Master of Education (Curriculum Studies)

ASSESSMENT IN FURTHER EDUCATION AND TRAINING (FET) LIFE SCIENCES: AN ANALYSIS OF ASSESSMENT TASKS IN THREE SELECTED SCHOOLS IN THE MPUMALANGA PROVINCE

BHEKENI STUART MAXWELL MKHOLO

A dissertation submitted in partial fulfillment of the degree of

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Supervisors: Dr. C. Bertram and

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Declaration

I, Bhekeni Stuart Maxwell Mkholo, hereby declare that the work on which this dissertation is based, is original (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other university or tertiary education institution or examination body.

Mr. B.S.M. Mkholo

Signature:

Date: December 2010

As supervisors, we have agreed that this dissertation may be submitted.

Dr. C.A. Bertram   Dr. E.R. Dempster

Abstract

This study describes the extent to which summative assessment tasks assess the different cognitive levels and learning outcomes with reference to the SAG (2008) for Grade 10 Life Sciences. Essentially, it describes the fit between the intended and implemented assessment, using documentary analysis as a research strategy.

In order to determine the fit between intended and implemented assessment the Life Sciences SAG (2008) and question papers on summative assessment tasks were analysed. The question papers were obtained from three schools which were sampled purposively in the Mpumalaga Province. The Life Sciences SAG (2008) was analysed in order to determine the official percentage weightings (marks) of the cognitive levels and learning outcomes which must be assessed in the summative assessment tasks (intended assessment). Using the Revised Bloom's Taxonomy as an analysis tool, question papers on summative assessment tasks were also analysed in order to determine the average percentage weightings (marks) of the cognitive levels and learning outcomes which were assessed (implemented assessment).

When the intended and implemented assessments were compared the following results were obtained: For practical tasks and end-of-year examinations there was an incongruity between the intended and implemented assessment in terms of the cognitive levels and learning outcomes. The discrepancy between the intended and the implemented assessment was also found in controlled tests but only in terms of the learning outcomes. In controlled tests the fit between intended and implemented assessment in terms of the cognitive levels could not be determined because the SAG (2008) does not prescribe the cognitive levels which must be assessed. Furthermore, a weak fit between the intended and the implemented assessment in terms of the lower cognitive levels and learning outcomes was found in mid-year examinations. However, there was a strong fit between the intended and implemented

assessment in terms of the higher cognitive levels in mid-year examinations. Lastly, for the research projects the fit between the intended and implemented assessment could not be determined because the Life Sciences SAG (2008) does not prescribe the cognitive levels as well as the percentage weightings of the learning outcomes which must be assessed.

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I am also most grateful to my parents, Christopher and Joyce Mkholo, my son Ndumiso Mkholo and my cousin Musawenkosi Phillip Khumalo for their support throughout this study. My special thanks go to my lovely wife for her immense support and perseverance which made this study a success. Not to forget Father God for giving me the strength and courage to make this study possible.

List of abbreviations

- **AS**: Assessment standard
- **CASS**: Continuous assessment
- **CBE**: Competence-based education
- **DOE**: Department of Education
- **FET**: Further Education and Training
- **LO**: Learning outcome
- **LPG**: Learning Programme Guidelines
- **NCS**: National Curriculum Statement
- **OBE**: Outcomes based education
- **OBA**: Outcomes based assessment
- **SAG**: Subject Assessment Guidelines (2008)
- **SS**: Subject Statement (2003)
- **SSA**: Sub-Saharan Africa
- **UNICEF**: United Nations Children's Fund
- **UNESCO**: United Nations Educational, Scientific, and Cultural Organization
- **UK**: United Kingdom
- **USA**: United States of America

Clarification of concepts used in this dissertation

- **Assessment**: a process of getting evidence by one or a number of means and making judgments of the evidence in order to make inferences about a learner's competence

- **Assessment standards**: Grade specific statements which describe the minimum level which learners should demonstrate the achievement of a learning outcome and ways or range (breath and depth) of demonstrating the achievement.

- **Assessment tasks**: a series of tasks/activities designed to assess a range skills, knowledge, values and attitudes implied in the assessment standards of the learning outcomes. These tasks may be class work or homework based, projects, practical or they may be set in an examination paper.

- **Assessors**: external examiners, educators at schools, district, regional and cluster level.

- **Authentic assessment**: refers to performance-based assessment that aims to assess knowledge, skills, values and attitudes in situations which closely resemble actual situations in which that knowledge and those skills, values and attitudes are used.

- **Assessment strategies**: refers to approaches taken to assess a learner's performance, using various assessment forms appropriate to the task and level of the learner's understanding.

- **Cognitive level**: The level of knowing determined by the cognitive processes through which knowledge is acquired.
- **Cognitive ability**: An internal mental capability one uses to perform a task. It is a learning potential or learning capacity.

- **Competence**: cognitive process/process skill/inner ability to do things that can be inferred from performance. It is specified in the learning outcome.

- **Context**; refers to the situations or conditions in which content is taught, leant an assessed. Contexts are derived from the socio-economic environment, interest, nature and needs of learners; nature of life Sciences.

- **Content**: refers to the following four knowledge areas of Life Sciences: tissues, cells and molecular studies; structures and control of processes in basic life systems; environmental studies; and diversity, change and continuity.

- **Continuous assessment**: An ongoing process which measures a learner's achievement during the course of a grade or level, providing information which is used to support a learner's development and enable improvements to be made in the learning and teaching process.

- **Criterion-referenced teaching and assessment**: the practice of teaching and assessing learners' performance against predetermined set of criteria. In the case of OBE curriculum the leaner is taught or assessed against agreed assessment criteria/standards derived from the learning outcomes.

- **Curriculum 2005**: an outcomes-based education (OBE) curriculum derived from nationally agreed critical and developmental outcomes that sketch the vision of the South Africans of a transformed society and the role education has to play in creating it. It is underpinned by the philosophies of progressive pedagogy such as learner-centred education, co-operative learning, teachers as facilitators; and the concepts of integrated approach to knowledge.

- **DOE adapted Blooms' categories**: Cognitive levels which have been adapted from the original Blooms' Taxonomy.

- **Educator cluster**: Teachers in a geographic cluster which design, standardise and moderate formal continuous assessment tasks and learner' performance. These educators support and share knowledge regarding the teaching, learned and assessment of Life Sciences.

- **Formative assessment**: form of assessment used to improve teaching and learning.

- **Formal continuous assessment task**s: practical tasks, research projects, controlled tests, mid-year-examinations and end-of-year examinations. They can be formative or summative depending on the purpose for which they are used.

- **Learning outcome**: is what a learner is capable of knowing and doing at the end of a learning experience. A learner's skills, knowledge, attitudes or values may demonstrate the achievement of a learning outcome or set of learning outcomes.

- **Norm-referenced assessment**: An assessment practice which compares a learner's performance with that of other learners in a given group

- **Outcomes-based education**: A learner-centred, results-oriented approach to education premised on the expectation that all learners can learn and succeed. It implies that learning institutions have the responsibility to optimize the conditions for success. It is an educational philosophy used to deliver the national educational goals (critical and developmental outcomes) defined in NQF.

- **Outcomes-based assessment**: the practice of assessing learners' performance against predetermined set of learning outcomes or their assessment standards.

- **Paper and pen tests**: tests requiring a written response, performed under controlled conditions and which measure a learners understanding and performances across a range of competences.

- **Performance-based assessment**: Task-based (authentic) assessment which measures how learners can apply the knowledge and skills they have learned in unfamiliar contexts or in a context outside the classroom. It covers the practical components of subjects by determining how well learners put theory into practice.

- **Performance-based task:** Practical and task-based (authentic) learning activities which enable learners acquire the knowledge, different skills, attitudes and values through discovery learning, cooperative learning. These activities promote problem solving and enquiry skills in the learners.

- **Policy:** refers to education/curriculum policy, which is an education plan of the ideal course of action. It expresses intentions of the Department of education of what needs to be done and provides guidelines to practice.

- **Programme of assessment**: refers to a year-long grade specific formal plan of assessment for a subject.

- **Standards**: Are fixed statements of competence that a learner must achieve. They are clear and detailed descriptions of different levels of achievement.

- **Summative assessment**: is a form of terminal assessment in which results are used to make judgment about the competence of a learner at the completion of a course or at the end of a term or year. It can also be used in a formative way to improve teaching and learning.

- **Summative assessment tasks**: are the formal CASS tasks (two practical tasks, one project, two tests and one mid- year-examination) and the end-of-year examinations.

- **Unit of analysis**: the entity or case which is analysed.

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CHAPTER 1
INTRODUCTION TO THE STUDY

1.1 BACKGROUND

During the Apartheid era assessment of learners in South African schools was mainly based on high-stakes, sit-down examinations consisting of paper and pencil tests. These examinations were norm-referenced, where the performance of individual learners was compared with the norm or average performance of other learners (Jansen, 1995). They were also context-blind and significantly targeted the recall of content knowledge instead of addressing the learning outcomes and the range of cognitive levels implied in them.

The introduction of the new curriculum (Curriculum 2005, which was subsequently called the National Curriculum Statement) in 1997 which is based on OBE philosophy, brought with it changes in the assessment practices of teachers in South African schools. In the new curriculum teachers are required to assess learners' performance based on explicitly stated criteria, - that is the assessment standards of the learning outcomes which are expected to be achieved by learners. The new curriculum also emphasises the use of different types and methods of assessments to provide ongoing feedback to teachers, learners and parents on learners' performance (Sieborger & Nakabugo, 2001). In essence it encourages both formative and summative assessment. Formative assessment is used continuously to assess learners' performance in order to improve teaching and learning. Summative assessment is also used continuously but for purposes of providing a formal report on learners' achievement of learning outcomes to the learners, teachers, parents or other people. Though this new assessment framework brought by the new curriculum was eagerly embraced by some teachers, most reluctantly accepted or resisted it (Chisholm, 2003).

This introductory chapter outlines: the field of education wherein the study is located, the purpose and rationale for this study as well as the critical research questions which informed it. It also presents an outline for this dissertation.

1.2. FIELD OF EDUCATION WHERE THE STUDY IS LOCATED

This study sits within the broader field of education policy, with a specific focus on curriculum policy. Essentially it is a study of the ‘fit’ between the intended and implemented assessment. In this study intended assessment refers to the assessment requirements specified in the curriculum (assessment) policy document. Intended assessment spells out what needs to be assessed in the assessment tasks constructed by the teachers. Implemented assessment, in this study, refers to the actual assessment practice which either reflects or not reflect the assessment requirements specified in the curriculum policy document. That is, it (implemented assessment) is what is assessed by the teachers in the actual assessment tasks they construct.

1.3. PURPOSE AND RATIONALE FOR THE STUDY

The main purpose of this study is to provide an in-depth description of the extent to which summative assessment tasks (formal CASS tasks and end-of-year examinations) from three selected schools in Grade 10 Life Sciences assess the different cognitive levels and learning outcomes as stipulated in the SAG (2008).

My interest in doing this study resulted from being a Grade 10 Life Sciences teacher and a school-based head of department for Life Sciences. In my opinion teachers and curriculum implementers at circuit, regional and provincial level construct summative assessment tasks (formal CASS tasks and end-of-year examinations) which do not assess the cognitive levels and learning outcomes as officially required in the Life Sciences SAG (2008). Thus my hypothesis is that:

- teachers do not implement the intended assessment policy. They tend to construct summative assessment tasks that do not mirror the official percentage weightings (marks) of the cognitive levels (particularly higher cognitive levels such as analysis, evaluation and creation) and learning outcomes stipulated in the Life Sciences SAG (2008).

This study may be informative to the curriculum development experts and advisers, who may influence the streamlining of the national or provincial assessment policies as is currently underway. It may also be useful to School Management Teams who may want to design efficient assessment programmes for their schools. Lastly, this study can be of benefit to the teachers, curriculum implementers or other assessors who want to improve their assessment practices.

1.3. CRITICAL RESEARCH QUESTIONS

The following questions informed this study:

1) What are the requirements of the Subject Assessment Guidelines (2008) for Life Sciences in terms of the:

   a. cognitive levels

   b. and learning outcomes (intended assessment policy)?

2) What are the:

   a. cognitive levels

   b. and learning outcomes represented in the actual assessment tasks in three schools (implemented assessment policy)?

3) What is the ‘fit’ between the intended assessment policy and the implemented assessment policy?

The specific objectives which had to be achieved in order to answer the first research question were the following:

- To analyse the Life Sciences Subject Statement (2003) in order to understand the purpose, nature and scope of Life Sciences as a subject.

- To analyse the Life Sciences SAG (2008) in order to determine the official percentage weightings (marks) of the different cognitive levels and learning outcomes prescribed for the formal CASS tasks and end-of-year examinations papers.

The specific objective which had to be achieved in order to answer the second research question was the following:

- To analyse, using the Revised Bloom's Taxonomy, the assessment standards of the learning outcomes stipulated in the Life Sciences Subject Statement (2003) in order to understand the cognitive levels and types of knowledge they address. Understanding the cognitive levels and types of knowledge addressed by the assessment standards of the learning outcomes was essential for the analysis of the test items of the formal CASS tasks and end-of-year examinations papers.

- To analyse, using the Revised Bloom's Taxonomy, formal CASS tasks and end-of-year-examination papers of three sampled schools in order to determine the average percentage weightings (marks) of the different cognitive levels (and types of knowledge) and learning outcomes which are assessed by these summative assessment tasks.

The specific objective which had to be achieved in order to answer the third research question was the following:

- To compare implemented assessment with intended assessment- that is, to compare the weightings (marks) of cognitive levels and learning outcomes assessed in formal CASS tasks and end-of-year examinations papers of the three schools with the prescribed percentage weightings (marks) in the Life Sciences SAG (2008).

1.4. DISSERTATION OUTLINE

As stated above, this dissertation analyses formal CASS tasks and end-of-year examinations from three different schools in the Mpumalanga province with regards to the extent to which they assess the different cognitive levels and learning outcomes as required in Life Sciences SAG (2008). The present chapter is an introduction that includes introductory perspectives to the research theme, critical research questions and rationale for the study, objectives and dissertation outline. The remaining chapters are as follows:

Chapter 2 provides a literature review of the study.

Chapter 3 describes the research design, methodology and conceptual frame work.

Chapter 4 presents the findings of the study which were obtained from the analysis of the Life Sciences Subject Statement (2003), SAG (2008) and formal CASS tasks and end-of-year question papers.

Chapter 5 presents a general discussion of the findings of the study

CHAPTER 2
LITERATURE REVIEW

2.1. INTRODUCTION

South Africa has undergone much curriculum reform since 1994. The Committee set up to review Curriculum 2005- subsequently known as the National Curriculum Statement- described the key principles which underpin the reform as learner-centred pedagogy, integrated knowledge, and outcomes-based education. This chapter will review the literature on these key concepts and on outcomes-based assessment. It will describe the key aspects of the Life Sciences curriculum statement.

2.2. THE NEW CURRICULUM AND LEARNER-CENTREDNESS

Learner-centred education originated in the early part of the twentieth century from the writings of John Dewey (1929) as a response to the need to modernise education (Bertram, Fotheringham & Harley, 2001). This educational approach is different from the traditional teacher-centred, syllabus-based approach to education in that learners participate more actively in the teaching and learning process. The role of the teacher is to guide and facilitate the learning process in order for the learners to construct knowledge and take control of their learning. Therefore in learner-centred education knowledge is not directly imparted to the learners but learners are assisted to construct their own knowledge.

Taylor (1999) asserts that learner-centred education has emerged at regular intervals over many centuries in different countries. In the UK, for example, it gained prominence during the sixties and early seventies (Cuban, 1997 quoted in Taylor, 1999). In Sub-Saharan African countries (Botswana, Nigeria, Ghana, Senegal, Namibia, Swaziland and Kenya) it resurged in the early 90's - following the progressive discourses on quality education, child-based education held in UNICEF, UNESCO and the World Declaration on Education for all (Jomtien Declaration, 1990) to which many countries are signatories (Kanjee & Sayed, 2008). In these countries curricula and assessment policies were reformed in favour of continuous assessment (CASS). CASS was considered a method of encouraging learner-centred education which was thought would improve the quality of teaching and learning process (Chisholm & Leyendecker, 2008).

In South Africa the philosophy of learner-centred education- which was previously harbored in liberal universities, private and former Model C schools- resurged in the new curriculum in 1997 (Muller, 2004). In line with the learner-centred approach to education the new curriculum emphasises the involvement of learners in authentic (performance-based) learning tasks. These activities enable learners to develop different types of knowledge and skills and to reflect their attitudes which are described in the learning outcomes (Department of Education, 2003). They also enable learners to have a deeper understanding of what is learned, promote their independent thinking, critical thinking skills, capacity to question, enquire, reason, weigh facts, form judgments and to communicate effectively (Bowie, et. al, 2008).

The pedagogical strategies used to involve learners in performance-based learning tasks include: discovery learning, where learners are encouraged to learn on their own to gain new knowledge; problem solving, where learners apply existing knowledge to a new situation or unfamiliar situation in order to gain new knowledge; and cooperative learning, which enables learners to work in small groups giving them opportunities to discuss. Cooperative learning is premised on the idea that socially learners talk in order to construct meaning of what they learn; and on the idea of continuous assessment of learners' performance which is used to improve the quality of teaching and learning (Muller, 2004).

Also characteristic of the new curriculum is the unique nature of the learning activities planned by the teacher. These activities aim to build on learners' prior knowledge and take into account such factors as learners' cognitive abilities, learning strategies, experiences, needs and their backgrounds (Chisholm, 2003). The educator uses all these factors to pace the learning of individual learners. At the start of the learning process the learning objective may be unclear but over time the teacher may refine learners' understanding of the subject matter by filling knowledge gaps, resolving inconsistencies; and assisting them to form links between new information and the existing knowledge base. As learners continue to build these links their knowledge widens, deepens and become meaningful. This enables them to achieve the desired learning outcomes.

2.3. THE NEW CURRICULUM AND INTEGRATED KNOWLEDGE

Another key design principle of the new curriculum is the integration of knowledge. This educational approach prepares learners to be life-long learners. Essentially knowledge integration aims to de-fragmentise knowledge so that learners can know that knowledge within and across subjects is linked, and that problems and issues contained in the curriculum are the same as those contained in their everyday lives (Mpumalanga Department of Education, 2005). This is claimed to move learning away from rote learning of isolated facts to more meaningful concepts and connection between concepts.

According to the Mpumalanga Department of Education (2005) integration of knowledge expands learners' opportunities to acquire knowledge, attain skills and develop attitudes and values encompassed across the curriculum. Moreover, it is claimed that learners actively participate in the learning activity, which enables them to take control of their learning in order to achieve common learning outcomes (Sieborger & Macintosh, 2002).

In essence in the new curriculum integration of knowledge takes place in following three ways: within each subject-through learning and assessment activities which enable learners to learn and use knowledge from different parts of the same subject; across subjects-through an issue or thematic lesson (such as water, ecosystem and pollution) and assessment activities which enable learners to learn and use knowledge from different subjects rather than learning them as separate subjects; and between school knowledge and experiential knowledge-by means of performance-based learning activities which enable learners to view knowledge gained from their lived experiences and the school as a set of related ideas, and through assessment activities which enable learners to apply school knowledge to real-life-contexts (Sieborger & Macintosh, 2002). In brief, the vision of the new curriculum is integration of knowledge which enables teaching and learning to take place in a holistic manner, and is used to support the development of learners' competence.

2.4. THE NEW CURRICULUM AND OUTCOMES-BASED EDUCATION (OBE)

The third principle which underpins the new curriculum is OBE. OBE is an approach to teaching and learning and assessment. It makes explicit to the teachers and learners the outcomes to be achieved by the learners at the end of the learning experience (Spady, 1993). However, the OBE curriculum is not exclusive only to South Africa. It has been implemented in various forms in English speaking countries such as Canada, USA, Australia and New Zealand (Malan, 2000). In these countries OBE was perceived as a means for education renewal, which would in turn result in the production of highly skilled work force needed for economic growth and social development. The same reasons, coupled with the need to drive social reconstruction in the post-Apartheid period, also informed the introduction of the OBE curriculum in South Africa.

Before OBE could be discussed to show how it underpins the new curriculum, a brief description of traditional approaches to education from which OBE originated will be presented as they also relate to this study.

Jansen & Christie (1999) link OBE to three traditional approaches to curriculum: the educational objectives movement, competence-based education and mastery learning movement. In addition to the above educational approaches, Malan (2000) links it to criterion-referenced assessment.

2.4.1. The educational objectives movement

This movement emerged in the USA around the turn of the twentieth century with the birth of the scientific movement in education (Eisner, 1967). Curriculum developers such as Bobbitt (1918) believed in the importance of formulating specific educational objectives to provide goals towards which curriculum is aimed (Popham, 1972). These objectives served as standards against which learners' achievements of curriculum outcomes were assessed (Eisner, 1967), thus they were used to frame test items.

In the late forties and during the fifties this movement received a further thrust. In 1949, for example, Ralph Tyler (1949) stressed the importance of: stating the objectives in behavioural terms, the selection of appropriate learning experiences (content) needed for the achievement of objectives, assessing learners' achievement of these objectives (Davis,1981).In 1956, Benjamin Bloom developed a taxonomy which classified educational objectives into cognitive-, affective- and psychomotor domain. The cognitive domain in particular, has been invaluable for many teachers in countries such as Canada, Britain, and Germany including South Africa. It has been used to formulate educational objectives, the construction of test items and examination papers (Malan, 2000), and to determine the cognitive challenge they offered to the learners (Krathwohl, 2002).

2.4.2. Competence based education

Competence-based education (CBE) originated in the USA in the 1960's as a result of the falling standards of education. Later on CBE spread in the UK where new ideas of CBE and continuous assessment were shaped (Lubisi, 1999; Muller, 2004).

In CBE learners had to be taught to certain publicly stated standards which represented an individual's competence required after schooling (Malan, 2000). Mitchell (1989) defined competence as the ability to perform activities within a given occupation or context to the standards expected and itself a learning outcome. Mitchell (1989) further argued that these standards should be stated in behavioural terms to reflect the skills and knowledge learners must achieve in order to demonstrate the competence in that occupation. Thus CBE was criterion-referenced as it stressed the importance of performance based on the predetermined standards. Moreover, in CBE learners were expected to have knowledge of the task and the ability to apply the skills to perform a task.

2.4.3. Mastery learning movement

Mastery learning employed individualised intervention programmes aimed at assisting learners with mild learning problems and those who did not benefit from traditional educational settings (Guskey et al, 1995, in Malan, 2000). The pedagogical strategies employed in mastery learning included similar learning environments, learners' support through different media and learning materials as well as individualized assistance. These strategies afforded all learners, at all levels of learning and of different aptitudes, enough time and opportunity to learn in order to master the presented material. Therefore, the aim in mastery learning was to enable learners to achieve the desired knowledge and skills.

Also characteristic of mastery learning was the formative use of assessing learners' performance. This form of assessment was used continuously to provide feedback to the teacher and the learners for the development of the learners and to improve teaching and learning.

2.4.4. Criterion-referenced assessment

Criterion-referenced assessment originated in behavioural psychology (Lunt, 1993). It aimed to assess learners on predetermined competences (knowledge and skills) against clearly stated performance criteria (Glaser, 1963; Walsh & Betz, 1995). Lunt (1993) maintained that the aim of this assessment approach was to establish the degree to which the learner has attained the learning objective in order to plan the next teaching or learning step. In order to indicate the performance of a learner in that skill or knowledge the teacher could use rubrics or a checklist.

Mpepo (1998) in Malan (2000) argues that criterion-referenced assessment was mostly employed in performance-based assessment. The aim of performance assessment was used to: determine learners' ability to apply the skills and knowledge they have learned in unfamiliar contexts or in contexts outside classrooms (Department of Education, 2003), assess creativity, planning, communication skills, measurement and estimation (Lubisi, 1999). Performance assessment tasks include research projects, demonstrations, interviews, oral presentations, essays, constructed response questions, and practical tasks such as conducting experiments and constructing models.

2.4.5. How does OBE underpin the new curriculum (Curriculum 2005)?

Whereas the curriculum espoused in Apartheid education was designed around objectives detailed in syllabi which outlined what the year's lessons should involve, the new curriculum (curriculum 2005) is designed around learning outcomes. These learning outcomes are built on the critical outcomes and developmental outcomes which are specified in the Constitution of the country (Chisholm, 2003).

The critical outcomes and developmental outcomes are expressions of what South Africans regard to be knowledge, skills, and values worth learning. The critical outcomes, as adapted from National Curriculum Statement (2003) require learners who are able to: identify and solve problems; collect, analyse, organize and critically evaluate data; communicate effectively using visual, symbolic and/or language skills in various modes ; use science and technology effectively and show responsibility towards the environment and health of others; and to demonstrate an understanding of the world as a set of related systems by recognizing that problem solving contexts do not exist in isolation. The developmental outcomes require learners who are able to: reflect on and explore a variety of strategies to learn more effectively; participate as responsible citizens in local, national and global communities; be culturally and aesthetically sensitive across a variety of social situations; explore education and career opportunities; and develop entrepreneurial opportunities (National Curriculum Statement, 2003).

The learning outcomes and their associated assessment standards constitute the body of knowledge for each subject and should, by design, lead to attainment of the critical and developmental outcomes (National Curriculum Statement, 2003). The learning outcomes describe the knowledge, skills, attitudes and values which are expected to be acquired and achieved by the learners to show integrated competence (Bowie et al, 2008). Thus, unlike the traditional educational objectives which were normally stated in behavioural terms to describe the knowledge and skills to be attained by the learners, learning outcomes are holistic in nature (Bertram, Fotheringham & Harley, 2001) since they also describe non-observable internal changes (attitudes and values) in the learners (Eraut, 1990).

