I understand that the researcher subscribes to the principles of:

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

Signature:________________________ Date:_________________

APPENDIX F. CONSENT LETTER TO PROVIDE LESSON PLANS BY THE TEACHER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

Department of Science, Mathematics and Technology Education
Tel: +27 (0)12 420 5659 Fax: +27 (0)12 420 5621

30th March 2012

Dear teacher

I am a student studying through the University of Pretoria. I am currently enrolled for my M.Ed in the Faculty of Education. I have to complete a research module and one of the requirements is that I conduct and write a research report about my work. I would like to ask you whether you will be willing to participate in this research.

The project is titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives**. Since the introduction of Technology as a subject or learning area in the South African school curriculum, teachers have been expected to use methodological approaches and appropriate content and activities to achieve factual, conceptual and procedural knowledge objectives. The research seeks to investigate what knowledge and cognitive process dimensions of technology are actually present in teachers' lesson objectives.

If you agree to participate, you will be asked to provide a minimum of 3 lesson plans addressing different content in grade 9 technology from which we will derive lesson objectives.

You do not have to participate in this research if you do not want to, and you will not be penalised in any way if you decide not to take part. If you decide to participate, but you change your mind later, you can withdraw your participation. No name should appear in the lesson plans, hence, once you have handed your lesson plans they can no longer be withdrawn since it will be difficult to identify them amongst the others. This also guarantees anonymity.

Your identity will be protected. Only my supervisor and I will have access to these lesson plans and this information will be treated as confidential. For reference purposes lesson plans will be numbered. The information that is collected will be used for academic purposes only. In my research report and in any other academic communication, numbers will be used when referring to the lesson plan and no other identifying information will be given.

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

Yours faithfully

Mathumbu D. (Researcher)
Cell: 082 851 1628
E-mail: zalabantu@gmail.com

Prof. MHW Braun (Supervisor)
Science, Mathematics &Technology Education
012 420 5659
Max.braun@up.ac.za

PROF M W H BRAUN
Head of Department
Department of Science,
Mathematics &
Technology Education
University of Pretoria

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CONSENT FORM

I, ____(your name),

agree / do not agree (delete what is not applicable)

to take part in the research project titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives** I understand that I have to provide a minimum of 3 grade 9 technology lesson plans addressing different content.

I understand that the researcher subscribes to the principles of:

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

Signature:________________________ Date:__________________

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

APPENDIX G. CONSENT LETTER TO PARTICIPATE IN THE FOCUS GROUP BY THE TEACHER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

Department of Science, Mathematics and Technology Education
Tel: +27 (0)12 420 5659 Fax: +27 (0)12 420 5621

30th March 2012

Dear teacher,

I am a student studying through the University of Pretoria. I am currently enrolled for my M.Ed in the Faculty of Education. I have to complete a research module and one of the requirements is that I conduct and write a research report about my work. I would like to ask you whether you will be willing to participate in this research.

The project is titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives**. Since the introduction of Technology as a subject or learning area in the South African school curriculum, teachers have been expected to use methodological approaches and appropriate content and activities to achieve factual, conceptual and procedural knowledge objectives. The research seeks to investigate what knowledge and cognitive process dimensions of technology are actually present in teachers' lesson objectives.

Lesson plans have been provided by teachers of Grade 9 Technology and these have been interpreted and lesson objectives have been classified and grouped. In order to validate interpretation, I request your participation in a discussion group with several technology teachers to discuss, explain or add your insights to the interpretation.

If you agree to participate, you will be asked to attend the discussion group which will last no longer than an hour.

You do not have to participate in this research if you do not want to, and you will not be penalised in any way if you decide not to take part. If you decide to participate, but you change your mind later, you can withdraw your participation.

Your identity will be protected. Only my supervisor and I will have access to the discussion group meeting and all personally identifying information will be treated as confidential. The information that is collected will be used for academic purposes only. In my research report and in any other academic communication pseudonyms will be used for comments from teachers in discussion groups and no other identifying information will be given.

1

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

Yours faithfully

Mathumbu D. (Researcher)
Cell: 082 851 1628
E-mail: zalabantu@gmail.com

Prof. MHW Braun (Supervisor)
Science, Mathematics &Technology Education
012 420 5659
Max.braun@up.ac.za

PROF M W H BRAUN
Head of Department

Department of Science,
Mathematics &
Technology Education
University of Pretoria

CONSENT FORM

I, ____(your name), agree / do not agree (delete what is not applicable) to take part in the research project titled: **The knowledge and cognitive process dimensions of technology teachers' lesson objectives** I understand that I will attend a discussion group voluntarily and participate in discussions that will enhance understanding and check interpretations of lesson objectives, activities and assessments. These may not have been derived from my own lesson plans.

I understand that the researcher subscribes to the principles of:

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

Signature:_________________________ Date:__________________

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