The new curriculum also aimed to bring changes in the teaching, learning and assessment methods. Changes in assessment in the new curriculum will be discussed later in this chapter in the section on outcomes-based assessment. The new teaching methods which should be selected to match the learning styles of the learners include amongst others: cooperative teaching, integration of knowledge, mediation, class discussions, thinking and problem-solving skills, coaching and mentoring (Mpumalanga Department of Education, 2005), investigations, independent or group-based projects, drama, games, self discovery, and group work (Le Roux, 2003). These teaching methods are used to facilitate learning and assessment of the learners. However, some of these teaching methods are better suited for teaching certain subjects than others. Moreover, the choice of the teaching method to be used for a learning activity of a particular subject depends on the learning outcome the teacher wants the learners to achieve in the learning activity. If, for example, the learning outcome of an activity focuses on the development of a skill, a more practical method such as conducting an investigation or project or drama may be used.

As regards learning in the new curriculum, knowledge is apparently no longer derived from textbooks or content of the syllabi. Instead, teachers and learners are encouraged to construct, discover, interpret and use knowledge (National Curriculum Statement, 2003) which is appropriate to the context of the learners. Moreover, learners are encouraged to develop such different skills as making judgments and decisions, doing research, analysing and interpreting data, evaluating, critical thinking, measurement and communication. These skills enable learners to apply them in contexts which improve their understanding of their environments and the world (Le Roux, 2003).

The curriculum documents of the new curriculum are the Subject Statements (2003), Subject Assessment Guidelines (2008) and Learning Programme Guidelines (Department of Education, 2003). The Subject Statements (2003) and Subject Assessment Guidelines (2008) are official documents which are prescribed by the National department of education, while the Learning Programme Guidelines (LPG) is not an official document given that it is designed for each subject by the subject teachers in the three grades in the FET Band. When compared to a syllabus approach these documents give greater weight to formative and outcomes-based assessment than high-risk tests and examinations (Griffin, 1998). These documents will be further described below in the section which describes Life Sciences curriculum statement.

2.5. ASSESSMENT IN THE NEW CURRICULUM: OUTCOMES-BASED ASSESSMENT (OBA)

Before OBA can be explained a brief review of educational assessment in South Africa over the past decade will be presented.

2.5.1. Assessment in South Africa over the past decade

The pedagogical paradigm which characterized Apartheid education was teacher-centredness. In this pedagogical paradigm, learning and assessment were largely the responsibility of the teacher (Killen and Vandeyar, 2003). Learners were not given opportunities to construct their own knowledge nor demonstrate it through various performance assessment activities.

In essence assessment in most schools, particularly exit-level (senior certificate) assessment was largely summative, norm-referenced and judgmental in nature. Summative assessment tasks were generally single occasion high stakes tests and examinations (Lubisi 1999) which were used as tools for ranking and selection of learners. Moreover, they frequently sampled what teachers have taught well so that learners could obtain high marks which would enable them to progress to the next grade and to reflect on teachers' high teaching abilities (Killen and Vandeyar, 2003). Consequently, tests and examinations encouraged rote-learning, focused on the recall and regurgitation of content knowledge (Gopal & Stears, 2007) and put little emphasis on the assessment of relevant curriculum learning outcomes, critical thinking skills and higher-order cognitive skills (Tema,1995).

2.5.2. The new curriculum and Outcomes-based assessment

One of the aims for the introduction of the new curriculum in South Africa was to change the assessment practices of teachers in schools. The new curriculum requires teachers to assess learners on their ability to demonstrate the achievement of knowledge, skills, values and attitudes encompassed in the learning outcomes so that learners can be considered competent. This form of assessment is called outcomes-based assessment.

The following principles, which are relevant for this study, inform outcomes-based assessment: standards-referenced assessment; transparent and clearly focused assessment; authentic (performance-based) assessment; the use of different types of assessment (Qualifications and Assessment Policy Framework Grades 10-12, 2003).

Standards-referenced assessment implies that the performance of learners is measured against the assessment standards of the learning outcomes (Killen & Vandeyar, 2003). The assessment standards define a range of levels of achievement of each learning outcome. Learners are expected to demonstrate the achievement of the learning outcomes by meeting the preset criteria (Mitchell, 1989) defined in the assessment standards. Thus when constructing assessment tasks teachers are expected to structure them in such a way that they reflect the assessment standards and allow comparisons of each learner's achievement with the criteria set in the assessment standards (Department of Education, 2003).

Outcomes-based assessment is also a transparent and clearly focused process. This means that the learning outcomes are made available to the learners prior to the assessment process. This assessment approach aims to assist learners to know the performance expected of them and enables them to prepare in advance in case formal assessment will be administered (Department of Education, 2002). It also aims to assist the teacher to assess the progress a learner has made towards the achievement of the learning outcomes (Department of Education, 1998).

Also characteristic of outcomes-based assessment is that teachers are expected to construct authentic (performance-based) assessment tasks, such as individual or group projects, practical work or experiments, so as to allow learners to demonstrate the skills, values and attitudes they have acquired from their classroom learning experiences (Lubisi, 1999). Most commonly, these tasks assess learners' ability to solve real problems by applying (factual, conceptual and procedural) knowledge and understanding in real situations; elicit both lower-order and higher-order cognitive skills in the learners (Lane and Tierney, 2008); and encourage collaboration and active involvement of learners in the learning process (Sieborger

& Macintosh, 2002). However, authentic assessment tasks can also be used formatively to provide feedback about the quality of learners' work to improve their learning (Black & William, 2008).

In outcomes-based assessment any assessment includes different types such as baseline- , diagnostic-, formative- and summative assessment. Summative assessment, which is a concern for this study, is assessment *of* learning. It is concerned with the summation of learners' achievement (Killen, 2007) and is largely used to provide teachers, learners and parents with information about how well a learner has achieved the learning outcomes of the curriculum (Bray ,1986). For this reason, summative assessment is more formal in character and includes prescribed summative assessment tasks such as controlled tests, practical tasks, research projects which are administered during the course of each term or at the end of each term as well as mid-year examinations and end-of-year (terminal) examinations.

Since the results obtained from summative assessment must show the level of learner attainment of the learning outcomes, teachers should design the summative assessment tasks in such a way that they are aligned with the assessment standards of the learning outcomes (Nitko, 1994). These summative assessment tasks are supposed to engage learners' different cognitive levels, for example focusing on the understanding of how facts relate and combine to assist learners to construct concepts which allow them to apply their knowledge and solve problems (Gultig & Stielau, 2005).

In the new curriculum continuous assessment (CASS) is integral to teaching and learning. It is a process of gathering valid and reliable data about the performance of learners which takes place at regular intervals throughout the course or lesson. The main features of CASS are the formative use of assessment (assessment *for* learning) where it is used to assist learners to achieve the learning outcomes, and summative use of assessment (assessment *of* learning) where it is used to measure the extent to which learners have achieved the learning outcomes.

In the SAG document CASS is taken to mean all assessment except the end-of examinations, but the SAG also limits CASS to particular formal assessment tasks. For example in Grade 10 Life Sciences formal CASS tasks are practical tasks, research projects and mid-year examinations. These CASS tasks are weighted at 25%. This ensures that the significance of the end-of- year examination as the principal determinant of learners' progression to the next grade is lessened. Thus in the new curriculum the end-of-year examinations have become just one of the many ways used to assess the performance of the learners. In essence CASS also encompasses the other principles of outcomes-based assessment explained in this chapter: it is a transparent, authentic (performance-based), clearly focused process of assessment based on the learning outcomes and assessment standards.

2.5.3. Implications of Outcomes-based Assessment

In this chapter it has been indicated that the new curriculum requires teachers to assist learners to achieve the learning outcomes, and to measure the degree to which learners have achieved those learning outcomes. This means that in order for the teachers to be able to make valid inferences about learners' performance they must ensure that they construct valid assessment tasks (Killen, 2003). Valid assessment tasks are important particularly when they constitute summative assessment which is used to determine the progress of the learners to the next grade. The two most important requirements which must be met by the summative assessment tasks for them to be valid are the following:

- The assessment tasks must reflect the curriculum learning outcomes which must be assessed (Eisner, 1993).

- The assessment tasks must reflect the cognitive levels implied in the learning outcomes (for example: using concepts and problem-solving) which must be assessed (Killen, 2007).

These requirements suggest that for the assessment tasks to be valid there should be a fit between intended and implemented curriculum (assessment). In the subject of Life Sciences the intended assessment is captured in the Life Sciences Subject Statement (2003) which prescribes the Grade 10-12 learning outcomes and assessment standards and the cognitive levels implied in them. It is also captured most explicitly in the Life Sciences Subject Assessment Guidelines (2008) which specifies the assessment requirements for the learning outcomes and cognitive levels which must be assessed in formal CASS (summative assessment) tasks. The implemented assessment is the actual summative assessment tasks which are constructed by the teachers in order to determine learners' attainment of the grade 10 Life Sciences learning outcomes.

The two important questions which directly relate to the third research question which informed this study are the following: Is the content of the intended curriculum (intended assessment policy) the same as the implemented curriculum (implemented assessment policy)? Do teachers assess what they are officially expected to assess? In answering these questions Dun et al. (2005), assert that "*it is not unusual for teachers to assess [knowledge] and skills that are not stipulated in a subject's learning outcomes*". This statement suggests that generally teachers lack the skills in aligning assessment tasks they construct with the intended learning outcomes. Thus they are faced with a challenge to align assessment tasks with the learning outcomes stipulated in the official curriculum. In support of statement McMillan and Workman (1998) as quoted by Wiley (2008) assert that much research indicates that many teachers lack sufficient competence in constructing assessment tasks, in particular tests which address the required learning outcomes. According to Wiley (2008) teachers often assess basic factual knowledge and rules and have difficulty in constructing assessment tasks which assess higher-order cognitive levels.

The poor alignment of assessment tasks with subject learning outcomes has also been reported by Black (2000). Black (2000) asserts that the findings of many studies on assessment practices show that assessment tasks constructed by teachers encourage rote and superficial learning, and that questions used in these assessment tasks do not reflect what needs to be assessed. Again, this shows that there is a need for teachers to hone their skills of assessing the learning outcomes or the cognitive processes intended in the curriculum.

Echoing the same sentiment for aligning assessment tasks with curriculum learning outcomes, Biggs (1999) questions the validity of assessment tasks which frequently assess some of the learning outcomes more than once to the neglect of the others. Biggs (1999) maintains that in order for the assessment tasks to give valid inferences about the learners' level of attainment of learning outcomes, the assessment tasks must sample all the intended curriculum learning outcomes.

In an attempt to explain the gap between intended and implemented curriculum (assessment), curriculum literature and studies on policy implementation have advanced varied reasons. Amongst these are the following: teachers' lack of knowledge, motivation and low level of planning or preparedness (Mclaughlin, 1998), practical environmental constraints, lack of skill to translate education policy into contextual reality, shortage of resources (Jansen, 2002) and the education policy document itself- which does not provide explicit implementation guidelines resulting in teachers reinterpreting and adapting it to fit their background knowledge (Blignaut, 2007).

2.6. DESCRIPTION OF THE LIFE SCIENCES CURRICULUM STATEMENT

Below is the description of the Life Sciences Curriculum Statement. It consists of Life Sciences Subject Statement (2003), Life Sciences Learning Programme Guidelines (LPG) and the Subject Assessment Guidelines (2008) which are documents for teaching, learning and assessment of life Sciences in the FET Band (Grades 10 -12).

2.6.1. Life Sciences Subject Statement (2003)

The Subject Statement (2003) is an official NCS document which describes the nature, purpose and scope of Life Sciences as well as the learning outcomes and their associated assessment standards. It also demarcates the content and context for attaining the assessment standards of the learning outcomes.

2.6.1.1. Nature and purpose of Life Sciences as a subject

The Subject Statement (2003) describes Life Sciences as a ‘systematic study of the natural and human-made environment’ (p.9). This involves studying the nature of science, the importance of biodiversity and the interdependence of living organisms, ways which promote healthy life styles, ways of ensuring sustainable use of natural resources, the influence of ethics and biases in Life Sciences, and the interrelationship of Life Sciences, technology, indigenous knowledge, environment and society. Understanding the interrelationships of Life Sciences technology, indigenous knowledge, environment and society coupled with the development of appropriate development of attitudes and values is perceived as a way of ensuring learners to be informed and responsible citizens in the South African society (Bezuidenhout, et al., 2007).

The Subject Statement ((2003) also describes the main purpose of Life Sciences as that of enabling learners to: ‘understand biological, physiological, sociological, environmental, technological and ecological processes and their application to human life; use scientific inquiry and problem solving skills to investigate nature; study Life Sciences concepts and processes using indigenous knowledge systems related to science to inform the present' (p.9) The exposure of learners to these different world views (indigenous knowledge and scientific knowledge) enables them to construct new knowledge which in turn promotes socio-economic and technological advancement of the society (Department of Education, 2003).

2.6.1.2. Scope of Life Sciences.

The Life Sciences curriculum aims to develop the following competencies on which learning outcomes are based: Scientific inquiry and problem- solving skills (Learning Outcome 1); Construction and application of Life Sciences knowledge (Learning Outcome 2) and demonstrate an understanding of nature science, the influence of ethics and biases in the Life Sciences, and the interrelationship of science, technology, indigenous knowledge, the environment and society (Learning Outcome 3). Each of the three learning outcomes is accompanied by three assessment standards which must be achieved by the learners. The Grade 10-12 Life Sciences learning outcomes and their associated assessment standards are indicated below in Figure 1.

Figure 1: Learning Outcomes and Assessment Standards

- Learning outcome 1: Scientific inquiry and problem- solving skills
  (The learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills)

1.1. Assessment standard: Identifying and questioning phenomena and planning an investigation.
2.1. Assessment standard: Conducting an investigation by collecting and manipulating data.
3.1. Assessment standard: Analysing, synthesising, evaluating data and communicating findings.

- Learning outcome 2: Construction and application of Life Sciences knowledge
(The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences)

1.2. Assessment standard: Accessing knowledge
2.2. Assessment standard: Interpreting and making meaning of knowledge in Life Sciences.
3.2. Assessment standard: Showing an understanding of the application of Life Sciences knowledge in everyday life.

- Learning outcome 3: Life Sciences, Technology, Environment and Society
(The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in the Life Sciences and the interrelationship of science, technology, indigenous knowledge, the environment and society)

1.3. Assessment standard: Exploring and evaluating scientific ideas of past and and present cultures.
2.3. Assessment standard: Comparing and evaluating the uses and development of resources and products and their impact on the environment and society.
3.3. Assessment standard: Comparing the influence of different beliefs, attitudes and values on scientific knowledge.

The first learning outcome focuses on exploring and investigating phenomena in everyday life using inquiry, problem solving and critical thinking skills. These involve the use of experimental and data-handling skills, usually referred to as 'science process skills' (kempa, 1986). Experimental skills include such skills as making hypotheses, predictions, planning and conducting investigations, observations, measurement, handling and recording data. Data-handling skills involve identifying, selecting, organising, presenting, translating and manipulating data and making inferences, deductions and conclusions from the data gathered.

The second learning outcome focuses on the construction and acquisition of Life Sciences knowledge to explain phenomena relevant to Life Sciences. Learners collect information from their lived experiences and from sources such as books, internet, magazines and newspapers using inquiry and thinking skills in order to interpret, apply and extend their understanding of concepts, principles, laws, theories and models.

The third learning outcome aims to encourage learners' awareness of the existence of different knowledge perspectives in a multicultural society. It enables learners to understand that knowledge viewpoints are tentative since they are based on scientific knowledge, beliefs, attitudes, values and biases which may change over time as new knowledge is discovered. Moreover it promotes learners' understanding of the interrelationship of Life Sciences, technology, indigenous knowledge and their impact on the environment and human lives.
The assessment standards are more detailed statements of factual, conceptual and procedural knowledge as well as skills, values and attitudes required by the learners to show integrated competence (Life Sciences Subject Statement, 2003). In essence they are: teaching and learning objectives, the focus of assessment and must serve as benchmarks for determining the level of attainment of the learning outcomes by the learners at each grade.

Each assessment standard of the three learning outcomes has a different cognitive demand. For example, the first assessment standard tends to assess lower-order abilities while the third assessment standard assesses higher-order abilities. Thus the evidence for the achievement of any learning outcome is acknowledged through learners' minimum performance in these assessment standards which inform the design of the summative assessment tasks. Moreover, each assessment standard of the three learning outcomes is further broken down into grade specific sub-standards which are important for the construction of assessment tasks. The

Grade 10 sub-standards for each assessment standard of the three learning outcomes, as adapted from Life Sciences Subject Statement (2003), are indicated in Table 2.1 to 2.3 below.

Table 2.1: Learning outcome 1 assessment standards and sub-standards

Assessment standards	**Sub-standards**
1.Identify and questioning phenomena and planning an investigation	1. Identify and question phenomena 2. Plan investigation using instructions 3. Consider implications of investigative procedure in a safe environment
2.Conducting an investigation by collecting and manipulating data	1. Systematically and accurately collect data using selected instruments and /or techniques and follow instructions 2. Display and summarise the data collected
3. Analysing synthesizing, evaluating data and communicating findings	1. Analyse,synthesise, evaluate data and communicate findings

Table 2.2: Learning outcome 2 assessment standards and sub-standards

Assessment standards	**Sub-standards**

1. Accessing knowledge	1. Use a prescribed method to access information
2.Interpreting and making meaning of knowledge in Life Sciences	1. Identify concepts, principles, laws, theories and models of Life Sciences in the context of everyday life 2. Describe and explain concepts, principles, laws, theories and models
3. Showing an understanding of the application of Life Sciences knowledge in everyday life.	1. Organise, analyse and interpret concepts, principles, laws, theories and models of Life Sciences in the context of everyday life

Table 2.3: Learning outcome 3 assessment standards and sub-standards

Assessment standards	**Sub-standards**
1. Exploring and evaluating scientific ideas of past and present cultures	1. Identify and investigate scientific ideas and indigenous knowledge of past and present cultures
2. Comparing and evaluating the uses and development of resources and products, and their impact on the environment and society	2. Describe different ways in which resources are used and applied to the development of products, and report on their impact on the environment and society
3. Comparing the influence of different beliefs, attitudes and values on scientific knowledge	1. Analyse, and describes the influence of different beliefs, attitudes and values on scientific knowledge and its application to society

Lastly, it should also be mentioned that the assessment standards do not prescribe the content. But the diversity of fields of inquiry in Life Sciences necessitated the development of content which is expected to be used by examiners and teachers to enhance the achievement of the assessment standards and consequently of the three learning outcomes. (Life Sciences Subject Statement, 2003). This content is organized around the following four knowledge areas: tissues, cells and molecular studies; structures and control of processes in basic life systems; environmental studies; and diversity, change and continuity.

2.6.2. Life Sciences Learning Programme Guidelines

As already indicated in this chapter, the Life Sciences LPG is not an official policy document since it is designed by the Life Sciences teachers for the three grades in the FET Band. However, this document is important in that it serves as a planning tool which specifies the scope of learning, teaching and assessment. It consists of the following parts: 1) subject framework- a structured plan which is used to ensure that knowledge, skills, values, attitudes, contexts and assessment are attended to in a sequential manner across the three grades, 2) work schedule- which provides the teacher with guidance on how to work towards the achievement of the Life Sciences learning outcomes. It is also used to sequence and pace learning, teaching and assessment in a particular grade and 3) lesson plans-which provide guidance on how the learning, teaching and assessment of Life Sciences activities will be carried out.

2.6.3. Life Sciences Subject Assessment Guidelines (2008)

The Life Sciences SAG (2008), is an official NCS document which contains the formal programme of assessment. The formal programme of assessment in grade 10 Life Sciences consists of seven summative assessment tasks which are allocated specific weighting. These summative assessment tasks are the formal CASS tasks which include two practical tasks, one project, two tests and one mid- year-examination paper; as well as the end- of-year examination which is constituted by paper one and two. The practical tasks, projects and tests are set and standardised by Life Sciences teachers within the schools or by the cluster leaders or curriculum implementers. The mid-year examinations are set and standardised by cluster leaders or curriculum implementers at regional level. The end-of-year examinations are set and standardised by the curriculum implementers at the regional level.

Practical task one and two are administered during the first and third term respectively. The same applies to the controlled test one and two. The project is administered during third term while, the mid-year-examination and end-of-year examination are administered towards the end of the second and fourth term respectively. The practical tasks and the project constitute performance assessment. Practical tasks enable learners to conduct experiments or to manipulate materials so that learners can apply their knowledge and demonstrate the development of problem solving skills and science process skills. These skills are mostly assessed through hands-on activities and hypothesis testing. The project enables learners to construct something or to demonstrate investigative skills. In a nutshell the practical tasks and the project require learners to perform in some way or to create an answer or a product that demonstrates Life Science knowledge or skills.

The SAG (2008) outlines the percentage weightings (marks) of the learning outcomes in controlled tests and examination papers as indicated in Table 2.4 below.

Table: 2.4.Percentage weighting (marks) of the learning outcomes in controlled tests and examinations papers.

Controlled tests	**Mid-year examinations**	**End-of-year examinations**

LO 1: 40% LO2: 40% LO3: 20%	LO 1: 40% LO2: 40% LO3: 20%	LO 1: 40% LO2: 40% LO3: 20%

The SAG (2008) also requires:

- Practical tasks to assess the ability to: follow instructions, make accurate observations, work safely, use and handle apparatus appropriately, measure effectively, gather and record data using drawings, graphs, and tables.
- Research projects to be investigative tasks which must assess the three Life Sciences learning outcomes, focusing on accessing knowledge through literature research and primary resources.
- Controlled tests and examinations to be balanced in terms of the cognitive levels, learning outcomes and assessment standards
- Controlled tests and examinations to assess the three Life Sciences learning outcomes using the knowledge areas that were covered in the particular term or terms.

The SAG (2008) also stipulates that examinations should consist of sections A, B and C. Section A should include question types such as multiple choice questions, terminology, matching items and diagrams. Section B should include questions which assess a variety of skills and competences and be based on data in various forms, paragraphs and drawings. Section C should consists of a question based on a case study, or data analysis and interpretation, as well as an essay question which should assess all the learning outcomes but mainly learning outcome 3. Lastly, the SAG (2008):

- Does not mention the cognitive levels and learning outcomes (and their percentage weightings) which must be assessed in practical tasks.

- Does not mention cognitive levels (and their percentage weightings) which must be assessed in the research projects. However, it mentions the three learning outcomes which must be assessed in the research projects, but with no percentage weightings for these learning outcomes.
- Does not mention the cognitive levels (and their percentage weightings) which must be assessed in controlled tests. However, it mentions the three learning outcomes (and their percentage weightings) which must be assessed in the controlled tests.
- Mentions the cognitive levels and learning outcomes (and their percentage weightings) which must be assessed in examinations.

2.7. CONCLUSION

This chapter has explored curriculum reform in South Africa which became an urgent priority after 1994 when the new democratic government was elected. It has discussed learner-centred education, integrated knowledge and outcomes-based education as key principles which underpinned the new curriculum. It has also discussed outcomes-based assessment as well as Life Sciences Subject Statement (2003), Life Sciences Learning Programme Guidelines (LPG) and the Subject Assessment Guidelines which constitute the Life Sciences Curriculum Statement (2008).

CHAPTER 3
RESEARCH METHODOLOGY

3.1. INTRODUCTION

This chapter describes the research methodology which led to the generation of quantitative data from the documents which were analysed in order to answer the questions which guided this study. First, the purpose of the study will be explained. Second, quantitative research, as an approach chosen for this study, will be explained. Third, a justification for choosing document analysis as a research design which informed this study will be provided. This will be followed by a description of this research strategy. Fourth, the Revised Bloom's Taxonomy, a tool which was used to analyse the contents of Grade 10 Life Sciences question papers, Life Sciences Subject Statement (2003) and SAG (2008), will be described. The schools from which the question papers were obtained and the sampling method used in their selection will also be described, and lastly, the strategies used for data analysis and to enhance the trustworthiness of this study will be discussed**.**

3.2. THE PURPOSE OF THE STUDY

As mentioned in chapter one, the purpose of this study is to determine the extent to which formal CASS tasks (practical tasks, research projects, controlled tests and mid-year examinations) and end-of-year examinations obtained from three schools assess the different cognitive levels and learning outcomes prescribed by the SAG (2008) for Grade 10 Life Sciences. However it was not my intention to generalise the findings of this study across contexts as they might not be pertinent to all the schools. Rather I hoped that the analysis and description of the sample of formal CASS tasks and end-of-year examination papers (summative assessment tasks) which were obtained from these schools would give an in-depth description of the assessment in the three schools.

This study was guided by the following research questions:

1) What are the requirements of the Subject Assessment Guidelines (2008) for Life Sciences in terms of the:

   a. cognitive levels

   b. and learning outcomes (intended assessment policy)?

2) What are the:

   a. cognitive levels

   b. and learning outcomes represented in the actual assessment tasks in three schools (implemented assessment policy)?

3) What is the 'fit' between the intended assessment policy and the implemented assessment policy?

In order to answer these research questions the Life Sciences Subject statement (2003) and Subject Assessment Guidelines (2008) which are official documents, were analysed. Second, the 2007 and 2008 Grade 10 Life Sciences assessment tasks for formal CASS and end-of-year examinations which were obtained from three schools in the Mpumalanga province were also analysed. Third, alignment between the intended and enacted assessment strategies was investigated.

3.3. POST-POSITIVISM AND QUANTITATIVE RESEARCH APPROACH

A quantitative research approach within a post-positivist frame work was used for this study. Quantitative researchers are interested in a systematic investigation of the relationships between phenomena. They may ask specific narrow research questions or formulate deductive hypotheses about phenomena which can be measured. In order to answer the research questions and confirm or reject the hypothesis quantitative researchers use numbers, tables and graphs which serve as a means by which collected observations (data) are expressed and to describe the relationship between the phenomena under study. Normally a considerable sample of data is collected which require verification, validation and recording before it is analysed.

The fact that quantitative research is a systematic process of investigation suggests that quantitative researchers know clearly in advance what they are looking for. Unlike qualitative researchers who may redesign some aspect of their studies while they are in progress and develop the codes while analysing the data, quantitative researchers carefully design all the aspects of their studies before data are collected and develop the codes before data are analysed.

In quantitative research qualitative (textual) data can be coded and analysed quantitatively. That is, qualitative data can also be assigned meaningful numbers which can then be manipulated to help the quantitative researcher infer the meaning of the data.

Lastly, Maree (2007) maintains that some quantitative researchers rely on a post-positivist framework to knowledge in order to develop knowledge from textual data. These 'researchers have an interest in some aspects of positivism such as quantification, yet wish to incorporate interpretivist concerns around subjectivity and meaning, and who are interested in the pragmatic combination of qualitative and quantitative methods' (Seale 1999 cited in Maree, 2007, p.65). Post-positivist researchers also believe that: knowledge is imperfect and that truth (reality) cannot be perfectly understood since it is influenced by many contextual factors such as culture, values beliefs, gender and language; objectivity in research can never be totally achieved, and therefore research is in part subjective; and that reality is subjective and mentally constructed by the person involved in the research. For this reason their concern is to establish and search for valid and reliable evidence in terms of the existence of phenomena rather than generalisations.

3.4. DOCUMENT ANALYSIS.

3.4.1. Justification for choosing document analysis as a research strategy.

The research strategy which informed this study was document analysis. According to Henning (2005) document analysis becomes a research strategy when documents are the main source of data, and when the procedures which are used to gather data from the documents are also the main analytical tool in the study. Given the purpose of this study and that primary data were the curriculum documents and summative assessment tasks (formal CASS tasks and end-of-year examinations), document analysis was an appropriate research strategy to use for this study.

Document analysis was advantageous because documents were freely available. They did not involve the collection of new data, and they could be collected during a shorter space of time than the data which could be based on interviews, questionnaires and observation. Moreover, as Harber (1997) observed, they could be analysed when institutions such as schools were closed in the absence of research participants.

The documents which were analysed in this study reflected the intended assessment envisaged in the Life Sciences SAG (2008) and the Subject Statement (2003), as well as the enacted assessment policy in the three schools which would not be easily investigated through interviews, observation and questionnaires.

Lastly document analysis was chosen as a research strategy because the documents which were used for this study were constructed before the study commenced. It would have been difficult to get hold of the educators who constructed them so that they could be interviewed or be given a questionnaire to state their regarding the intended assessment policy and the enacted assessment policy. Thus in a way these documents conveyed the messages and perspectives of the educators who constructed them.

3.4.2. Description of document analysis (content analysis)

Document analysis, which is also called content analysis, is a research strategy in which a public record is the unit of analysis. Dane (1990) describes it as a systematic examination of written or visual contents of a communication. It can be utilised in situations where the researcher requires a means of sytematising and quantifying qualitative data which does not suit the research purpose. Thus this research strategy deals with data which was generated before the study commenced.

Various purposes can be served through document analysis. Holsti (1968) in Dane states that it can be used to determine: 1) the changes in content over time, 2) the relationship between the characteristics of the author of the document and the content and 3) the extent to which the content of the document conforms to some external standards. Document analysis can also be used to: 4) discover the relative importance of, or interest in, certain topics or problems, 5) discover level of difficulty of presentation in textbooks or other publications, 6) to analyse types of errors in learners' work and 7) to describe prevailing practices or conditions. The third and seventh functions were the concerns of this study because it aimed at describing the alignment between the actual assessment practice in the three schools (enacted assessment) and the official assessment requirement (intended assessment policy) stipulated in the Life Sciences SAG (2008).

Neuman (2000) lists the following steps which should be followed in analyzing the contents of documents: 1). *determining the purpose of research* - such as testing the hypothesis where it is used to investigate the relationships of phenomena. In this study the ‘fit’ between the Life Sciences intended assessment and the enacted assessment was investigated, 2) *definition of important terms/constructs* which will be considered during the analysis of the content – For example, in this study important terms such as learning outcomes, assessment standards, cognitive levels and knowledge types were defined, 3) *specification of unit of analysis and the target of analysis* - the units of analysis are the exact entity to be analysed in a study and the target of analysis is what is look at in the unit of analysis. According to Dane (1990) and Bailey (1982) the clarification of the units of analysis and the target of analysis are important in content analysis in order to establish the categories which reflect the purpose of the study and which are needed to answer the research questions. In this study the units of analysis were the sentences in: the Life Sciences Subject statement (2003), the SAG (2003) and the summative assessment tasks. The targets of analysis in the sentences of the Life Sciences Subject Statement (2003) were the assessment standards of the learning outcomes and the cognitive levels and knowledge types which are identified in the assessment standards. The targets of analysis in the sentences of the SAG (2008) were the assessment requirements for the learning outcomes and cognitive levels and knowledge types which must be assessed in summative assessment tasks. The targets of analysis in the sentences (test items) of summative assessment tasks were the assessment standards of the learning outcomes as well as the cognitive levels and knowledge types which were assessed, 4) *location of data*- here the researcher locates relevant documents which contains the textual data which will be analysed in order to answer the research questions or to investigate the research hypothesis, 5) *the development of the sample plan* – in this step the researcher decides on the sampling strategy to be used in order to identify the places or institutions from which the required documents whose content will be analysed. For example, the researcher may decide to use purposive sampling to select the schools which she/he knows might possess the summative assessment tasks which are required for the purpose of her/ his research purpose and 6) *formulation of coding categories* – here the researcher formulates relevant categories which are clear in such a way that they could be used by another researcher to analyse the same content and get the same results.

In document analysis the qualitative data which are analysed are coded and transformed into numerical data (charts, tables and graphs) which are then used to answer the research questions or confirm or reject the hypothesis.

3.5. ANALYSIS TOOL: THE REVISED BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES.

It has been indicated in this chapter that the Revised Bloom's Taxonomy was used as an analysis tool to examine the contents of the summative assessment tasks, Life Sciences Subject Statement (2003) and the SAG (2008). Before this tool can be described, a brief description of the original taxonomy, the Blooms' Taxonomy of Educational objectives, will be presented. The similarity between educational objectives and the learning outcomes and their assessment standards, which are the concern of this study, will also be highlighted.

3.5.1. Bloom's Taxonomy of educational objectives (Original taxonomy).

This tool consisted of the affective, psychomotor and cognitive domains (Eisner, 1967). The cognitive domain, which is the primary focus of this study, pertained to outcomes which had to do with the recall or recognition of factual knowledge and the development of cognitive skills. This domain consisted of the following six major cognitive levels which were situated on a single dimension: Knowledge, Comprehension, Application, Analysis, Synthesis and

Evaluation. These cognitive levels were arranged hierarchically from knowledge, which was the lowest and concrete level of cognition, to evaluation the highest and most abstract level of cognition (Anderson, 2005). Mastery by a learner of the lower and simpler cognitive levels was a prerequisite to mastery of the higher and more complex ones. According to Bloom (1956) educators could use these cognitive level: to design teaching objectives which would promote both lower and higher order cognitive processes for meaningful learning to occur, to design assessment tasks which could be used to assess the attainment of the educational objectives by the learners, and to analyse test items in order to determine the types of objectives and cognitive levels they assess.

According to Eisner, (1967) educational objectives are standards against which the achievement of curriculum outcomes is to be measured. Educational objectives contain the verbs which describe the actions and cognitive skills the learner must display at the end of teaching (Anderson, 2002). They also contain the content - stated in nouns or noun phrases- which must be learned in order to achieve the objective (Anderson, 2002). An analysis of the learning outcomes and their assessment standards using the Taxonomy Table of the Revised Bloom's Taxonomy revealed that the learning outcomes and their assessment standards were also structured in the same way as educational objectives. Therefore the learning outcomes and their assessment standards are just mandated educational objectives, and like the educational objectives, the extent to which they are assessed in an assessment task can be determined.

3.5.2. The Revised Bloom's Taxonomy.

To keep Bloom's taxonomy relevant to today's cognitive theories, a group of researchers in the fields of cognitive psychology and education, collaborated with Krathwohl and Anderson (2002) and published a Revised Bloom's Taxonomy. The Revised Bloom's Taxonomy is considered appropriate for analysing educational objectives, hereafter referred to as learning outcomes, as well as assessment tasks. It consists of two dimensions: the knowledge dimension and the cognitive process dimension. These dimensions are represented by the following Taxonomy Table.

Table 3.1. The Taxonomy Table of the Revised Bloom's Taxonomy

	The Cognitive Process Dimension					
The Knowledge Dimension	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta-cognitive Knowledge						

The knowledge dimension incorporates four types of knowledge. The cognitive process dimension includes six cognitive levels which can be applied to the four types of knowledge. This implies that a learning outcome can fall under any one of the four types of knowledge of the knowledge dimension, and under any one of the six categories of the cognitive process dimension in the Taxonomy Table. Cells are formed where the types of knowledge and the cognitive levels intersect in the Taxonomy Table. Therefore each cell classifies and gives a visual representation of the cognitive level and the type of knowledge addressed in a learning outcome. In case a learning outcome falls in more than one cell, it is classified according to the most complex cognitive level (Anderson, 2002).However, Krathwohl (2002) says if a learning outcome falls in more than one cell it must be placed in all the cells to show the different cognitive levels and types of knowledge it addresses.

Using the Taxonomy Table (Table 3.1) I could analyse the assessment standards stipulated in the Life Sciences Subject Statement (2003) in order to understand the cognitive levels and knowledge types they address. Moreover, because any form of assessment task is connected to the learning outcomes (Airasian & Miranda, 2002), the Taxonomy Table provided a way to examine the different cognitive levels and the assessment standards of the learning outcomes which were assessed in the test items of the summative assessment tasks. It gave an immediate overlap between assessment standards and assessment tasks.

Below is a brief description of the cognitive levels/processes and the types of knowledge in the Revised Bloom's Taxonomy. This description has been adapted from Mayer (2002), Krathwohl (2002), Airasian & Miranda (2002) and Anderson (2002).

Cognitive levels:

The cognitive levels which are stated in verb forms are arranged hierarchically as follows: Remember, Understand, Apply, Analyse, Evaluate, and Create (Krathwohl, 2002). The verbs in each learning outcome determine the cognitive levels addressed in a learning outcome. Within each cognitive level there are specific cognitive processes which are formed by verbs but stated as nouns (gerunds). These specific cognitive processes describe the breadth and boundaries of the cognitive level addressed in the learning outcome (Airasian & Miranda, 2002).Therefore in order to determine the cognitive levels addressed in the learning outcome the educator must examine the verbs or gerunds used in that objective.

Remember is a cognitive level which operates when the learning outcome requires the retention of knowledge as it was taught. It involves the retrieval of knowledge from long term memory. When the aim of teaching or assessment task is on rote learning isolated from context, the focus is only on remembering fragments of knowledge. Thus the cognitive level which is addressed in that learning outcome or assessment task is only about the recall of knowledge which was learned. The specific cognitive processes associated with remember are *recognising* and *recalling.* Recognition involves identifying knowledge in memory. For example in Life Sciences, a learning outcome could be “Identify the structures of the human digestive system”. A corresponding test item would be “Label parts A (esophagus), B (pancreas) and C (duodenum)”. Recalling involves retrieving knowledge from memory. For example in Life Sciences a learning outcome could require “Knowledge of biological terms”. A corresponding test item would be “Give the correct biological term for each of the following statements”.

Understand is a cognitive level which operates when meaning is constructed from an instructional message or assessment task by making connections between new knowledge and existing knowledge. For example, in a test a learner might demonstrate an understanding when she solves a new problem using her prior knowledge. The specific cognitive processes associated with this cognitive process are: *interpreting*-converting information to another, as in clarifying something; *exemplifying*- giving an example or instance of a general concept or principle; *classifying*-determining the category into which something or instance belongs; *summarizing*-generating a short statement to represent something learned or to abstract a general theme; *inferring*-drawing a logical conclusion from information learned or presented; *comparing*-detecting similarities and differences between objects, events ideas or situations; and *explaining*-constructing a mental model and using a cause and effect model of a system.

Apply is a cognitive level which is used when a learning outcome involves the use of procedures to solve a problem. It is closely linked to procedural knowledge because it involves methods of doing something and methods of inquiry. For example, a learning outcome which requires learners to “investigate whether the water in a local water source is suitable for use or not” might require learners to use the prescribed methods to test the acidity, alkalinity or neutrality of water. The specific cognitive processes associated with this cognitive level are: *executing* which involves the application of a procedure to a familiar task and *implementing* which involves an application of a procedure to an unfamiliar task.

Analyze is a cognitive level which is used when a learning outcome involves breaking up the material into its constituents, and finding out how the parts are related to each other and to the whole structure. A learning outcome could be “determine relevant apparatus for planning a biological experiment and the way in which they fit together to conduct the experiment”. The corresponding test item may ask learners to select and organise experimental apparatus from those given which fit together to conduct the experiment successfully. The specific cognitive processes in this cognitive level are *differentiating*, *organising* and *attributing*. Differentiating occurs when a selection of relevant or important parts from irrelevant ones is done in the presented material. Organising involves determining how various elements of a structure function together within a structure. Attributing involves determining the point of view, biases values, or the intent underlying the presented material

Evaluate is a cognitive level which is used when a learning outcome involves making judgments based on criteria and standards. The criteria for evaluation can be quality, effectiveness, efficiency and consistency. The standards for evaluation may be qualitative or quantitative. A learning outcome could be “to design quality experiments”. In Life Sciences a corresponding test item may require learners to detect inconsistencies in a given experiment. The specific cognitive processes associated with this cognitive level are *checking* and *critiquing*. Checking involves detecting inconsistencies within a product or process. When combined with such specific cognitive processes as *planning* and *implementing*, checking involves how well a plan is working. Critiquing occurs when the detection of inconsistencies between products based on external criteria is done.

Create is a cognitive level which is used when a learning outcome requires the production of a novel and original product such as writing an essay on the biological importance of the process of photosynthesis. It involves reorganizing elements into a new structure. The specific cognitive processes associated with this cognitive level are *generating*, *planning* and *producing*. Generating involves inventing tentative solutions to a problem. Planning involves designing or devising a method or plan for doing a task. Producing involves the actual construction or invention of a product.

Types of knowledge:

The knowledge dimension consists of four general types of knowledge which are appropriate for all subjects and grade levels in a school (Anderson, 2002).They are Factual knowledge, Conceptual knowledge, Procedural knowledge and Meta-cognitive knowledge. Each type of knowledge is described using various noun phrases. In order to determine the type of knowledge being addressed in the learning outcome the analyst must identify the noun phrase. These types of knowledge cross all the cognitive levels of the cognitive process dimension. This is because the learning outcomes which are designed or assessed by educators may require the learner to remember, understand, apply, analyse, evaluate or to create knowledge (Anderson, 2002).

Factual knowledge consists of the terms, details, facts and elements which must be known by the learners in order to be familiar with a particular subject matter or to solve problems in it (Krathwohl, 2002).

Conceptual knowledge is knowledge of: 1) classifications – ability to organise into categories; 2) principles – to know standards; 3) generalisations - ability to simplify; 4) theories - ability to form hypothesis; 5) models and 6) structures (Krathwohl, 2002).

Procedural knowledge is knowledge of how to do or make something (Anderson, 2002). It is knowledge of subject-specific methods, techniques, algorithms, skills as well the criteria one uses to determine when one must use procedural knowledge.

Meta-cognitive knowledge is knowledge of general strategies for learning, thinking and problem solving and the conditions under which these strategies can be used (Airasian & Miranda, 2002). It includes knowledge of the various strategies learners might use to memorise learning material, to extract meaning from a written text, to understand what they read from a book or hear in the classroom, and to plan, control their learning and thinking (Pintrich, 2002).

From the above discussion of the Revised Bloom's Taxonomy it is clear that the knowledge dimension cannot be separated from the cognitive process dimension. This is because any learning outcome has the content which is the knowledge a learner is expected to learn, and a verb which shows what the learner must do with the content or to that content (Anderson, 2002).

The major limitation of the Revised Bloom's Taxonomy is that different analysts may not agree on the cognitive levels and type of knowledge which are addressed in a learning outcome or assessed in an assessment task. Analysts may differ in their understanding and interpretations of the verbs and nouns or noun phrases used in the learning outcome or in an assessment task which can lead to the placement of the same learning outcome or assessment task in different cells of the Taxonomy Table.

3.6. SAMPLING METHOD USED FOR THE SELECTION OF THE SCHOOLS

The method which was used for the selection of the schools was purposive sampling. This method of sampling involves the selection of sites which possess the characteristics being sought and to locate the people involved in the event to be studied (Cohen, Manion & Morrison, 2008).

The selection of these schools was based on the following criteria: First, question papers on formal CASS tasks and end-of-year examinations were well kept in these schools because they had Life Sciences cluster leaders. A Life Sciences cluster is formed by a group of Life Sciences teachers who are teaching in neighboring schools**.** These teachers elect an experienced and knowledgeable Life Sciences teacher to lead them in matters pertaining the teaching, learning and assessment of Life Sciences. Essentially, the core duties of a Life Sciences cluster leader are to organize cluster workshops, monitor the moderation of formal CASS tasks and CASS marks, and to design learning and assessment activities for his/her cluster.

Cluster leaders work closely with the curriculum implementers who give them official Life Sciences documents which must be disseminated to different schools. The curriculum implementers also advise them about the construction and standardisation of formal CASS tasks to be administered by the teachers in the schools. Therefore it was assumed that cluster leaders kept all Life Sciences documents and were experts in the construction of assessment tasks.

Second, the schools administered research projects, practical tasks and controlled tests which were set and standardised by Life Sciences teachers or by the cluster leaders. Third, they administered standardised mid-year examinations which were set by the cluster leaders or by curriculum implementers at regional level. Lastly, the schools administered standardised end-of-year examinations which were set by the curriculum implementers at the regional level. Based on the above criteria I was able to obtain the question papers needed for this study.

3.7. DESCRIPTION OF THE SCHOOLS

The question papers which were analysed in this study were obtained from Life Sciences cluster leaders of three schools. These schools are located in three different circuits in the Gert Sibande region of the Mpumalanga province. They are all urban FET schools and are funded by the Mpumalanga Department of Education. In these schools a majority of Grade 10 learners take Life Sciences as a subject. Moreover all the three schools have well qualified Life Sciences teachers, one of whom has been a Life Sciences cluster leader for two consecutive years.

School A is located in the Bethal circuit. This school is mono-cultural, with only black African teachers and learners. Learners in this school come from working class families, and English is the only official language of teaching and learning. It has limited resources.

School B is located in Stan-West circuit. It is a multi-cultural school with Black, Indian and Coloured learners from middle- and working class families. There are only Black and Indian teachers in this school. English is the only official language of teaching and learning. It has adequate resources.

School C is located in the Volksrust circuit. This school is multi-cultural, with Black, White and Indian teachers and learners. Learners come from middle- and working class families. English and Afrikaans are the official languages of teaching and learning in this school. It has adequate resources.

3.8. DETERMINATION OF THE AUTHENTICITY OF THE DOCUMENTS USED IN THE STUDY

According to Neuman (2000) the authenticity of the documents must be established in order to show the credibility of the study. The authenticity of the question papers was established by checking their contents and the dates in which they were administered to the Grade 10 learners. Authenticity of the question papers was further established by asking Grade 10 Life Sciences cluster leaders and teachers from other schools to confirm their legitimacy. The Life Sciences Subject Statement (2003) and SAG (2008) were authentic in that they were official documents which were disseminated to all the schools by the National Department of Education.

3.9. DATA ANALYSIS STRATEGY

To answer the research questions the following procedure was followed in the analysis of the documents:

3.9.1. Analysis of the Life Sciences SAG (2008) in terms of a) cognitive levels and b) learning outcomes

3.9.1.1. Practical tasks

The SAG (2008) is not explicit about the percentage weightings of the cognitive levels and learning outcomes which must be assessed in the practical tasks. It only described the abilities/science process skills which must be assessed in practical tasks. Using the Taxonomy Table of the Revised Bloom‘s Taxonomy the action verbs and nouns or noun phrases in these abilities were examined in order to determine the cognitive levels and type of knowledge as well as the learning outcome (s) implied in them. The analysis of these abilities showed that practical tasks should only assess the third cognitive level (application of procedural knowledge) and learning outcome one, which were then tabulated with a percentage weighting of 100%.

3.9.1.2. Research project

The SAG (2008) requires research projects to be investigative tasks which assess the three learning outcomes, and focus on accessing knowledge through literature research and primary resources. An analysis of these assessment requirements led to the conclusion that different research projects must have variable percentage weightings for the three learning outcomes and cognitive levels. It was also concluded that in research projects all the cognitive levels were assessed in order to enable learners to ‘apply, analyse, evaluate and create based on factual, conceptual and procedural knowledge they have previously gained’ (Ferguson, 2002).The three learning outcomes and the different cognitive levels were then tabulated, but without the percentage weightings .

3.9.1.3. Controlled tests

With regards to the controlled tests, the official percentage weightings of the three learning outcomes which are prescribed in the SAG (2008) were analysed and tabulated. Since the SAG (2008) also does not prescribe cognitive levels (and their official percentage weightings) which must be assessed in controlled tests, they could not be tabulated.

3.9.1.4. Mid and end-of-year examinations

For mid and end-of-year examinations the SAG (2008) prescribes the cognitive levels which were adapted from the original Bloom's Taxonomy. Table 3.2 shows the cognitive levels (and their percentage weightings) of the adapted Bloom's Taxonomy prescribed in the SAG (2008) and before they were analysed with the Revised Bloom's Taxonomy.

Table3.2. Cognitive levels (and their percentage weightings) of the adapted Bloom's Taxonomy prescribed in the SAG (2008) for mid and end-of- year examinations

BLOOM'S CATEGORY NAME	CATEGORY REFERENCE	ITEM RECOGNITION DETAILS	%WEIGHTING
KNOWLEDGE	A	Items require recall of facts	30

COMPREHENSION • Interpretive • Verbal • Numerical	B (BI) (BV) (BN)	Items require more than "A" and assess understanding of routine and familiar material: e.g. from verbal to symbolic and/or from symbolic to verbal e.g. explanations e.g. standard exercises	20
APPLICATION	C	Items require the application of abstractions and generalizations to new, novel or unfamiliar situations	30
HIGHER ABILITIES: • Analysis • Synthesis • Evaluation	D	Items require: Analysis of data and pattern recognition Synthesis of data Evaluation of data against given criteria	20

These cognitive levels and their official percentage weightings were analysed using the Revised Bloom's Taxonomy. Table 3.3 shows the cognitive levels (and their percentage weightings) of the Revised Bloom's Taxonomy which resulted after the analysis of the cognitive levels of the adapted Blooms' Taxonomy. Lastly, the official percentage weightings of the three learning outcomes which must be assessed in mid and end-of year examinations were also analysed and tabulated.

Table 3.3. Cognitive levels (and their percentage weightings) of the Revised Bloom's Taxonomy for mid and end-of- year examinations

Revised Bloom's cognitive levels	**% Weighting**
Remember factual knowledge	30
Understand factual knowledge Understand conceptual knowledge Understand procedural knowledge	20
Apply conceptual and procedural knowledge	30
Analyse factual, conceptual and Procedural knowledge	20
Create conceptual and procedural knowledge	
Evaluate conceptual and procedural knowledge	

3.9.2. Analysis of the Life Sciences Subject Statement (2003), formal CASS tasks and end-of-year examinations.

The first step taken to answer the second research question involved the analysis of the Life Sciences Subject Statement (2003), formal CASS tasks and end-of-year examinations. Examplars of analysed formal CASS tasks and end-of-year examination papers are shown in appendices A, B, C, D and E.

3.9.2.1. Analysis of the Life Sciences Subject Statement (2003) in terms of the cognitive levels addressed in the assessment standards of the learning outcomes

Using the Taxonomy Table of the Revised Blooms' Taxonomy the assessment standards of the learning outcomes which are stipulated in the Subject Statement (2003) were also analysed. The aim was to determine the different cognitive levels and types of knowledge addressed by the assessment standards, thereby gaining enough insight into their nature. This knowledge was essential for the analysis of the test items of the summative assessment tasks. In each assessment standard of the learning outcomes the verb(s) or gerund(s) which characterised the cognitive level(s), and noun(s) or noun phrase(s) which characterized the type (s) of knowledge addressed in that assessment standard were identified. The assessment standards were coded and placed into relevant cells of the Taxonomy Table for each learning outcome. Thus each learning outcome had one Taxonomy Table. The Taxonomy Tables served as templates for validating the assessment standards and learning outcomes which were assessed in the test items of the question papers.

3.9.2.2. Analysis of the test items in question papers on formal CASS tasks and end-of-year examinations.

The total number of question papers which were analysed was thirty six. There were twenty eight question papers on formal CASS tasks and eight on the end-of-year examinations. Table 3.4 shows the number and type of the summative assessment tasks which were analysed per school.

Table 3. 4. Number and type of summative assessment tasks analysed per school

SCHOOL A

	Controlled tests	Practical Tasks	Projects	Mid-year exams	End-of-year exams
2007	2	2	-	-	2 (p1&2)
2008	2	1	1	-	-
Total	**4**	**3**	**1**	**-**	**2**

SCHOOL B

	Controlled tests	Practical Tasks	Projects	Mid-year exams	End-of-year exams
2007	2	2	1	-	-
2008	2	2	-	1	2 (p1&2)
Total	**4**	**4**	**1**	**1**	**2**

SCHOOL C

	Controlled tests	Practical Tasks	Projects	Mid-year exams	End-of-year exams
2007	2	1	1	1	2 (p1&2)
2008	2	1	1	1	2 (p1&2)
Total	**4**	**2**	**2**	**2**	**4**

The analysis of test items in question papers on formal CASS tasks and end-of-year examinations was as follows: In each test item the verb and the noun or noun phrase were examined. The verb (an action verb or adverb) indicated the cognitive level which was assessed by the test item, while the noun or noun phrase indicated the type of knowledge which was assessed in that test item. Where a test item had two or more verbs which indicated that it was assessing more than one cognitive level, it was taken to be assessing the highest cognitive level.

Each test item was re-examined to determine the assessment standard it assessed. This assessment standard was in turn, used to determine the learning outcome which was assessed in the test item. Then each test item was coded twice - once according to the Revised

Bloom's Taxonomy which indicated the cognitive level and the type of knowledge which are assessed by the test item, and secondly according to the assessment standard and learning outcome which are assessed by the test item.

In short answer questions such as multiple choices, matching and supply (terminology), true or false questions, clues about the cognitive levels and knowledge which were assessed were found in the introductory statements of the questions. These are written statements which instructed the learners what to do in a question- such as "choose the correct answer…" or "match the statements in column A with statements/terms in column B...", or "indicate whether the following statements are true or false…" or "give the correct biological term…".The action verbs in these statements indicated the cognitive levels which were assessed in the question, while the noun phrases indicated the type of knowledge which was assessed. The statements were re-examined to determine the assessment standards they assessed. These assessment standards were in turn, used to determine the learning outcomes which were assessed in the statements. Each statement was coded twice - once according to the Revised Bloom's Taxonomy to indicate the cognitive level and the type of knowledge which are assessed by the statement, and secondly according to the assessment standard and learning outcome which are assessed by the statement**.**

In extended response questions such as essays, clues about the cognitive levels and the types of knowledge which were assessed were found in the action verbs or adverbs and nouns or noun phrases used in the rubrics or from those used in the instructions of the essays. The rubrics and the instructions of the essays were re-examined to determine the assessment standards of the learning outcomes which were assessed. The rubrics and the instructions of the essays were also coded twice - once according to the Revised Bloom's Taxonomy to indicate the cognitive level and the type of knowledge which are assessed, and secondly according to the assessment standard and learning outcome which are assessed.

3.9.2.3. The determination of average percentage weightings of the different cognitive levels, assessment standards of the learning outcomes in the formal CASS tasks and end-of-year examinations.

The second step taken towards answering the second research question involved determining the percentage weightings of the different cognitive levels and the assessment standards of the learning outcomes which were assessed in each question paper.

The cognitive levels and the assessment standards of the learning outcomes which were obtained from the analysis of the question papers were entered into spread sheets using the Microsoft Excel programme. Each question paper had a spread sheet consisting of the following five coding categories: the test item (or question) numbers taken from the question paper, cognitive level which was assessed by the test item, assessment standard and learning outcome were assessed by the test item, number of marks allocated to the test item, and the percentage weighting (mark) of the test item in the question paper.

Using Microsoft Excel programme the marks allocated to each test item or question in each question paper were converted into percentage in the spread sheet. This indicated the percentage weighting (mark) of the cognitive level and the assessment standard of the learning outcome which was assessed by each test item or question in each question paper. In that thirty six question papers obtained from the three schools were analysed, thirty six spread sheets were produced- twenty eight for the formal CASS tasks (twelve for controlled tests, nine for practical tasks, four for research projects, three for mid- year examinations) and eight for end-of-year examinations. The percentage weightings (marks) of the cognitive levels in the spread sheets were then used to calculate the average percentage weightings the each cognitive level which was assessed in each formal CASS task and end-of-year examination papers. The percentage weightings of the assessment standards were also used to calculate average percentage weightings of the learning outcomes which were assessed in each type of formal CASS task and end-of year examinations papers. The average percentage weightings of the cognitive levels and learning outcomes which were assessed in formal CASS tasks and end-of-year examinations are shown in summary statistic Tables 4.8 to 4.11.

3.9.3. Comparison of the official assessment requirements and the implemented assessment

In order to determine the fit between intended and implemented assessment tables 4.12 to 4.23 were constructed. The tables compare the percentage weightings prescribed for the cognitive levels and learning outcomes in the SAG (2008) with the average percentage weightings of the cognitive levels and learning outcomes which were assessed in formal CASS tasks and end-of-year examinations.

3.10. STRATEGIES USED TO ENHANCE THE VALIDITY AND RELIABILITY OF THIS STUDY.

In quantitative research reliability and validity are conceptualized differently than in qualitative research. In qualitative quantitative research designs reliability and validity refer to the trustworthiness and credibility of data analysis procedures and data interpretation (Henning, 2005).According to Terre Blanche & Durrheim (1999) in quantitative research the concept of reliability refers to the extent to which research results from the research instrument are consistent on repeated trials. They describe validity as the extent to which the research results which are produced by the researcher are believable to the researcher, research participants and the person who reads the study.

In this study the following strategies adapted from Maree (2007) were used to enhance the reliability and validity of the study.

- Contents and the dates of the question papers obtained from Life Sciences cluster leaders of the three schools were checked.
- Life Sciences cluster leaders and teachers from other schools were consulted to confirm the legitimacy of the question papers by comparing the contents of question papers which were administered in their schools with the content of the question papers obtained from the cluster leaders of the three schools.
- Multiple sources of data were used to overcome biases in data analysis and interpretation. Twenty eight question papers on formal CASS tasks and eight question papers on the end-of-year examinations were used as data sources.
- A well researched and valid tool, the Revised Bloom's Taxonomy, was used to analyse the question papers to establish the cognitive levels and the assessment standards and learning outcomes which are assessed.
- I engaged closely with the analysis tool and the documents that were used to answer the research questions, and repeatedly interpreted the contents of the documents. My interpretation of these documents changed and evolved in the process.
- Initial analysis and coding of the test items in question papers and assessment standards and learning outcomes in the Subject Statement (2008) was done together with the supervisors**.** The quality of subsequent interpretation of the documents was

ensured in consultation with the supervisors which strengthened inter-coder reliability.

- Standard coding categories such as cognitive levels and objectives/assessment standards and learning outcomes which were adapted from the Taxonomy Table were used. This made the analysis and coding of test items, short answer questions, extended response questions and the introductory statements of questions a consistent process which improved the validity of the study.
- Validation and verification of the research findings was done by providing the supervisors with copies of the research findings. Their comments and suggestions improved the validity of the research findings.
- The limitation of the Revised Bloom's Taxonomy as an analysis tool was stated upfront.
- To ensure that the reader understands how I arrived at the findings of the study, I described the analysis process in great detail.
- I did not attempt to generalise the findings of this study across schools.

3.11. LIMITATIONS OF THE STUDY

This study is limited because different analysts may have different interpretations on the type of cognitive levels which are addressed by the assessment standards of the learning outcomes stipulated in the SAG (2008), assessed in test items of the formal CASS tasks and end-of-year examinations, and implied in the DOE-adapted Bloom's categories for the mid and end-of-year examinations.

Secondly, the SAG (2008) does not prescribe the cognitive levels (and their official percentage weightings) which must be assessed in research projects and controlled tests. Therefore, the average percentage weightings of the cognitive levels which were assessed in these assessment tasks could not be compared with their official percentage weightings. Similarly, in that the SAG (2008) also does not prescribe the official percentage weightings the three Life Sciences learning outcomes which must be assessed in research projects, the average percentage weightings of these learning outcomes in research projects could not be mapped onto their official percentage weightings.

Lastly, the question papers which were analysed in this study were obtained from only three schools located in three different circuits in the Gert-Sibande region of the Mpumalanga province. Moreover, only a limited number of research projects and mid-year examination papers were obtained for analysis. Therefore, the findings of this study could not be generalised to all the schools. However, readers may extract features of the findings of this study which are applicable to their schools.

3.12. CONCLUSION

This chapter has described document analysis as a research strategy which informed this study. It has described a quantitative research approach which is consistent with the epistemological assumption of post-positivism. The Revised Bloom's Taxonomy which used to analyse the documents was also described. The data analysis strategy, strategies employed to enhance the validity of the study as well as the limitations of the study were also explained. I would like to restate that the research procedures employed in the study were not aimed at generalizing the findings to all the schools, but aimed at understanding the extent to which the assessment of the different cognitive levels and learning outcomes in formal CASS tasks and end-of-year examinations (summative assessment tasks) for grade ten Life Sciences meet the official assessment requirements stipulated in the SAG (2008).

The chapter which follows will present the research findings of this study with regard to the assessment of the different cognitive levels and learning outcomes in summative assessment tasks (formal CASS tasks and end-of year examinations).

CHAPTER 4
RESEARCH FINDINGS

4.1. INTRODUCTION

This chapter presents the findings of the study regarding the extent to which formal CASS tasks and end-of-year examinations (summative assessment tasks) for grade ten Life Sciences assess the different cognitive levels and knowledge types and learning outcomes as required in the SAG (2008). First, the Taxonomy Tables of the Revised Bloom's Taxonomy will be presented to indicate the cognitive levels and types of knowledge addressed in the assessment standards of the learning outcomes in grade ten Life Sciences. Second, in order to answer the first research question the intended curriculum (assessment) will be presented- by stating the prescribed percentage weightings (marks) in the SAG (2008) for the cognitive levels and knowledge types and learning outcomes which must be assessed in formal CASS tasks and end-of-year examinations. Third, in order to answer the second research question the implemented assessment will be presented. In this regard the average percentage weightings of the cognitive levels and knowledge types and learning outcomes which were found to be assessed in formal CASS tasks and end-of-year examinations in the three sampled schools will be presented. Lastly, in order to answer the third research questions comparison of the intended and the implemented assessment in the three schools will be made.

4.2. TAXONOMY TABLES FOR GRADE TEN LIFE SCIENCES LEARNING OUTCOMES

The Taxonomy tables, as already mentioned in chapter three, indicated the cognitive levels and types of knowledge which were addressed by the assessment standards of the three learning outcomes. This information was essential for the analysis of the test items of the summative assessment tasks. They also served as templates for validating the assessment standards of the learning outcomes which were assessed in the test items of the formal CASS tasks and end-of-year examination papers. The Grade 10 learning outcomes and their associated assessment standards as stated in the Life Sciences Subject Statement (2003) are already presented in chapter two, tables 2.1 to 2.3. Tables 4.1 to 4.3 present the Taxonomy tables for the Grade10 learning outcomes and assessment standards.

Table 4.1. Revised Bloom's Taxonomy table for the assessment standards of learning outcome one (AS1.1; AS2.1; AS3.1)

Knowledge Dimension	**Cognitive Process Dimension**					
	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6
A. Factual Knowledge	AS1.1			AS1.1		
B. Conceptual Knowledge				AS3.1	AS3.1	AS3.1 AS1.1
C. Procedural Knowledge		AS2.1	AS1.1 AS2.1 AS3.1		AS1.1	
D. Meta-Cognitive Knowledge						

Table 4.2. Revised Bloom's Taxonomy table for the assessment standards of learning outcome two (AS1.2; AS2.2; AS3.2)

	Cognitive Process Dimension					
Knowledge Dimension	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6
A. Factual Knowledge						AS1.2
B. Conceptual Knowledge	AS2.2	AS2.2 AS3.2		AS3.2		
C. Procedural Knowledge			AS1.2			
D. Meta-Cognitive Knowledge						

Table 4.3. Revised Bloom's Taxonomy table for the assessment standards of learning outcome three (AS1.3; AS2.3; AS3.3)

	Cognitive Process Dimension					
Knowledge Dimension	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6
A. Factual Knowledge						
B. Conceptual Knowledge	AS1.3 AS3.3	AS2.3	AS1.3	AS3.3		
C. Procedural Knowledge		AS2.3	AS3.3			
D. Meta-cognitive Knowledge						

4.3. INTENDED ASSESSMENT

4.3.1. Official assessment requirements for formal CASS tasks and end-of-year examinations as prescribed in the SAG (2008).

4.3.1.1. Learning outcomes

Table 4.4 presents the percentage weightings (marks) of learning outcomes in formal CASS tasks and end-of-year examinations as stipulated in the SAG (2008).

Table 4.4. Percentage weightings of learning outcomes in formal CASS tasks and end-of-year examinations (SAG 2008, pp. 7-10)

	Formal CASS tasks				**End-of year examination**
	Practical tasks	**Research project**	**Controlled tests**	**Mid-year examination**	
	LO 1:100% (not specified, but assumed)	LO1, LO2 and LO3 must be assessed. But weighting is variable depending on project type	LO1:40% LO2:40% LO3:20%	LO1:40% LO2:40% LO3:20%	LO: 40% LO2:40% LO3:20%
Contribution to final mark	**12.5%**	**5%**	**5%**	**2.5%**	**75%**

4.3.1.2. Cognitive levels

Tables 4.5 to 4.7 present the prescribed percentage weighting (marks) of the cognitive levels which must be assessed in practical tasks, research projects, mid-year examinations and end-of-year examinations as stipulated in the SAG (2008). The figures for controlled tests are not given because the SAG (2008) does not state these cognitive levels and their percentage weightings. However, as indicated in chapter two the SAG (2008) states controlled tests must be balanced in terms of the cognitive levels which are assesse

Table 4.5. Percentage weightings of cognitive level and knowledge type in practical tasks.

Revised Bloom's cognitive levels and knowledge type	% **weighting**
Apply procedural knowledge	100% (Not specified, but assumed)

Table 4.6. Percentage weightings of cognitive levels ad knowledge types in research projects

Revised Bloom's Cognitive levels and knowledge types	**% weighting**
Remember, understand, apply, analyse, evaluate and create using factual, conceptual or procedural knowledge	Not specified, but is variable depending on project type. All the cognitive levels must be assessed

Table: 4.7. Percentage weightings of cognitive levels and knowledge types in mid and end-of-year examinations papers using DOE-adapted Bloom's categories and Revised Bloom's Taxonomy

Bloom's category (Cognitive levels)	**Category reference**	**Item recognition details**	**Revised Bloom's cognitive levels and knowledge types**	**% weighting in SAG (2008)**
KNOWLEDGE	A	Items require recall of facts	Remember factual knowledge	30
COMPREHENSION	B	Items require more than "A" and assess understanding of routine and familiar material:	Understand factual knowledge	20
Interpretive	(BI)	e.g. from verbal to symbolic and/or from symbolic to verbal	Understand conceptual knowledge	
Verbal	(BV)	e.g. explanations	Understand procedural knowledge	
Numerical	(BN)	e.g. standard exercises		
APPLICATION	C	Items require the application of abstractions and generalizations to new, novel or unfamiliar situations	Apply conceptual and procedural knowledge	30
HIGHER ABILITIES:	D	Items require:		20
Analysis		Analysis of data and pattern recognition	Analyse factual, conceptual and procedural knowledge	
Synthesis		Synthesis of data	Create conceptual and procedural knowledge	
Evaluation		Evaluation of data against given criteria	Evaluate conceptual and procedural knowledge	

4.4. IMPLEMENTED ASSESSMENT

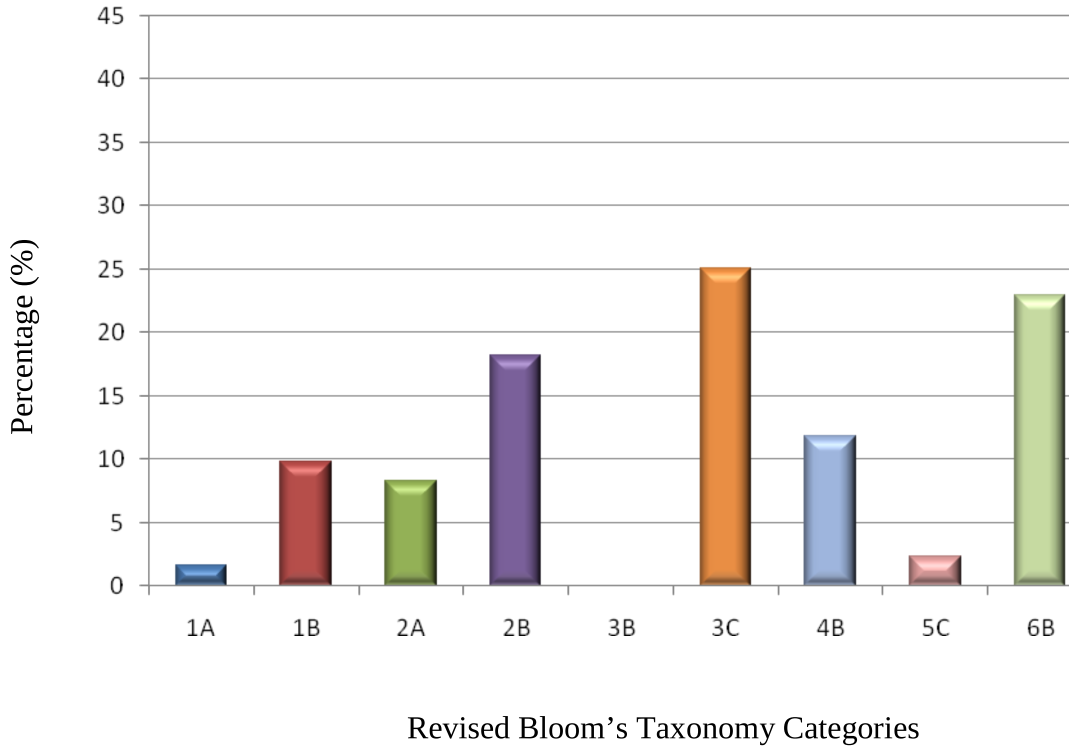
4.4.1. Average percentage weightings of cognitive levels and knowledge types assessed in formal CASS tasks

Table 4.8 and Figures 4.1.to 4.4 present data on the average percentage weightings (marks) of the cognitive levels and types of knowledge which were found to be assessed in formal CASS tasks from the sampled schools.

Table 4.8. Average percentage weighting per cognitive level and knowledge type found in formal continuous assessment tasks in sampled schools

Cognitive Level	**Average percentage (%) weighting**			
	Practical tasks	Research projects	Controlled Tests	Mid-year examinations
1A (Remember factual knowledge)	1.6	0.0	17.2	12.5
1B (Remember conceptual knowledge)	9.8	7.8	29.8	28.5
2A (Understand factual knowledge)	8.3	3.3	0.0	0.0
2B (Understand conceptual knowledge)	18.2	24.8	39.2	40.4
3B (Apply conceptual knowledge)	0.0	1.1	0.0	0.0
3C (Apply procedural knowledge)	25.1	7.4	0.3	0.0
4B (Analyse conceptual knowledge)	11.8	33.0	11.7	13.1
5C (Evaluate procedural knowledge)	2.3	0.0	1.1	0.2
6B (Create conceptual knowledge)	22.9	22.6	0.8	5.3
Total	**100**	**100**	**100**	**100**
Number of schools	**3**	**3**	**3**	**2**
Number of assessment tasks	**9**	**4**	**12**	**3**

FIGURE 4.1 Average percentage weighting of Revised Bloom's Taxonomy Categories in practical tasks (for three schools)



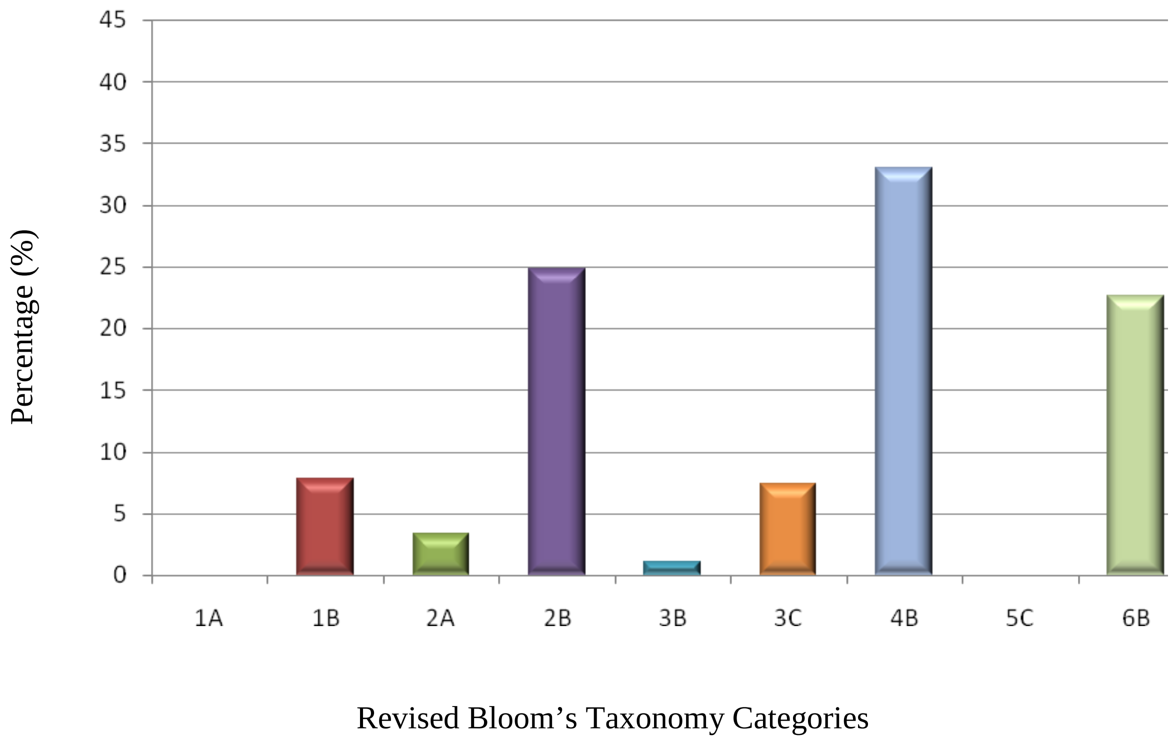
A considerable amount of questions in practical tasks focused on the assessment of understanding concepts (2B); application of procedure (3C) and creation of concepts (6B).The questions which assessed the understanding of conceptual knowledge, and therefore placed in this cognitive level, were those requiring learners to define, describe, and explain Life Sciences concepts. Some were also requiring learners to observe or give the biological functions or causes of air pollution and diseases such as asthma and HIV.

Questions which assessed the application of procedural knowledge were mostly found in practical tasks and research projects. They required learners to follow instructions in order to perform a task, do some calculations and setting up experiments, or use Life Sciences methods to obtain data. For example they required learners to follow instructions in order to conduct a Life Sciences experiment.

Lastly, questions which were categorized as assessing creation of conceptual knowledge (6B) were those which required learners to do complex planning which required them to synthesis and to be creative. For example they assessed on a plan for an experiment and required the learners to communicate the results of the experiment by drawing a graph or writing a report.

Apparent from the graph is that in research projects questions mostly assessed the

FIGURE 4.2 Average percentage weighting of Revised Bloom's Taxonomy Categories in projects (for three schools)

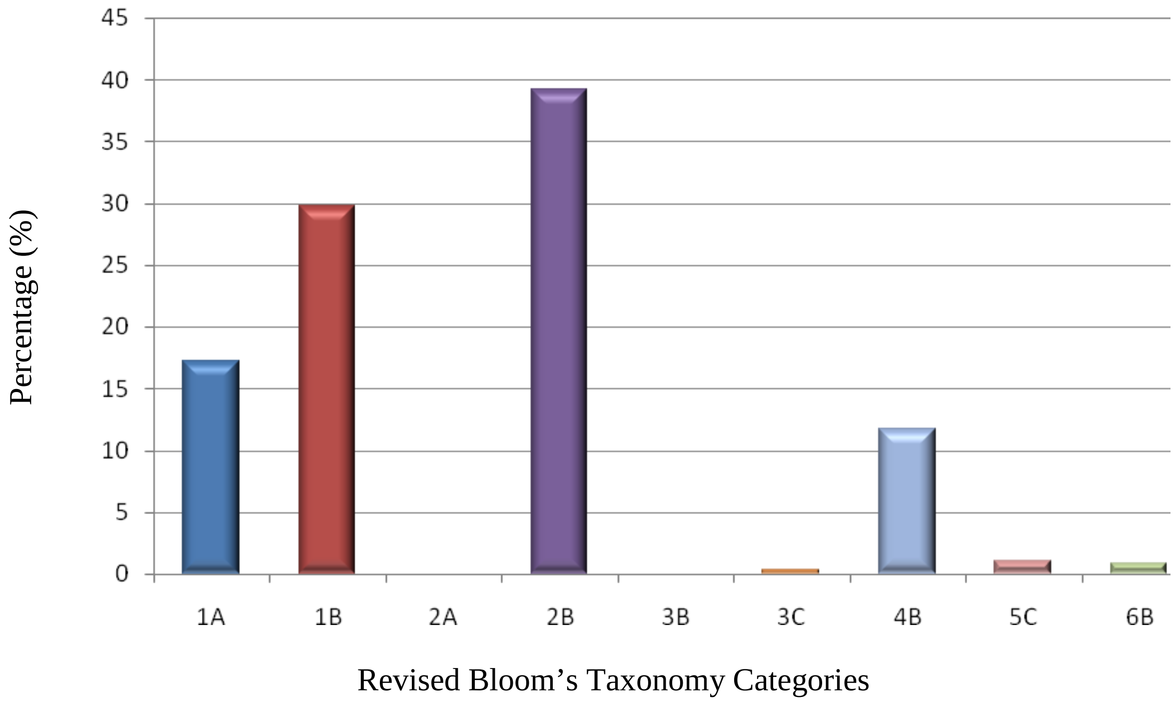


understanding, analysis and creation of conceptual knowledge. Questions categorised as assessing understanding conceptual knowledge (2B) were such as those which required learners to conduct a research project on the causes and symptoms of a particular disease (for example, a type of cancer) and how it could be treated.

Questions which assessed the analysis of conceptual knowledge (4B) and assigned to this cognitive level were such as those which required the analysis of: graphs, case studies, people's beliefs, attitudes and values on scientific knowledge and its application to society.

Questions which assessed the creation of conceptual knowledge (6B) and assigned to this cognitive level required learners for example to devise a plan for a research project, drawing graphs or write a research report in order to communicate the research findings.

FIGURE 4.3 Average percentage weighting of Revised Bloom's Taxonomy Categories in controlled tests (for three schools)

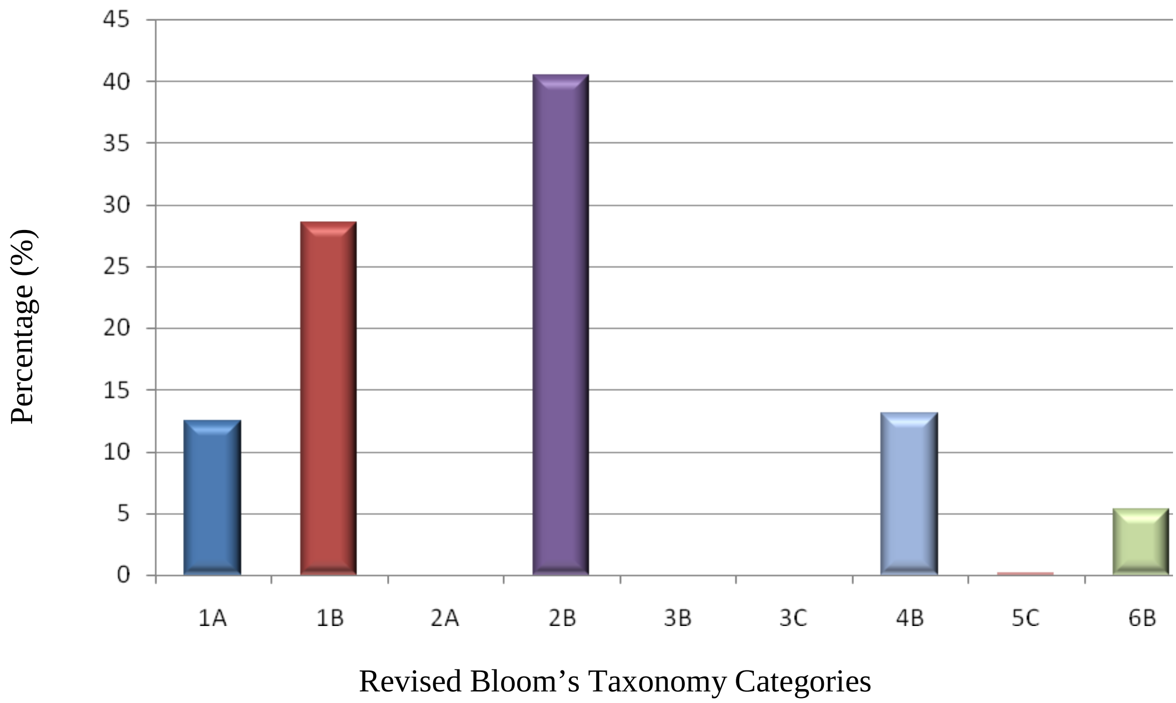


Questions which were assessed in controlled tests seemed to be the reproduction of the questions mostly assessed in mid-year and end-of-year examination papers. They tended to focus on four cognitive levels namely: the recall of factual (1A) and conceptual (1B) knowledge, the understanding of conceptual knowledge (2B) and analysis of conceptual knowledge (4B).

However, a number of questions in controlled tests focused on the assessment of the recall of conceptual knowledge and the understanding of conceptual knowledge (2B). Questions which were categorised as assessing the recall of conceptual knowledge required learners identify concepts and structures; identify present and past scientific ideas and indigenous knowledge.

Questions which were categorised as assessing the understanding of conceptual knowledge required learners to demonstrate an understanding about their awareness of the impact of resources or products on environment and society. They also required learners to define some Life Sciences concepts. Other required the learners to furnish the causes or functions of various biological processes.

FIGURE 4.4 Average percentage weighting of Revised Bloom's Taxonomy Categories in mid-year examination papers (for three schools)



Mid-year examination papers tended to assess mostly the recall of conceptual knowledge (1B) and the understanding of conceptual knowledge (2B). Questions which were categorised as assessing the recall of conceptual knowledge required learners identify Life Sciences concepts, principles and structures; identify present and past scientific ideas and indigenous knowledge. Some required learners to describe peoples' beliefs, attitudes and values on scientific knowledge.

Questions which were categorised as assessing the understanding of conceptual knowledge required learners required learners to: define, explain and describe some Life Sciences concepts, give the causes or functions of various biological processes; and to demonstrate an understanding about their awareness of the impact of resources or products on environment and society.

Another trend observed in the graph is that in mid-year examinations the assessment of the recall of facts (1A) and the analysis of concepts (4B) was almost equal. Questions which were categorised as assessing the recall of factual knowledge (1A) required learners to recognise different Life Sciences phenomena such as photosynthesis, respiration, and protein synthesis and food digestion. Questions which were categorised as assessing analysis of conceptual knowledge (4B) required the analysis of graphs and case studies, people's beliefs, attitudes and values on scientific knowledge and its application to society.

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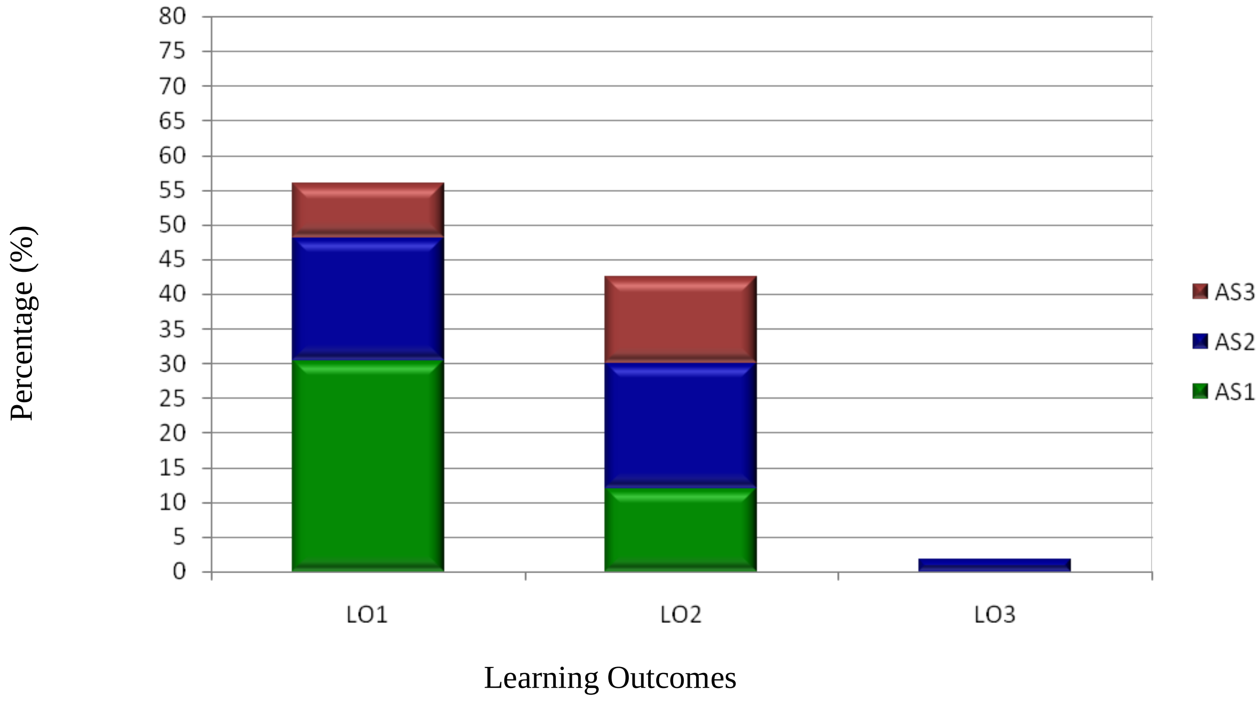
4.4.2. Average percentage weightings of learning outcomes assessed in formal CASS tasks.

Table 4.9 presents data on the average percentage weightings of the assessment standards assessed in formal CASS tasks from the three schools. In Figures 4.5 to 4.8 the percentage weightings of the assessment standards associated with each learning outcome have been stacked to indicate the average percentage weighting of that learning outcome in each formal CASS task.

Table 4.9 Average percentage weighting per assessment standard and learning outcome found in formal continuous assessment tasks in three schools

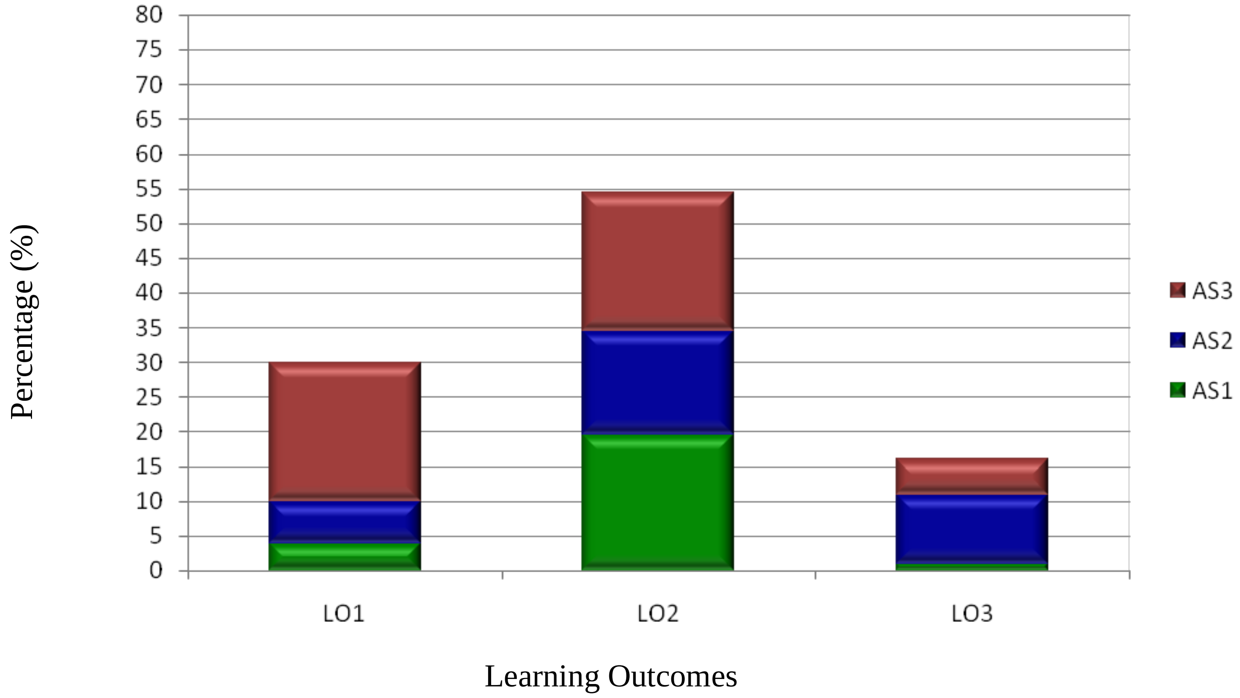
learning outcome(LO	**Assessment standard (AS)**	**Average percentage (%) weighting**			
		Practical tasks	Research projects	Controlled tests	Mid-year examinations
LO1	AS1	30.4	3.7	18.3	12.7
	AS2	17.8	5.9	0.0	0.0
	AS3	7.7	20.0	9.8	8.4
LO2	AS1	12.0	18.5	0.3	0.0
	AS2	18.1	16.7	49.1	44.5
	AS3	12.3	18.9	21.3	28.3
LO3	AS1	0.0	1.1	0.2	1.3
	AS2	1.7	8.1	0.3	2.9
	AS3	0.0	7.0	0.6	1.8
Total		**100**	**100**	**100**	**100**
Number of schools		**3**	**3**	**3**	**2**
Number of assessment tasks		**9**	**4**	**12**	**3**

FIGURE 4.5 Average percentage weighting of learning outcomes in practical tasks (for three schools)



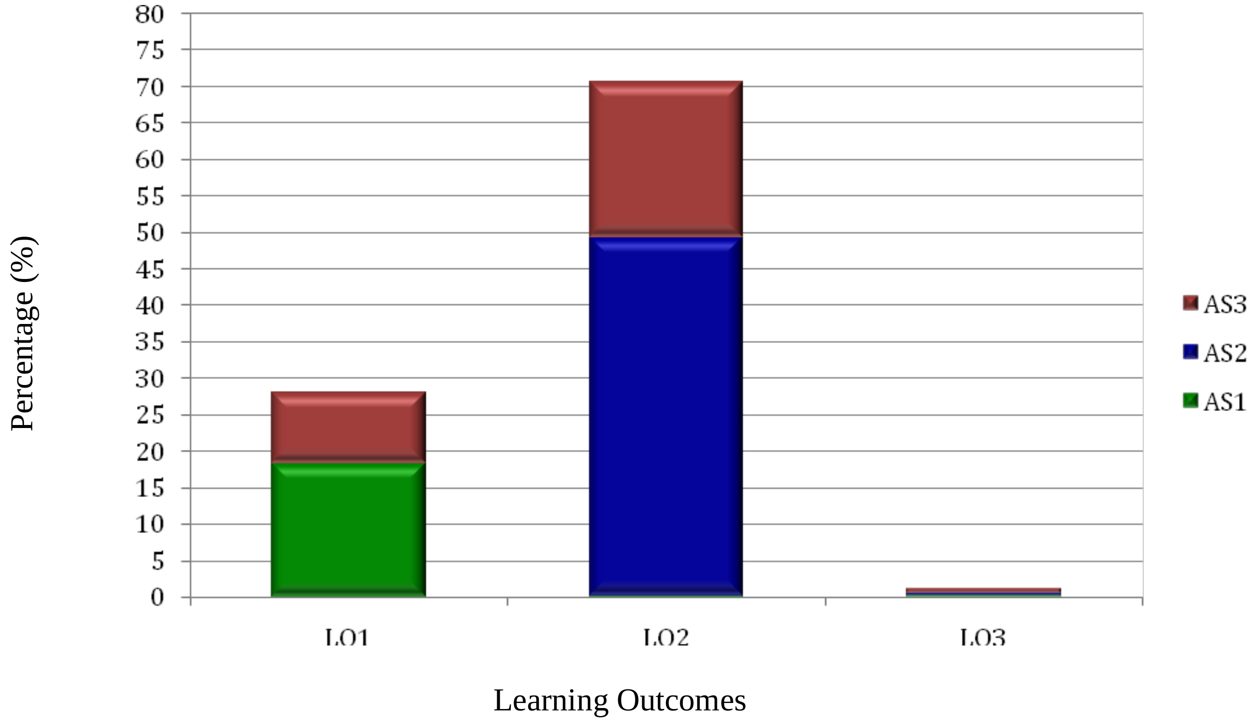
In practical tasks all the learning outcomes were assessed. However, in practical tasks questions mostly assessed learning outcome one (56%) than learning outcome two (42%) and three (2%).

FIGURE 4.6.Average percentage weighting of learning outcomes in projects (for three schools)



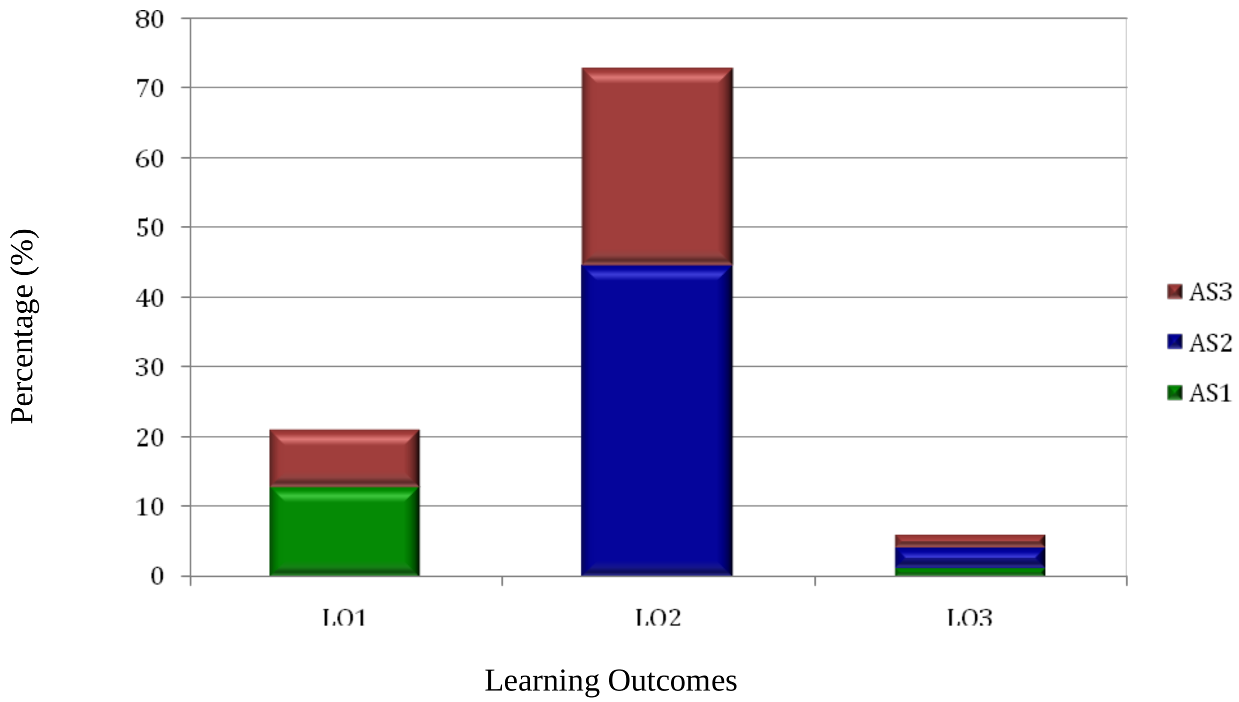
In projects all the learning outcomes were assessed. But questions tended to assess learning outcome two (54%). Learning outcome one (30%) was fairly assessed, while learning outcome three (16%) was least assessed.

FIGURE 4.7. Average percentage weighting of learning outcomes in controlled tests (for three schools)



In controlled tests all the learning outcomes were assessed. However, a number of questions tended to assess learning outcome two (70.1%). While learning outcome one (28.1%) was fairly assessed, learning outcome three was inadequately assessed as it received an insignificant percentage weighting of (1.1%).

FIGURE 4.8. Average percentage weighting of learning outcomes in mid-year examinations (for three schools)



In mid-year examinations all the learning outcomes were assessed. Questions tended to mostly assess learning outcome two (72.8%). Learning outcome one (21.1%) was fairly assessed and learning outcome three (6%) was least assessed.

4.4.3. Average percentage weightings of cognitive levels and types of knowledge assessed in end of year examinations

Table 4.10 presents data on the average percentage weightings of the cognitive levels and types of knowledge which were found to be assessed in end-of-year examination papers from the three schools.

Table 4.10.Average percentage weighting per cognitive level and knowledge type found in end-of-year examination papers in three schools.

Cognitive Level	**Average percentage (%) weighting**
1A (Remember factual knowledge)	11.6
1B (Remember conceptual knowledge)	22.5
2B (Understand conceptual knowledge)	38.7
3C (Apply procedural knowledge)	1.5
4B (Analyse conceptual knowledge)	19.1
5B (Evaluate conceptual knowledge)	0.2
6B (Create conceptual knowledge)	6.4
Total	**100**
Number of schools	**3**
Number of assessment tasks	**8**

Apparent from Table 4.10 is that end-of-year examination papers mostly focused on assessing the following three cognitive levels: recall of conceptual knowledge (1B), understanding of conceptual knowledge (2B) and analysis of conceptual knowledge (4B). They accounted for about 80.4% of marks.

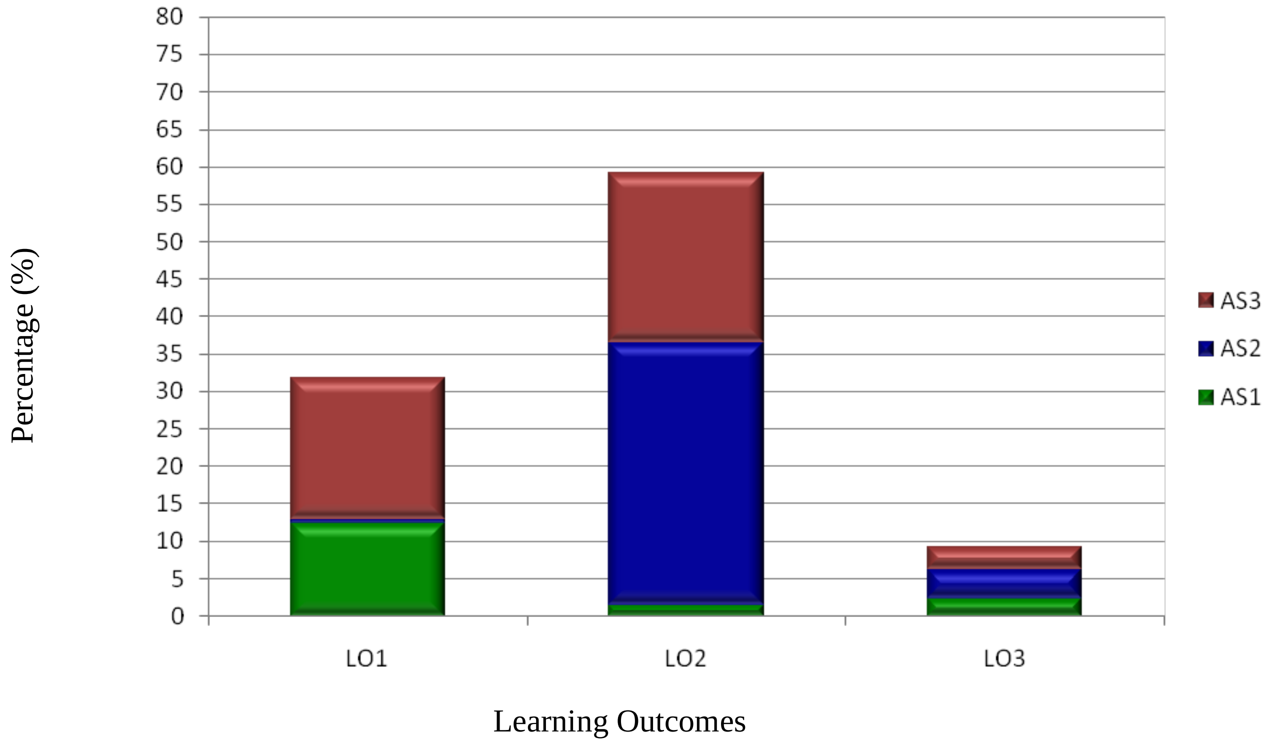
4.4.4. Average percentage weightings of learning outcomes assessed in end-of-year examinations.

Table 4.11 and Figure 4.9 present the average percentage weightings of the learning outcomes in end-of-year examination papers from the three schools. In Figure 4.9 the percentage weightings of the assessment standards associated with each learning outcome have been stacked to indicate the average percentage weighting of that learning outcome in end-of-year examination papers.

Table 4.11. Average percentage weighting per assessment standard and learning outcome found in end-of-year examinations in three schools

Learning outcome (LO)	**Assessment standard (AS)**	**Average (%) weighting**
LO 1	AS1	12.5
	AS2	0.5
	AS3	18.7
LO2	AS1	1.5
	AS2	35.0
	AS3	22.6
LO3	AS1	2.4
	AS2	3.8
	AS3	3.0
Total		**100**
Number of schools		**3**
Numer of assessment tasks		**8**

FIGURE4.9 Average percentage weighting learning outcomes in end-of-year examination papers (for three schools)



In end-of-year examinations all the learning outcomes were assessed. However, questions mostly assessed learning outcome two. Learning outcome one was fairly assessed and learning outcome three was least assessed.

4.5. COMPARING THE INTENDED AND THE IMPLEMENTED ASSESSMENT

4.5.1. Comparison of weightings (marks) prescribed in SAG (2008) with weightings in formal CASS tasks

4.5.1.1. Cognitive levels and knowledge types

Practical tasks

Table 4.12 maps the official percentage weighting of the third cognitive level and knowledge type (3C), assumed to be assessed by the prescribed abilities in the SAG (2008), onto the average percentage weightings of the cognitive levels which were found to be assessed in practical tasks.

Table 4.12. Percentage weighting per cognitive level and knowledge type prescribed in the SAG (2008) and found in practical tasks in three schools

Knowledge Dimension	**Cognitive Process Dimension**						**Totals**
	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6	
A. Factual Knowledge	1.6%	8.3%					**9.9%**
B.Conceptual Knowledge	9.8%	18.2%		11.8%		22.9%	**62.7%**
C. Procedural Knowledge			**100%** 25.1%		2.3%		**27.4%**
D. Meta-Cognitive Knowledge							
Totals	**11.4%**	**26.5%**	**25.1%**	**11.8%**	**2.3%**	**22.9%**	

In practical tasks the average percentage weighting of the third cognitive level (3C) did not match the assumed percentage weighting. This was weighted at 25.1% instead of the assumed **100%** weighting. Although this cognitive level weighted much higher than the other cognitive levels in practical tasks, a considerable amount of other cognitive levels (1A, 1B, 2A, 2B, 4B, 5C and 6B) as well as types of knowledge not implied in the intended abilities were assessed. They collectively weighted 74.9%. However, lower cognitive levels (1A, 1B, 2A and 2B) weighted much higher (63%) than higher cognitive levels (37%) in practical tasks, with the second cognitive level (understanding of factual and conceptual knowledge) receiving a higher percentage weighting (26.5%) than the other cognitive levels. Lastly, in practical tasks conceptual knowledge (62.7%) was weighted much higher than procedural 27.4% and factual 9.9% (Table 4.12).

Research projects

Since the SAG (2008) does not prescribe the cognitive levels and their percentage weightings for the research projects, it was not possible to map the intended weightings of the cognitive levels which must be assessed in projects onto the implemented weightings assessed in actual projects. Therefore, only a discussion of the percentage weightings of these cognitive levels is presented. Table 4.13 presents the average percentage weightings of the cognitive levels and knowledge types which were assessed in projects in the three schools.

Table 4.13. Average percentage weighting per cognitive level and knowledge type found in projects in three schools.

Knowledge Dimension	Cognitive Process Dimension						Totals
	Remember 1	Understand 2	Apply 3	Analyse 4	Evaluate 5	Create 6	
A. Factual Knowledge		3.3%					**3.3%**
B.Conceptual Knowledge	7.8%	24.8%	1.1%	33.0%		22.6%	**89.3%**
C. Procedural Knowledge			7.4%				**7.4%**
D. Meta-Cognitive Knowledge							
Totals	**7.8%**	**28.1%**	**8.5%**	**33.0%**		**22.6%**	

In research projects higher cognitive levels (4B and 6B) weighted much higher than lower cognitive levels (1B, 2A, 2B and 3C) with analysis of conceptual knowledge (4B) receiving the highest percentage weighting. The collective percentage weighting of higher cognitive levels was 55.6% while lower cognitive levels weighted 44.4%. The second (2A and 2B) and sixth (6B) cognitive levels also received significant average percentage weightings in research projects. Furthermore, whereas the first (1B) and third (3B and 3C) cognitive levels were least assessed, the fifth cognitive level (evaluation of knowledge) was not assessed at all (Table 4.13). Lastly, in research projects conceptual knowledge (89.3%) weighted much higher than factual (3.3%) and procedural (7.4%) knowledge.

Controlled tests

Since the SAG (2008) does not prescribe the percentage weightings of the cognitive levels which must be assessed in controlled tests, it was also not possible to compare the official percentage weightings of the cognitive levels which must be assessed in controlled tests with the average percentage weightings of the cognitive levels which were assessed in actual controlled tests. Thus, only a discussion of the percentage weightings of these cognitive levels is presented. Table 4.14 shows the average percentage weighting of the cognitive levels which were assessed in controlled tests in the three schools.

Table 4.14. Average percentage weighting per cognitive level and knowledge type found in controlled tests in three schools.

Cognitive level	**Average percentage (%) weighting**
1A (Remember factual knowledge)	17.2
1B (Remember conceptual knowledge)	29.8
2B (Understand conceptual knowledge)	39.2
3C (Apply procedural knowledge)	0.3
4B (Analyse conceptual knowledge)	11.7
5C (Evaluate procedural knowledge)	1.1
6B (Create conceptual knowledge)	0.8
Total	**100**

In controlled tests all the cognitive levels were assessed. However the assessment of the different cognitive levels was not balanced (Table 4.14) in that lower cognitive levels (1A, 1B; 2B and 3C) weighted much higher (86.5 %) than higher cognitive levels (4B, 5C and 6B) which weighted 13.6%. Moreover, the first (recall of factual and conceptual knowledge) and the second (understanding of conceptual knowledge) cognitive levels were mostly assessed in controlled tests. These cognitive levels weighted 47% and 39.2% respectively. The only higher cognitive level which received a significant percentage weighting was the analysis of conceptual knowledge (11.7%); while the application of procedural knowledge (3C), evaluation of procedural knowledge (5C) and creation of conceptual knowledge (6B) were the least assessed cognitive levels. These cognitive levels weighted 0.3%, 1.1% and 0.8% respectively. Lastly, conceptual knowledge (81.5%) weighted much higher than factual knowledge (17.2 %.) and procedural knowledge (1.4%) in controlled tests.

Mid-year examinations

In Table 4.15 and Table 4.16 the percentage weightings (marks) of the lower and higher cognitive levels which are prescribed in the SAG (2008) are compared with the average percentage weighting of the cognitive levels which were assessed in mid-year examination papers in the two schools.

Table 4.15. Percentage weighting per lower cognitive level and knowledge type prescribed in the SAG (2008) and found in mid-year examination papers in two schools.

Cognitive level in SAG (2008) (Lower abilities)	**Percentage (%) weighting in SAG (2008)**	**Cognitive levels in mid-year examinations (Lower abilities)**	**Average percentage (%) weighting in mid-year examinations**
1A (Remember factual knowledge) 1B (Remember conceptual knowledge) is not required to be assessed	30 Not prescribed	1A 1B	12.5 28.5
2A (Understand factual knowledge) 2B (Understand conceptual knowledge) 2C (Understand procedural knowledge)	20	2A 2B 2C	0 40.4 0
3B (Apply conceptual knowledge) 3C (Apply procedural knowledge)	30	3B 3C	0 0

The average percentage weightings of the lower cognitive levels which were assessed in mid-year examinations did not match the official assessment requirements. The recall of factual knowledge (1A) only weighted 12.5%. Instead of giving this first cognitive level a weighting 30% as prescribed in the SAG (2008), the mid-year examination papers mainly assessed the recall of conceptual knowledge (1B) which weighted 28.5%. This cognitive level was not officially required to be assessed. With regards to the assessment of the second cognitive level, mid-year examination papers only assessed the understanding of conceptual knowledge (40.4%) which weighted much higher than the prescribed percentage weighting of 20%. As shown in Table 4.15, there were no questions assessing the understanding factual (2A) and procedural knowledge (2C) as required in the SAG (2008). Moreover, the mid-year examination papers did not assess the third cognitive level (application of conceptual and procedural knowledge). In the SAG (2008) the prescribed percentage weighting for this cognitive level was also 30%.

Table 4.15 also shows that questions assessing the second cognitive level did not address factual and procedural knowledge, while those assessing the third cognitive level did not address conceptual and procedural knowledge as required in the SAG (2008).

Table 4.16. Percentage weighting per higher cognitive level and knowledge type prescribed in the SAG (2008) and found in mid-year examination papers in two schools

Cognitive level (Higher abilities)	**Percentage (%) weighting in SAG (2008)**	**Cognitive levels in mid-year examinations (Higher abilities)**	**Average percentage (%) weighting in mid-year examinations**
4A (Analyse factual knowledge)	20	4A	0
4B (Analyse conceptual knowledge)		4B	13.1
4C (Analyse procedural knowledge)		4C	0
5B (Evaluate conceptual knowledge)		5B	0.2
5C (Evaluate procedural knowledge)		5C	0
6B (Create conceptual knowledge)		6B	5.3
6C (Create procedural knowledge)		6C	0

It is apparent from table 4.16 that in mid-year examinations questions assessing the fourth cognitive level did not address factual and procedural knowledge, while those assessing the fifth and sixth cognitive levels did not address procedural knowledge as required in the SAG (2008). However, the total percentage weighting (18.6%) of the higher cognitive levels (4B, 5B and 6B) assessed in mid-year examination papers was 1.4% lesser than prescribed official percentage weighting of 20%. This insignificant difference therefore suggests a strong "fit" between the official and implemented assessment for the mid-year examinations in terms of the higher cognitive levels.

4.5.1.2. Learning outcomes

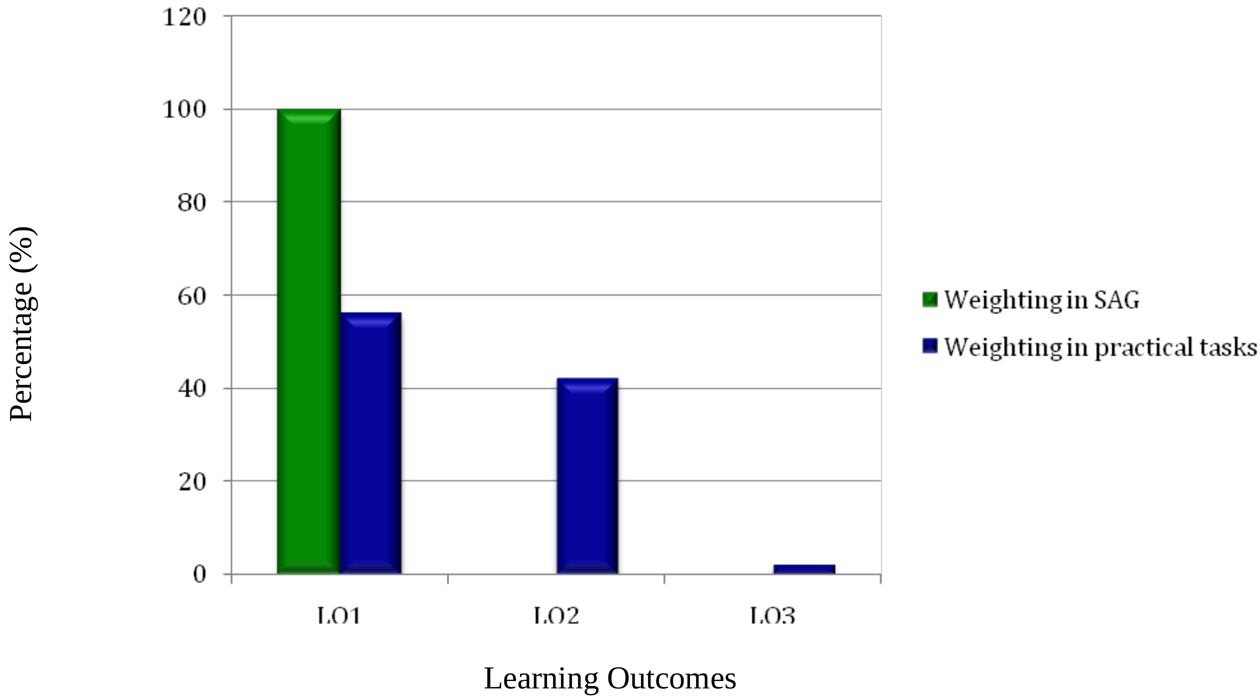
Practical tasks

Table 4.17 and Figure 4.10 compare the official percentage weighting of learning outcome one which resulted from the analysis of the prescribed abilities in the SAG (2008) with the average percentage weightings of the learning outcomes which were found to be assessed in practical tasks.

Table 4.17. Percentage weighting per learning outcome prescribed in the SAG (2008) and found in practical tasks in three schools.

Learning outcome	**Percentage (%) weighting in SAG (2008)**	**Average percentage (%) weighting in practical task**
LO:1	100	56
LO:2	Not prescribed	42
LO:3	Not prescribed	2

FIGURE4.10 Percentage weighting per learning outcome prescribed in SAG and found in practical tasks (for three schools)



Practical tasks assessed all the three learning outcomes instead of assessing only learning outcome one (as per the analysis of the abilities stated in the SAG for practical tasks), with an assumed percentage weighting of 100%. The average percentage weighting of learning outcome one was only 56% in practical tasks, and therefore did not match the assumed percentage weighting of 100%.

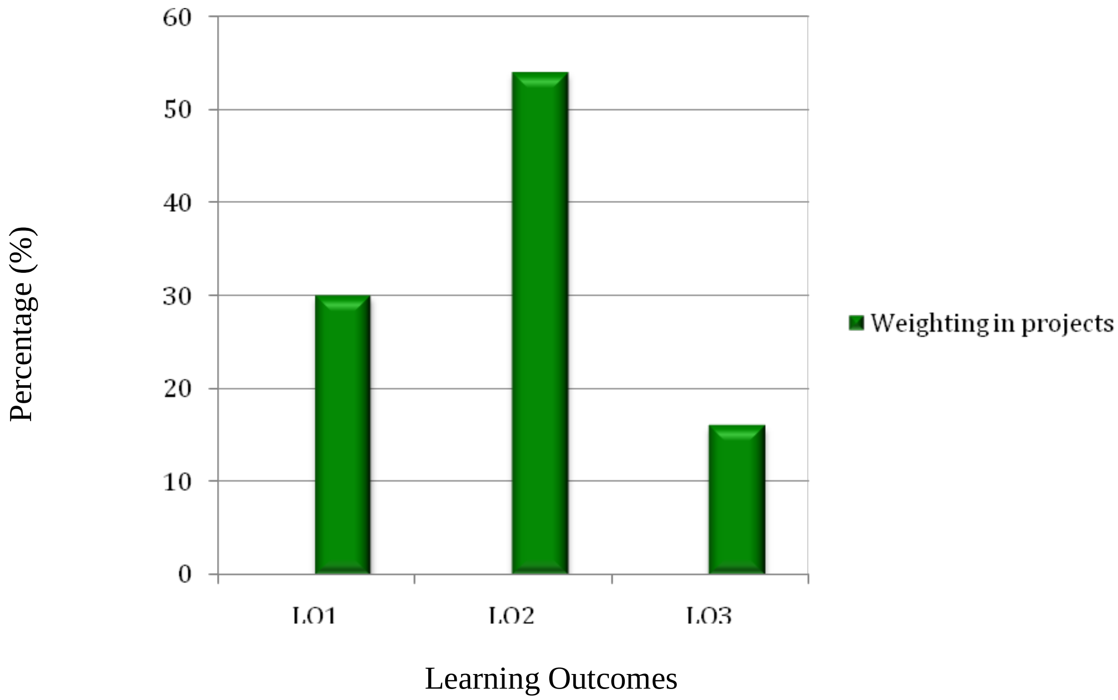
Projects

Table 4.18 and Figure 4.11 present the percentage weightings of the learning outcomes which were assessed in the research projects.

Table 4.18. Percentage weighting per learning outcome prescribed in the SAG (2008) and found in research projects in three schools.

Learning outcome	**Percentage (%) weighting in SAG (2008)**	**Average percentage (%) weighting in projects**
LO:1	Not prescribed, but all three learning outcomes must be assessed	30
LO:2		54
LO:3		16

FIGURE4.11 Percentage weighting per learning outcome prescribed in the SAG and found in projects (for three schools)



Since the SAG (2008) does not prescribe the official percentage weightings for the three learning outcomes which must be assessed in research projects, it was not possible to map their official percentage weightings onto their average percentage weightings in actual research projects. However, in projects all the learning outcomes were assessed as it is required in the SAG (2008). As already indicated above in this chapter, in projects learning outcome two (54%) was mostly assessed; while learning outcome one (30%) was fairly assessed and learning outcome three (16%) was least assessed.

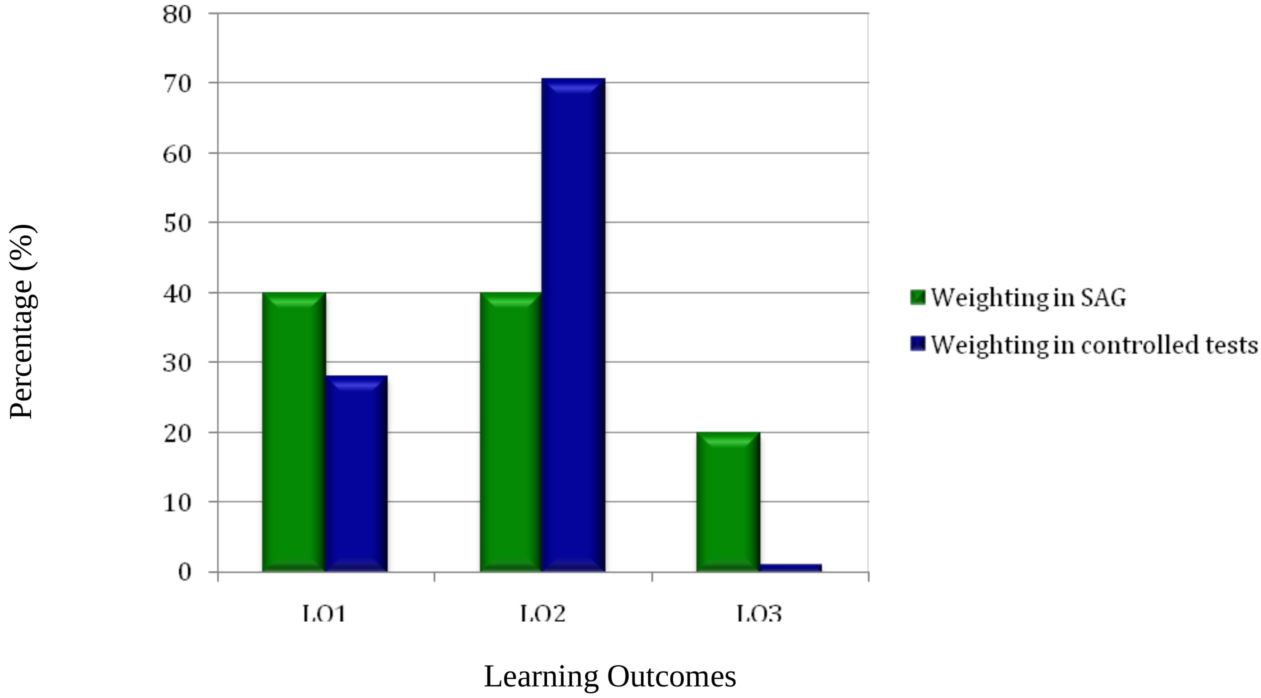
Controlled tests

Table 4.19 and Figure 4.12 compare the prescribed the official percentage weightings (marks) of the learning outcomes which must be assessed in controlled tests with the average percentage weightings of the learning outcomes which were assessed in the actual controlled tests.

Table 4.19. Percentage weighting per learning outcome prescribed in the SAG (2008) and found in controlled tests in three schools.

Learning outcome	**Percentage (%) weighting in SAG (2008)**	**Average percentage (%) weighting in controlled tests**
LO:1	40	28.1
LO:2	40	70.7
LO:3	20	1.1

FIGURE4.12 Percentage weighting per learning outcome prescribed in the SAG 2008 and found in controlled tests (for three schools)



In controlled tests the percentage weightings of the three learning outcomes did not match the official percentage weighting prescribed in the SAG (2008). The average percentage mark of learning outcome two was 70.1% instead of the official weighting of 40%. Moreover, learning outcome one weighted 28.1% instead of 40%, and learning outcome three weighted 1.1% instead of 20%.

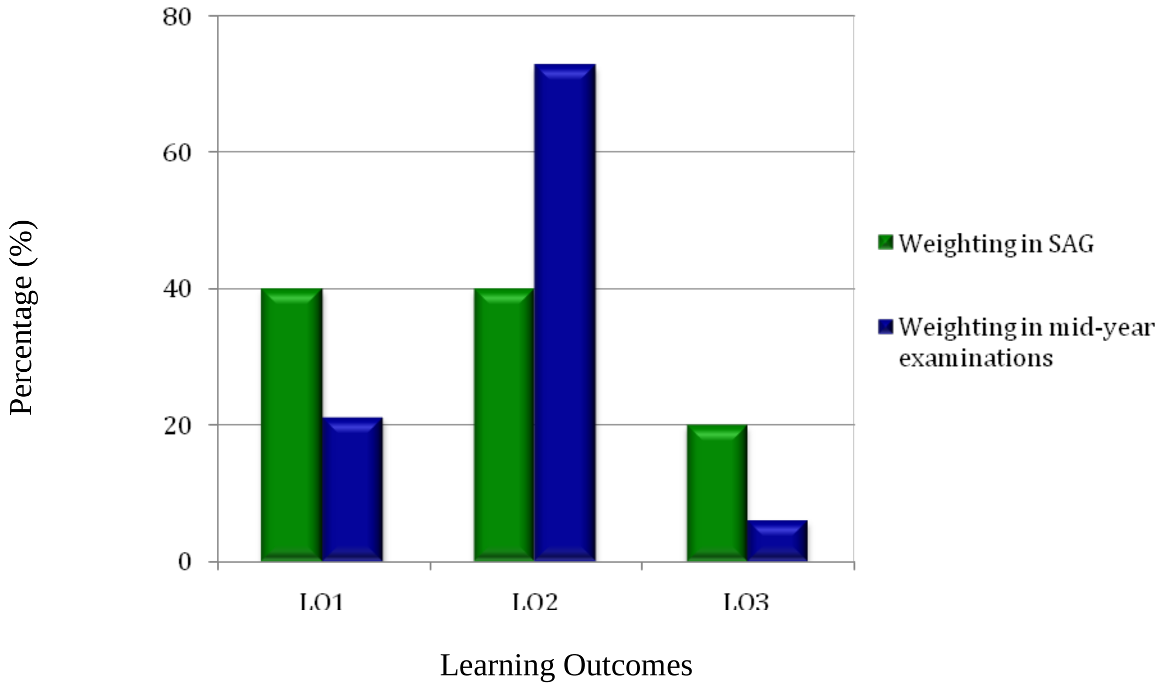
Mid-year examinations

Table 4.20 and Figure 4.13 compare the prescribed the official percentage weightings (marks) of the learning outcomes which must be assessed mid-year examinations with the average percentage weightings of the learning outcomes which were assessed in the actual mid-year examinations.

Table 4.20. Percentage weighting per learning outcome prescribed in the SAG (2008) and found in mid-year examinations in two schools.

Learning outcome	Percentage (%) weighting in SAG (2008)	Average percentage (%) weighting in mid-year examinations
LO:1	40	21.1
LO:2	40	72.8
LO:3	20	6

FIGURE4.13 Percentage weighting per learning outcome prescribed in the SAG 2008 and found in mid-year examinations (for three schools)



The percentage weighting of the three learning outcomes in mid-year examination papers did not match the percentage weighting prescribed in the SAG (2008). Question papers mostly assessed learning outcome two with an average percentage mark of 72.8% instead of the official weighting of 40%. Learning outcome one weighted 21.1% instead of weighting 40% as officially stipulated in the SAG (2008). Learning outcome three received a weighting of 6% instead of the official weighting 20%.

4.5.2. Comparison of weightings (marks) prescribed in SAG (2008) with weightings in end-of-year examination papers.

4.5.2.1. Cognitive levels and knowledge types

Table 4.21 and Table 4.22 compares the percentage weighting (marks) of the lower and higher cognitive levels which are prescribed in the SAG (2008) with the average percentage weighting (marks) of the cognitive levels which were assessed in end-of-year examination papers in the three schools.

Table 4.21. Percentage weighting per lower cognitive level and knowledge type prescribed in the SAG (2008) and found in end-of-year examination papers in three schools.

Cognitive level (Lower abilities)	**Percentage (%) weighting prescribed in SAG (2008)**	**Cognitive levels in end-of-year examinations (Lower abilities)**	**Average percentage (%) weighting in end-of-year examinations**
1A (Remember factual knowledge) 1B (Remember conceptual knowledge) is not required to be assessed	30 Not prescribed	1A 1B	11.6 22.5
2A (Understand factual knowledge) 2B (Understand conceptual knowledge) 2C (Understand procedural knowledge)	20	2A 2B 2C	0 38.7 0
3B (Apply conceptual knowledge) 3C (Apply procedural knowledge)	30	3B 3C	0 1.5

In end-of-year examination papers about 11.6% of the marks were allocated to the recall of factual knowledge (1A) instead of 30% as stipulated in the SAG (2008). The question papers mainly assessed the recall of conceptual knowledge (1B) which weighted (22.5%) and not required to be assessed. Regarding the assessment of the second cognitive level the question papers mainly focused on the assessment understanding of conceptual knowledge (2B), but disregarded understanding of factual (2A) and procedural knowledge (2C). Understanding conceptual knowledge received a weighting of 38.7%, which was 18% more than the official weighting of 20%. Moreover, instead of assessing both application of conceptual and procedural knowledge (3B and 3C) which were supposed to receive a weighting of 30% as prescribed in the SAG (2008), the question papers only assessed the application of procedural knowledge which received an insignificant weighting of 1.5 %. In end-of-year examination papers questions assessing the second and third cognitive levels were also not spread across the different types of knowledge as required in the SAG (2008). While conceptual knowledge received a highest percentage weighting of 61.2%, factual and procedural knowledge weighted 11.6%, and 1.5% respectively. Lastly, the total percentage weighting for lower cognitive levels was 74.3% which is 5.7% less than the prescribed total percentage weighting of 80%.

Table 4.22: Percentage weighting per higher cognitive level and knowledge type prescribed in the SAG (2008) and found in end-of-year examination papers in three schools

Cognitive level (Higher abilities)	**Percentage (%) weighting prescribed in SAG (2008)**	**Cognitive levels in end-of-year examinations (Higher abilities)**	**Average percentage (%) weighting in end-of-year examinations**
4A (Analyse factual knowledge)		4A	0
4B (Analyse conceptual knowledge)		4B	19.2
4C (Analyse procedural knowledge)		4C	0
	20		
5B (Evaluate conceptual knowledge)		5B	0.2
5C (Evaluate procedural knowledge)		5C	0
6B (Create conceptual knowledge)		6B	
6C (Create procedural knowledge)		6C	6.4
			0

In mid-year examination papers the percentage weighting of the higher cognitive levels was not balanced. These cognitive levels were supposed to share a percentage weighting of 20%

which is prescribed in the SAG (2008). The questions mainly focused on the analysis of conceptual knowledge (4B) which weighted 19.2%. While the creation of conceptual knowledge (6.4%) was fairly assessed, evaluation of conceptual knowledge (0.2%) was least assessed. Furthermore, questions were not spread across the different types of knowledge as required in the SAG (2008). There were no questions assessing the analysis of factual (4A) and procedural (4C) knowledge as well as evaluation (5C) and creation (6C) of procedural knowledge. Lastly, the total percentage weighting for higher cognitive levels was 25.8% which is 5, 8% more than the prescribed total percentage weighting of 20%.

In general, questions in end-of-year examinations were not spread across the different types of knowledge as required in the SAG (2008). Conceptual knowledge (87%) weighted much higher than factual knowledge (11.6%) and procedural knowledge (1.5%).

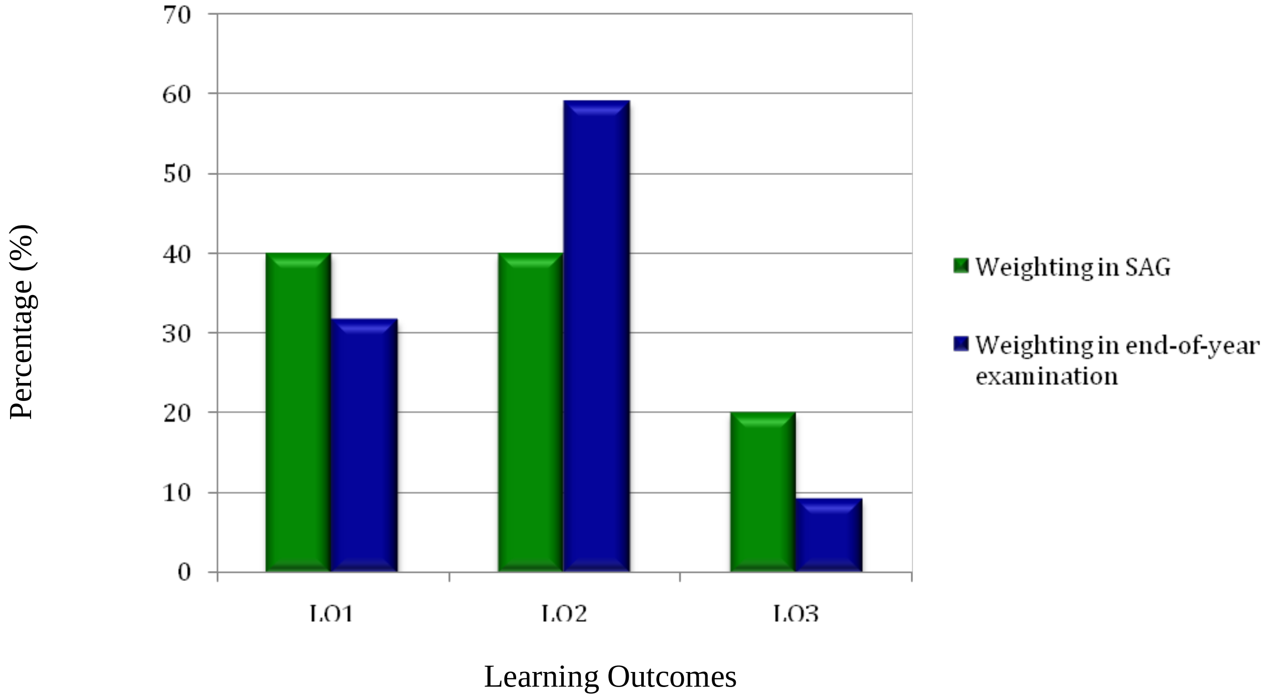
4.5.2.2. Learning outcomes

In Table 4.23 and Figure 4.14 the percentage weighting (marks) of the learning outcomes which are prescribed in the SAG (2008) are compared with the average percentage weighting (marks) of the learning outcomes which were assessed in end-of-year examinations in the three schools.

Table 4.23. Percentage weighting per learning outcome prescribed in the SAG (2008) and found in end-of-year examination papers in three schools.

Learning outcome	**Percentage (%) weighting in SAG (2008)**	**Average percentage (%) weighting in end-of-year examinations**
LO:1	40	31.7
LO:2	40	59.1
LO:3	20	9.2

FIGURE4.14 Percentage weighting per learning outcome prescribed in the SAG and found in end-of-year examination papers (for three schools)



The percentage weighting of the three learning outcomes did not match the official assessment requirements as stipulated in the SAG (2008). Whereas in the SAG (2008) learning outcome one and two were given a percentage weighting of 40% and learning outcome three a percentage weighting of 20%, in the end-of-year examination question papers learning outcome one and two received a percentage weighting of 31.7% and 59.1% respectively; and learning outcome three received a percentage weighting of 9.2%.Thus more focus was given on the assessment of learning outcome two than learning outcome three. The percentage weighting of learning outcome two in the end-of-year examinations was 19% more than the 40% weighting stipulated in the SA G (2008), while the percentage weighting of learning outcome three was 10,8% less than the officially required 20% weighting. Though learning outcome one was fairly assessed, the percentage weighting of this learning outcome was 8.3% less than the official 40% weighting.

4.6. CONCLUSION

This chapter has presented the main findings of the study regarding the extent to which formal CASS tasks and end-of-year examinations in grade ten Life Sciences assess the different cognitive levels and learning outcomes as required in the SAG (2008).

In practical tasks the average percentage weighting of the third cognitive level (application of procedural knowledge) and learning outcome one did not match the assumed percentage weighting of 100% which resulted from the analysis of abilities stated in the SAG (2008) for practical tasks. Application of procedural knowledge weighted 25.1% instead of 100%, and learning outcome one weighted 56% instead of 100%.

It was not possible to compare the average percentage weightings of the cognitive levels and learning outcomes which were assessed in research projects with their official percentage weightings. The reason being that the SAG (2008) does not prescribe the cognitive levels (and their official percentage weightings) which must be assessed in research projects. It only states that all the three Life Sciences learning outcomes must be assessed in the research projects, but without their official percentage weightings. However, the research projects assessed all the three learning outcomes. Learning outcome two (54%) weighted much higher than learning outcome one (30%) and three (16%).

In controlled tests the findings showed that the average percentage weightings of the three learning outcomes did not match the official percentage weighting prescribed in the SAG (2008). As in projects, the SAG (2008) also does not prescribe the cognitive levels (and their percentage weightings) which must be assessed in controlled tests, Thus, the average percentage weightings of the cognitive levels which were assessed in controlled tests could not be compared with their official percentage weightings.

The findings also showed that the average percentage weightings of the cognitive levels and learning outcomes which were assessed in mid and end-of year examinations did not match the official percentage weightings stipulated in the SAG (2008).

CHAPTER 5
DISCUSSION

5.1. INTRODUCTION

Chapter four has described the intended assessment stated in the SAG (2008) in terms of the cognitive levels and learning outcomes which must be assessed in formal CASS tasks and end-of-year examinations in Grade 10 Life Sciences. It also described the implemented assessment in terms of the cognitive levels and learning outcomes which are assessed in formal CASS tasks and end-of-year examinations. Lastly, it described the fit between the intended and implemented assessment - essentially comparing the average percentage weightings (marks) of cognitive levels and learning outcomes which were assessed in formal CASS tasks and end-of-year examination papers with their official percentage weightings (marks) stated in the SAG (2008). This chapter presents a summary of the principal findings of this study, explains them and presents the recommendations for further research.

5.2. SUMMARY OF FINDINGS

5.2.1. Formal CASS tasks

5.2.1.1 Practical tasks

Analysis of the abilities which must be assessed in practical tasks as stated in the SAG (2008) indicated that practical tasks must assess the third cognitive level (application of procedural knowledge) and learning outcome one. For this reason it was assumed that the application of procedural knowledge weighted 100% in practical tasks. Similarly, it was assumed that learning outcome one also weighted 100% in practical tasks. The findings of the study showed incongruence between the intended and implemented assessment in practical tasks. This is because the average percentage weighting of this cognitive level (application of procedural knowledge) and learning outcome one in actual practical tasks did not match the assumed 100% weightings. Application of procedural knowledge weighted 25.1% instead of 100%, and learning outcome one weighted 56% instead of 100%.

In practical tasks other cognitive levels such as the recall of factual and conceptual knowledge (11.4%), understanding factual and conceptual knowledge (26.5%), analysis (11.8%) and creation (22.9%) of conceptual knowledge and evaluation of procedural knowledge (22.9%) were also assessed in spite of the fact that they were not implied in the abilities stated in the SAG (208) for practical tasks. Moreover, practical tasks assessed learning outcome two (42%) and three (2%) which were also not implied in the abilities stated in the SAG (208).

The fact that the third cognitive level (application of procedural knowledge) and learning outcome one were inadequately assessed in practical tasks, suggests that the practical tasks constructed by the teachers in the three schools lacked cognitive and outcome validity. By the lack of cognitive validity is meant that practical tasks did not fully invoke in the learners the cognitive activity (application of procedural knowledge) as intended in the SAG (2008).By the lack of outcome validity is meant that the intended learning outcome implied by the abilities stated in the SAG (2008) was not assessed in practical tasks. Thus practical tasks possibly did not provide valid evidence about learners' achievement of this cognitive level (application of procedural knowledge) and learning outcome one.

5.2.1.2. Research projects

The SAG (2008) does not prescribe the cognitive levels (and their official percentage weightings) which must be assessed in the research projects. It also does not prescribe percentage weightings of the three learning outcomes which it stated must be assessed in research projects. For this reason the average percentage weightings of the cognitive levels and learning outcomes which must be assessed in research projects could not be mapped onto the official percentage weightings.

However, in research projects five different cognitive levels were assessed with the exception of the fifth cognitive level (evaluation of knowledge). Higher cognitive levels (55.6 %) weighted much higher than lower cognitive levels (44.4 %.), with the fourth cognitive level (analysis of conceptual knowledge) receiving the highest percentage weighting of 33 %.

Certainly it is a good thing that the research projects focused on both lower and higher cognitive levels, because projects largely require learners to use different cognitive levels for critical analysis, critical thinking as well as for communication (written and spoken).. The second cognitive level (understanding of factual and conceptual knowledge) and the sixth cognitive level (creation of conceptual knowledge) also received significant average percentage weightings of 28.1%; and 22.6% respectively. The cognitive levels which were least assessed were the recall of conceptual knowledge (7.8%) as well as the application of conceptual and procedural knowledge (8.5%). In addition, conceptual knowledge (89.3%) weighted much higher than factual (3.3%) and procedural (7.4%) knowledge in research projects.

Lastly, all the three learning outcomes were assessed in the research projects. However, the percentage weightings of the learning outcomes differed. Learning outcome two (54%) weighted much higher than learning outcome one (30%) and three (16%).

5.2.1.3. Controlled tests

In controlled tests there was a discrepancy between the intended and the implemented assessment in terms of the learning outcomes. That is, the average percentage weightings of the three learning outcomes did not match the official percentage weightings stipulated in the SAG (2008). For example, learning outcome one weighted 28.1% instead of 40%, while learning outcome two weighted 70.1% instead of 40% and learning outcome three weighted 1.1% instead 20%.

Regarding the assessment of the cognitive levels in controlled tests, the SAG (2008) does not prescribe them (and their official percentage weightings). Thus, the average percentage weightings of the cognitive levels which were assessed in controlled tests could not be compared with their official percentage weightings. However, in controlled tests lower cognitive levels (86.5 %) weighted much higher than higher cognitive levels (13.6%), with the recall of factual and conceptual knowledge (47%) and understanding of conceptual knowledge (39.2%) receiving a significant percentage weighting. Application (0.3%) and evaluation (1.1%) of procedural knowledge as well as creation of conceptual knowledge (0.8%) were least assessed cognitive levels. Furthermore, conceptual knowledge (81.5%) weighted much higher than factual (17.2 %.) and procedural (1.4%) knowledge. It is good that conceptual knowledge, not only factual knowledge is assessed in controlled tests. However, it is not good that procedural knowledge was not adequately assessed as Life Sciences is a subject which mostly requires the understanding and application of scientific method.

5.2.1.4. Mid-year examinations

The findings of the study showed a weak 'fit' between the intended and implemented assessment for mid-year examinations in terms of the lower cognitive levels. For example, the recall of factual knowledge (1A) only weighted 12.5% instead of the prescribed 30% weighting. 28.5% of the marks were allocated to the assessment of the recall of conceptual knowledge which was not required to be assessed. Moreover, while the understanding conceptual knowledge (2B) was mostly assessed weighting 20% more than the prescribed percentage weighting of 40%, understanding factual (2A) and conceptual (2C) knowledge were not assessed at all**.** Lastly, application of conceptual (3B) and procedural (3C) knowledge were also not assessed though this cognitive level was supposed to weight 30%.

On the other hand the findings of the study showed a strong 'fit' between the intended and implemented assessment for mid-year examinations in terms of the higher cognitive levels. These cognitive levels were the: analysis of conceptual knowledge (13.1%), evaluation of conceptual knowledge (0.2%) and creation of conceptual knowledge (5.3%). Their total percentage weighting was 18.6%, therefore only 1.4 % less than the prescribed total percentage weighting of 20%. Also apparent from the research findings is that procedural knowledge was completely not assessed in mid-year examinations.

Lastly, in mid-year examinations there was an incongruity between the intended and the implemented assessment in terms of the learning outcomes. Mid-year examination papers mostly assessed learning outcome two (72.8%) instead of the prescribed weighting of 40%. Learning outcome one weighted 21.1% instead of 40%, while learning outcome three weighted 6% instead of 20%.

5.2.2. End-of-year examinations

In end-of-year examinations there was also schism between the intended and the implemented assessment. The average percentage weightings of the higher and lower cognitive levels and learning outcomes did not match the prescribed percentage weightings. In assessing lower cognitive levels the end-of-year examination papers only assessed 11.6% of the recall of factual knowledge (1A) instead of the prescribed 30% weighting. The question papers mainly assessed the recall of conceptual knowledge (22.5%) which was not required to be assessed. Understanding of conceptual knowledge weighted 38.7%, which was 18% more than the official weighting of 20%. Understanding of factual (2A) and procedural knowledge (2C) were not assessed. Moreover, instead of assessing both application of conceptual and procedural knowledge which were supposed to receive a weighting of 30%, the question papers only assessed the application of procedural knowledge (1.5 %).

Regarding the assessment of higher cognitive levels the end-of-year examination papers mainly focused on the analysis of conceptual knowledge (19.2%). Evaluation of conceptual knowledge (0.2%) was least assessed, while the creation of conceptual knowledge (6.4%) was fairly assessed. Moreover, there were no questions assessing the analysis of factual and procedural knowledge, as well as evaluation and creation of procedural knowledge as required in the SAG (2008).

In end-of-year examination papers the total percentage weighting for lower cognitive levels was 74.3%, therefore 5.7% less than the prescribed total percentage weighting of 80%; while the total percentage weighting for higher cognitive levels was 25.8%, therefore 5% more than the prescribed total percentage weighting of 20%.

In end-of-year examinations there was also a discrepancy between the intended and implemented assessment. The average percentage weighting of learning outcome two (59.1%) was 19.1% more than the prescribed percentage weighting of 40%. The average percentage weighting of learning outcome one was 3.7% instead of 40%, and that of learning outcome three was 9.2% instead of 20%.

Lastly, it is worth commenting about the assessment of procedural knowledge and learning outcome two and three in formal CASS tasks and end-of year examinations. In general the research findings showed that the assessment of procedural knowledge was not good. As already indicated in this chapter, in practical tasks it received an average weighting of 25.1% when it was supposed to weight 100%. In controlled tests, research projects and end-of-year examinations it received an insignificant weighting of 1.4%, 7.4% and 1.5% respectively; while in mid-year examinations it was not assessed at all. This is disturbing because Life Sciences is an experimental and investigative subject which is concerned with the development and understanding of scientific method (procedural knowledge). One also wonders how is it possible that these assessment tasks, particularly the controlled tests and examinations, can be used diagnostically as required in the SAG (2008) when they failed to sample procedural knowledge.

The findings of this study also showed that practical tasks, controlled tests, mid- and end-of-year examinations tended to focus on the assessment of learning outcome two and hardly at all on learning outcome three. It is possible that the teachers who constructed these assessment tasks might have easily interpreted and understood learning outcome two (than learning outcome three), because it is mostly concerned about the understanding, interpretation, memorisation and application of life sciences facts and concepts.

5.3. EXPLANATIONS OF THE RESEARCH FINDINGS

The results of this study have indicated a lack of fit between the intended and implemented assessment for a number of assessment tasks which were analysed. The following three reasons which are often discussed in curriculum literature and policy implementation studies were thought to be most appropriate to account for this discrepancy.

5.3.1. Inadequate training or support in the curriculum.

Inadequate training or support of the teachers in implementing the curriculum could be a cause of the schism between the intended and implemented assessment exemplified by this study. Given the legacy of some weak teachers from teacher preparation programmes before 1990 (Blignaut, 2007), and the dearth of capacity in many South African teachers to meet the demands of the new curriculum, the national department of education instituted in-service training and follow-up support programmes to ensure that teachers in schools implement the new curriculum policy (Chisholm, 2003) as intended. However, the training and support programmes received by the teachers who constructed the assessment tasks seem to have been inadequate to equip them with the knowledge of the cognitive levels and Life sciences learning outcomes as well as the assessment skills. Consequently they failed to implement the SAG (2008) as intended.

The following instances demonstrate the teachers' lack of knowledge of cognitive levels and learning outcomes as well as the lack of assessment skills. In controlled tests, mid and end-of-year examinations learning outcome three was inadequately assessed. Furthermore, in mid and end-of year examinations the teachers assessed the recall of conceptual knowledge which was not officially required to be assessed. Lastly, in practical tasks they assessed learning outcome two and three as well as other cognitive levels in spite of the fact that practical tasks were only concerned with learning outcome one and the application of procedural knowledge. These examples indicate that the teachers who constructed these assessment tasks were either inadequately trained or not supported in terms of understanding the assessment requirements stipulated in the SAG (2008) as well as the cognitive levels and Life Sciences learning outcomes. The findings of the Rand Change Agent study (reported by McLaughlin, 1998) on education policy implementation showed that successful implementation of education policy objectives depended on teachers' subject knowledge and competence. Thus in order for teachers who constructed the assessment tasks to be able to implement the SAG (2008) as intended they needed to be properly trained and supported to have enough knowledge on the concept of the cognitive levels, Life Sciences learning outcomes and the assessment requirements stated in the SAG (2008) .

5.3.2. Teachers' personal beliefs and epistemologies.

The gap between the SAG (2008) and assessment practice may also be ascribed to the past knowledge and personal beliefs of the teachers who constructed the assessment tasks. According to Morrow (2001) current practices of humans have histories. Fullan (2001) and Jansen (2001) concur with this assertion when they suggest that personal beliefs held by individuals are hard to change and often incongruent with the intentions of policies. The new and complex methods of assessment ushered in the SAG (2008) might have been incompatible with long held personal beliefs and previous knowledge of assessment of these teachers regarding a valid assessment practice. Thus, adopting and implementing the new assessment changes probably threatened their dominant professional identity and which made them stick to what they know regarding valid assessment of learners' performance. This identity, as Blignaut (2007, p.56) suggested, might have been shaped by the 'theory of Fundamental Pedagogics which underpinned teacher education programmes in tertiary institutions in the past'. This kind of identity made the teachers to have a conception of assessment which is antithetical to one advocated by the new curriculum.

5.3.3. Implicit nature of the SAG (2008).

The gap between the SAG (2008) and assessment practice could also be attributed to the implicit nature of the SAG (2008).An analysis of the SAG (2008) showed that it is not user friendly. For example, the cognitive levels as well as their official percentage weightings in practical tasks, research projects, and controlled tests are not stated in the SAG (2008). The official percentage weightings of the learning outcomes which must be assessed in practical tasks and the research projects are also not stated in this policy; only words which need to be interpreted have been used to communicate their official assessment requirements. Undoubtedly, the teachers who constructed these assessment tasks found it difficult to interpret and understand the assessment requirements for these assessment tasks. This resulted in their failure to implement the SAG (2008) as intended. Darling-Hammond (2000) highlights the problem of implicit education policies. She argues that for education policies to bring about reform in education they must not only be designed to direct education systems, but must also be explicit and capacitating the schools, administrators and teachers who are implementers of those policies in order to bridge the gap between education policy and practice.

5.4. RECOMMENDATIONS FOR FURTHER RESEARCH

This study has described the extent to which formal CASS tasks and end-of-year examinations from three selected schools in Grade 10 Life Sciences assess the different cognitive levels and learning outcomes as stipulated in the SAG (2008). However, the following are recommended for further research on policy implementation:

- Conduct a study which will determine the effects teachers' beliefs; professional identities; knowledge of Life Sciences as a subject and the concept of cognitive levels on the implementation of Life Sciences SAG (2008).
- Conduct a study which will determine the effects of the structure of the Life Sciences Subject Assessment Guidelines (2008) on its implementation.
- Conduct a study which will determine the effects of the curriculum support and training programmes currently given to the Life Sciences teachers on the implementation of the Life Sciences SAG (2008).

5.5. CONCLUSION

This chapter has discussed the principal findings of the study. It also furnished an explanation for the discrepancy between the intended and implemented assessment for some of the assessment tasks. The three main reasons which were furnished to account for this discrepancy were: inadequate training and support, the implicit nature of the SAG (2008), and the neglect of the beliefs and epistemologies of the teachers who constructed these assessment tasks. Lastly this chapter presented the recommendations for further research.

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Appendix A Exemplar of practical tasks

PRACTICAL 1 2008 Page 1

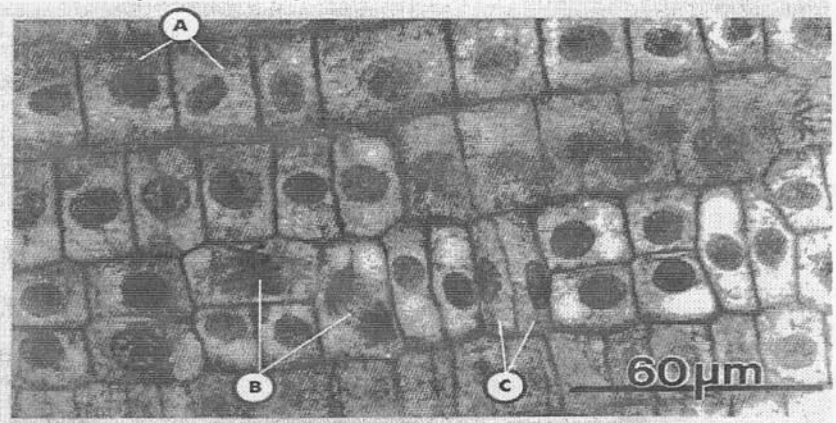
Model

NB This is taken from Rubric → 6B, 1A, 2A

PRACTICAL GRADE 10

1. Make/build a labeled model to show the stages and phases of mitosis (14)

2. Study the following micrograph and answer the questions



A photomicrograph that shows mitosis in some cells

a. Are the cells in the micrograph plant cells or animal cells? Explain your answer. (2) 1B, 2B

b. Which of the labels A, B or C show mitosis? Give a reason for your answer. (4) 1B, 2B

c. Which cells are fully grown? (1)

d. Which cells are daughter cells? (1)

e. Where in plants will you find many dividing cells? (2)

f. What is a tumor? (1) 1B

Total: 25

Appendix B Exemplar of research projects

Page 2

Grade 10 **Project** extended response **2007**
Total = 10

The knowledge area: **gaseous exchange**

Topic: **Smoking and your health**

Hypothesis: **Smoking can affect health.**

LO 2;AS1;AS2,(a) (b)
LO3; AS1;3

Assessment

- This project is well suited to group assessment
- Groups can use the following criteria to assess each other:

[redacted]

- Good introduction, with clear links to content.
- Body of presentation clear, not wandering of the subject.
- Clear separate points.
- Summary highlights the main points.
- Support material link to the content.
- Correct responses to questions. x
- Enthusiasm and creativity.

Instructions

In groups, research and prepare a presentation, which may include:

- A poem or song (no longer than 20 lines or 200 words).
- A drama (no longer than 20 minutes).
- A speech (no longer than 10 minutes).

In your presentations, refer to the following:

1. effects of smoking.
2. statistics to support your findings.
3. smoking and society.

6

6 B AS 3
3 C AS 1.2
2 B AS 2.2

[redacted]

The marking grid

~~The learner~~

CRITERION	GUIDLINE	MARKS	Scores
Satisfactory introduction	Is the project introduced clearly. Does the project contain some of the key concepts.	2	
Relevant content	Does the content focus on the project you are proposing.	2	
Logical presentation	Is the content presented logically and coherently?	2	
Language and style	Has the report been edited for language and style errors.	2	
Satisfactory conclusion	Does the conclusion follow logically from the body of the argument? Is the main argument/point of view summed up? Does the conclusion end effectively?	2	

[redacted]

6 B, C theory

A The learner: ~~clear~~
– clearly introduces the project that contains key concepts
B presents/writes a project that whose ~~focus~~ content is on the proje
C. presents the content logically + ~~&~~ coherently
D ~~has~~ presents/edited the language + style
E. presents a logical ~~+ effective~~ conclusion following from the main body of argument

[redacted]

Appendix C Exemplar of controlled tests

Page

NO LO3
NO LO3 *

Clusterfest 2

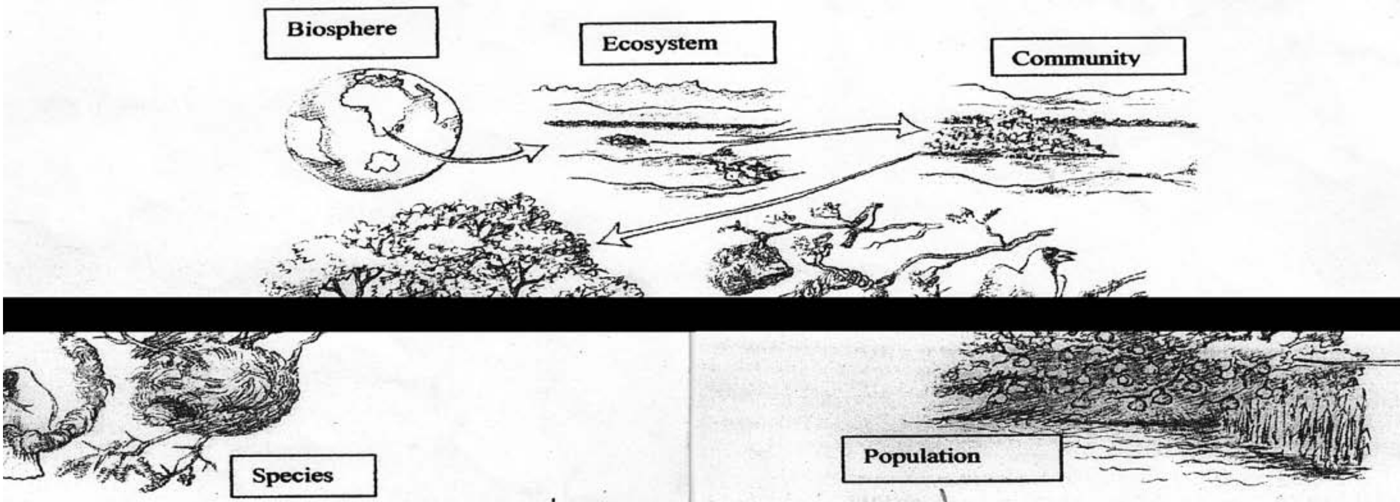
VOLKSRUST CIRCUIT
LIFE SCIENCES
GRADE 10

EXAMINOR: JC BUITENDAG
MODERATOR: M PHEIFFER

DATE: Augustus / August 08
TIME : 55 MIN
MARKS : 70

QUESTION 1

Study the following diagram and answer the questions that follow



1.1 Define
a. biosphere
b. ecosystem
c. community
d. population
e. species

1B AS 2.2

(10)

1.2 Explain where and why life is possible in the t… s of the biosphere 2B AS 2.2 (10)

[2…

QUES…

2.1 Study the following diagram and answer the … s that follow

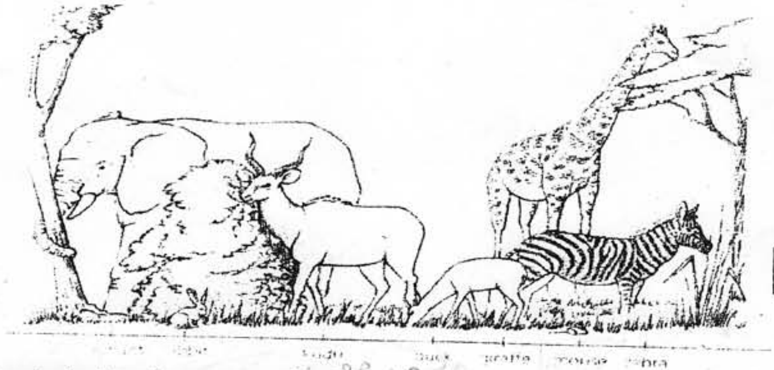
Identify the biotic components in the system 1B AS 2.2 (5)

Identify the abiotic components in the system 1B AS 2.2 (3)

2.1.3 Identify two examples of interaction between biotic and abiotic components in the system 1B AS 2.2 (4)

2.1.4 Identify two examples of interaction between biotic and biotic components in the system 1B AS 2.2 (4)

2.2 Study the following diagram and answer the questions that follow



Animals that feed

2.2.1 Will all the animals in the diagram survive? 2B AS 2.2 (1)

2.2.2 Explain the similarities and differences between their feeding habits. 2B AS 2.2

[redacted]

2.2.3 list of resources for which plants will compete. 1B AS 2.2 recall (4)

[25]

QUESTION 3

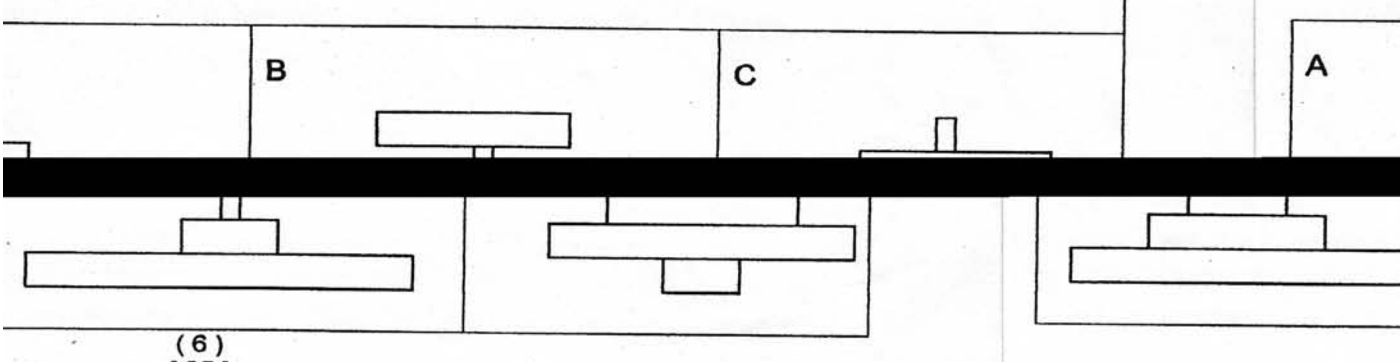
3.1
5 terrestrial biome 1B AS 2.2
2 aquatic biome 1B AS 2.2 ✓ (7)

3.2 xplain the role played by plants in the following cycles.
water 2B AS 3.2
carbon 2B AS 3.2
nitrogen 2B AS 3.2 (9)

3.3 ree types of food pyramids. 1B AS 2.2 (3)

3.4 e following food chains to the correct pyramid of numbers. Only write down A, B or C next to tion number 2B AS 3.2

3.4.1 zebras – lions - fleas — categories & relationships
3.4.2 eetles – lizards – owl
3.4.3 ish – heron - crocodile

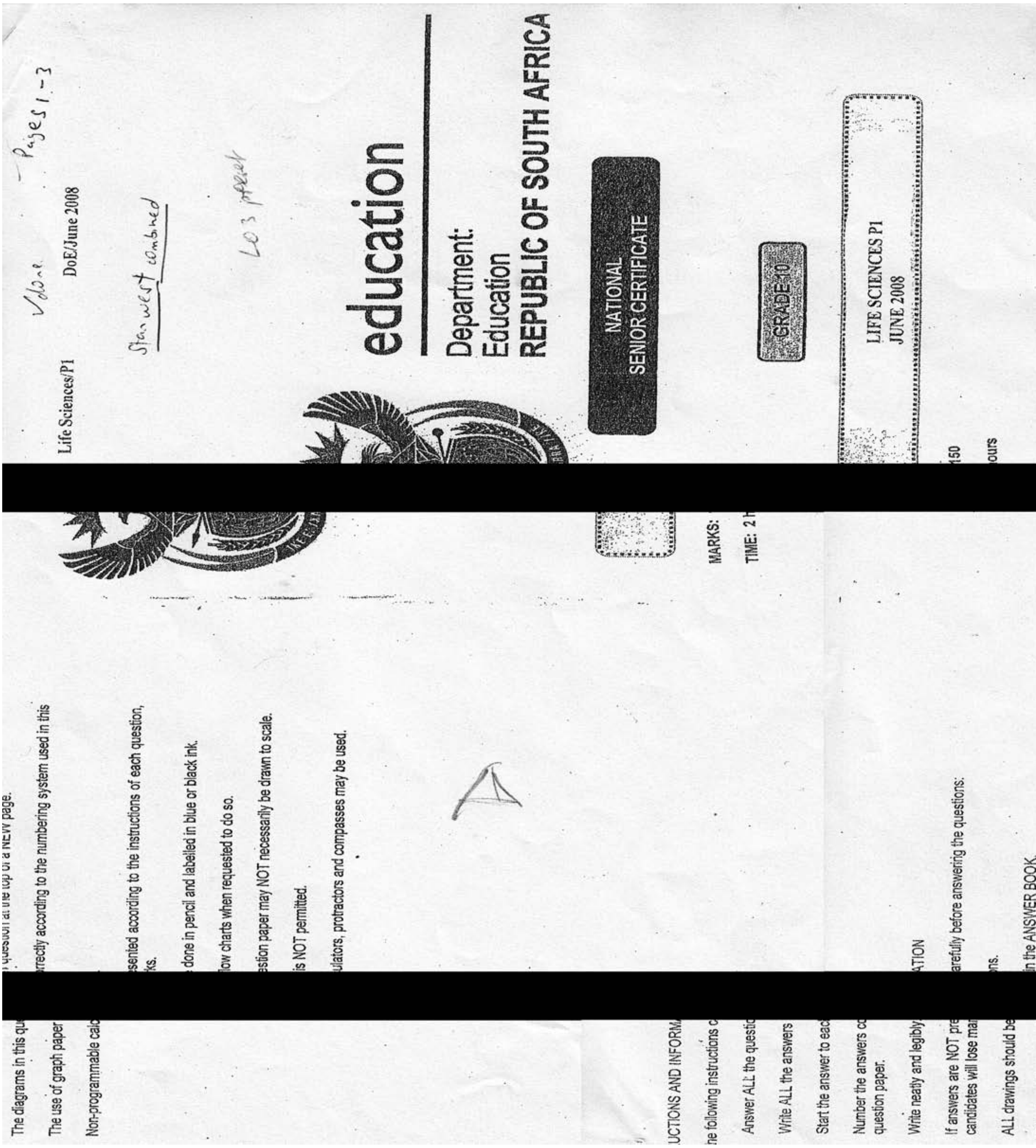


[redacted]

(6)
[25]

TAAL 70 / TOTAL 70

Appendix D Exemplar of mid-year examinations



Life Sciences/P1 DoE/June 2008

Vdone - Pages 1-3

Stanwest combined

LO3 present

education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL
SENIOR CERTIFICATE

GRADE 10

LIFE SCIENCES P1
JUNE 2008

MARKS: [redacted] 150

TIME: 2 h [redacted] ours

The diagrams in this qu
The use of graph paper
Non-programmable calc
UCTIONS AND INFORM
he following instructions c
Answer ALL the questio
Write ALL the answers
Start the answer to eac
Number the answers co
question paper.
Write neatly and legibly.
If answers are NOT pre
candidates will lose mar
ALL drawings should be

[redacted]

question at the top of a NEW page.
rrectly according to the numbering system used in this
esented according to the instructions of each question,
rks.
done in pencil and labelled in blue or black ink.
low charts when requested to do so.
estion paper may NOT necessarily be drawn to scale.
is NOT permitted.
ulators, protractors and compasses may be used.
ATION
arefully before answering the questions:
ns.
in the ANSWER BOOK.

-1-

Question [redacted]

50 marks

correct ans [redacted] 1: Various possible options are provided as answers to the following questions. Choose the
answer bo [redacted] wer and write only the letter (A – D) next to the question number (1.1 to 1.6) in your
[redacted] ok. Write each answer on a new line.

1.1 An org [redacted] anelle that serves as a "power station" of the cell.
A. [redacted] Chloroplast. B. Plasma lemma. 2B 3.2
C. [redacted] Mitochondrion. D. Ribosome.

1.2 Which [redacted] of the factors will not increase the rate of photosynthesis?
A. [redacted] High light intensity. B. Increase in oxygen concentration.
C. [redacted] Increase in carbon dioxide concentration. D. Increase in temperature. 2B 3.2

1.3 Which [redacted] of the following is not found inside a nucleus?
A. [redacted] Chromatin. B. Nuclear plasma. 2B 3.2
C. [redacted] Mitochondrion. D. Nucleolus.

1.4 Which [redacted] one of the following reactions take place in the human liver?
A. [redacted] Proteins changed into amino acids. B. Starch changed into maltose. 2B 3.2
C. [redacted] Glycogen changed into glucose. D. Bile changed into haemoglobin.

1.5 What is [redacted] the most important function of the large intestine in the human body?
A. [redacted] Absorb digested food. B. Storage of fats. 2B 3.2
C. [redacted] Digestion of cellulose. D. Absorption of water.

1.6 During [redacted] which stage does replication of DNA take place?
A. [redacted] Interphase. B. Prophase. 1A 2B 3.2
C. [redacted] metaphase. D. Anaphase. (6 x 2 = 12)

Question 2 [redacted]: Give the correct biological term for each of the following descriptions. Write only the
term next to [redacted] the question number. Write each answer on a new line.

2.1 A g [redacted] roup of similar cells with the same origin and function. 1B 2.2
2.2 The [redacted] light trapping pigment found in the leaves of plants. 1A 1.1
2.3 A fl [redacted] at, leaf shaped piece of cartilage that prevents food from entering the trachea. 1A 1.1
2.4 The [redacted] protein molecule responsible for the transport of oxygen and carbon dioxide. 1B 2.2
2.5 The [redacted] building blocks of proteins. 1A 1.1
2.6 The [redacted] cell organelles responsible for protein synthesis. 1A 1.1
2.7 The [redacted] folds formed by the inner membrane of mitochondria. 1A 1.1
2.8 The [redacted] stage whereby the cytoplasm of a cell divides completely. 1B 2.2 (8)

1A

Question 3 [redacted]: Match the items in column B with the statements in column A. Write down only the
letters A to [redacted] K next to each question number. Write each answer on a new line. (7)

	Column A		Column B
1	Organi [redacted] c compound stored in the liver. 1A 1.1	A	Breathing
2	Green [redacted] organelles found in some plants only. 1A 1.1	B	Chloroplasts
3	A gas n [redacted] eeded for respiration to take place. 1A	C	Diffusion
4	The mo [redacted] vement of air into and out of the lungs. 1B 2.2	D	Glucose
5	The ab [redacted] sorption of CO_2 and the release of O_2 in leaves. 1B 2.2	E	Glycogen
6	The co [redacted] mponent in blood playing a major part in clotting. 1A 1.1	F	Oxygen
7	Energy [redacted] rich carbohydrates formed during photosynthesis. 1A	G	Plastids
		H	Platelets
		I	Red blood cells
		J	Starch

2A

Section A [redacted]

[redacted] ons that follow:

	White blood cells/mm³	Platelets/mm³
	560	250 000
	6 100	260 000
	5 000	500

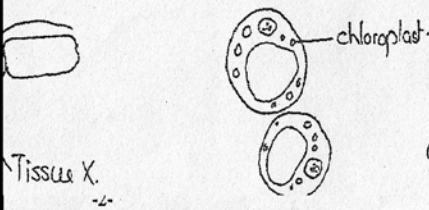
of the following:
es. 1B 4B 3.2 (1)
1B 4B 3.2 (1)
t likely has an iron deficiency in his/her diet? 1B 3.2 (1)
n 4.2. 2B 2B 2.2 (2)
ost likely HIV positive? 1B 3.2 (1)
n 4.4. 2B 2.2 (2)
should be careful not to cut or scrape his/her skin. 2B 3.2 (2)
t likely lives along the coast/at a low altitude? 1B 3.2 (1)
n 4.7. 2B 2.2 (2)
nd answer the questions based on it.

is throat. John noticed that mike could not cough, talk or
nsciousness.
Maneuver (a procedure that is used to help someone who is
hance to save his friend's life. He quickly stood behind
ike's waist and with all his strength pulled hard and
Mike's stomach. Within a few seconds the piece of food
slumped to the ground and screamed.
d alive, but he did not understand why he still seemed to be
e was grabbing his side and complaining of pain. Mike was
was discovered that John had accidentally broken two of
When Mike's parents found out about the incident, the were
John for assault.

procedure on his friend? Give a reason for your answer. (2) 4B A 3.3
le for Mike's injury? Give a reason for your answer. (2) 4B A 3.3
the school can ensure that learners know what to do in (1B) A 3 (1B)
(2)

ams, name the tissue and give one (1) function of each tissue

6.2 1B 2.2



Tissue X. (4)

-2-

ws the composition of blood of three (3) different people. Study

-3- 4B 3.2

Section B: 60 marks

Question 7:

7.1 Draw a labeled diagram of a plant cell. (4B), 3C (10)

7.2 If you were asked to draw a labeled diagram of an animal cell, based in your drawing made in question 7.1, name two (2) structures you would exclude from the animal cell. (2) 1B 2.2

7.3 Which structure in the plant cell is permeable? 1B 2.2 (1)

7.4 What function does mitosis perform in animals? 2B 2.2 (4)

7.5 Answer the following questions concerning tissue types:

(a) What happens when a liquid or food enters your trachea wrongfully? 2B 3.2 (1) 1B.22.

(b) Name the tissue type preventing dust and germs getting into your lungs. 1B (1) 1B

(c) What tissue type keeps the trachea open? 1A 1B 2.2 (1)

(d) Why is it important that the trachea stays open? 2B 2.2 (2)

(e) Why does the breathing rate increase when a person exercises? 2B 3.2 (3)

7.6 Imagine a cigarette factory in your area provides jobs for a large number of people. Recently the government proposed that the factory be closed down because of the health risk caused by smoking. A meeting has been arranged by a government official to address the community regarding the issue. LO3

(a) Would you support the closure of the factory? 4B AS.3.3 (1)

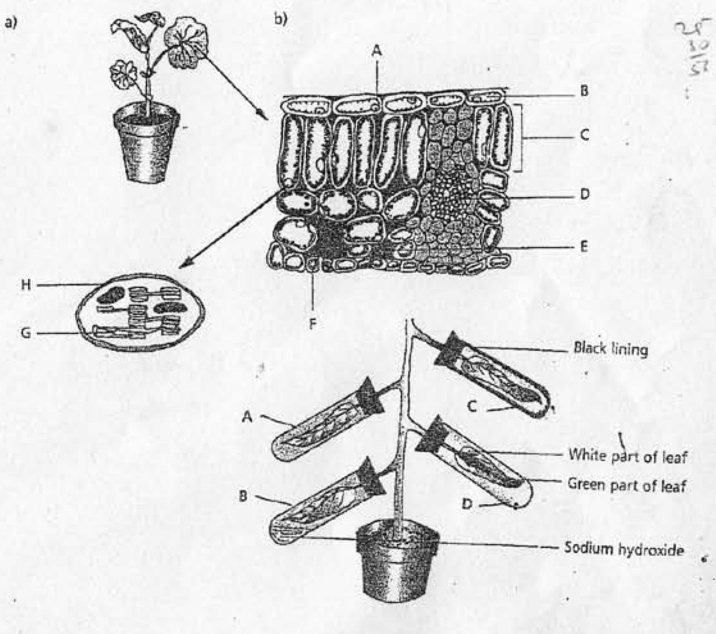
(b) Give two (2) reasons for your answer. 2B 2.2 (2)

7.7 What animal tissue type lines out the alveoli and why. 2B 2.2. (2)

Total 30 marks.

Question 8:

8.1 Study the following diagrams and answer the questions that follow.



25
30
57

-4- 1B 2.2. 4/...

(a) Identify the parts marked C, D and E. (3)

(b) Name the gases that move through F during daytime. 1A 1.1 (3)

(c) Which gases moves through F at nighttime? 1A 1.1 (1)

(d) Name one (1) function of B and E each relating to photosynthesis. 2B 3.2 (2)

8.2 Study the apparatus that was used to study the factors influencing photosynthesis. Green leaves were used in test tubes A to C. A variegated leave was used in test tube D.

(a) Name the factor tested for in each of test tubes B, C and D. 1A 1.1 (3)

(b) What is the function of sodium hydroxide? 1A 1.1 (1)

(c) Indicate the colour changes that will be observed if an iodine solution were to be poured on the leaves in test tubes A and D after the investigation were completed. AS3.1 (2)

8.3 Name four cell types found in phloem tissue in plants. 1B 2.2 (4)

8.4 Name two (2) functions of xylem. 2B 2.2 (2)

Total 20 marks max

Question 9: Read the passage below and answer the questions based on it.

> *Kwashiorkor* is caused by a lack of protein in the diet, especially in young children. The symptoms of the disease is as follows: swollen abdomen, stick like legs, hair may have an orange tint to it, crying and moaning for no reason at all, slowing down of mental and physical development. The children may look fat and have swollen abdomens. The abdomen enlarges because fluids collect in tissue, which causes organs such as the liver to enlarge. Kwashiorkor arises when there is not enough food because of drought and war, or food sources are destroyed by diseases and pests, or people are very poor and cannot afford to buy expensive food. It is also possible that people are not well informed on a balanced diet.

9.1 Why is kwashiorkor regarded as a deficiency disease? 2B 3.2 (2)

9.2 From the passage, list three causes of kwashiorkor. 2B 2.2 (3)

9.3 Give three symptoms of kwashiorkor. 1B AS1.3 (3)

9.4 Suggest two (2) ways in which the Department of Health can try to solve the problem. (2) 2B AS 2.2

Section C: 40 marks

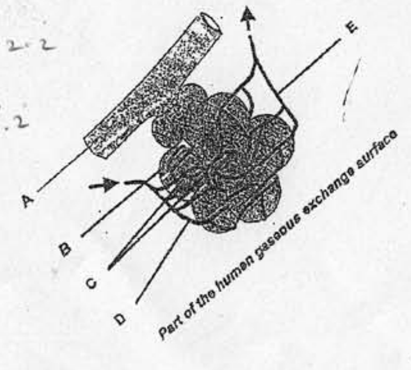
Question 10:

10.1 Study the diagram of a part of the human gaseous exchange system and answer the questions that follows.

(a) Label parts A and C. (2) 1A 2.2.

(b) List two features visible in the diagram making this an effective structure for gaseous exchange. (2) 1B 2.2

(c) State on major difference in the composition of the blood found in blood vessels D and E. (2) 2B 3.2



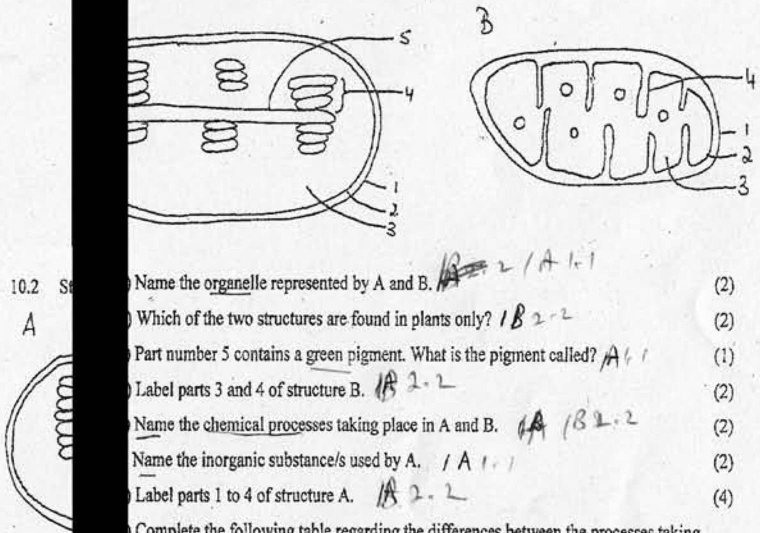
[redacted]

-5-

10.2 St[redacted]udy the following diagrams of two organelles found in plants and/or animals.

A

B



(a)[redacted] Name the organelle represented by A and B. ~~1B~~ 2 / A 1.1 (2)

(b)[redacted] Which of the two structures are found in plants only? / B 2.2 (2)

(c)[redacted] Part number 5 contains a green pigment. What is the pigment called? A 1.1 (1)

(d)[redacted] Label parts 3 and 4 of structure B. 1B 2.2 (2)

(e)[redacted] Name the chemical processes taking place in A and B. 1A 1B 2.2 (2)

(f)[redacted] Name the inorganic substance/s used by A. / A 1.1 (2)

(g)[redacted] Label parts 1 to 4 of structure A. 1A 2.2 (4)

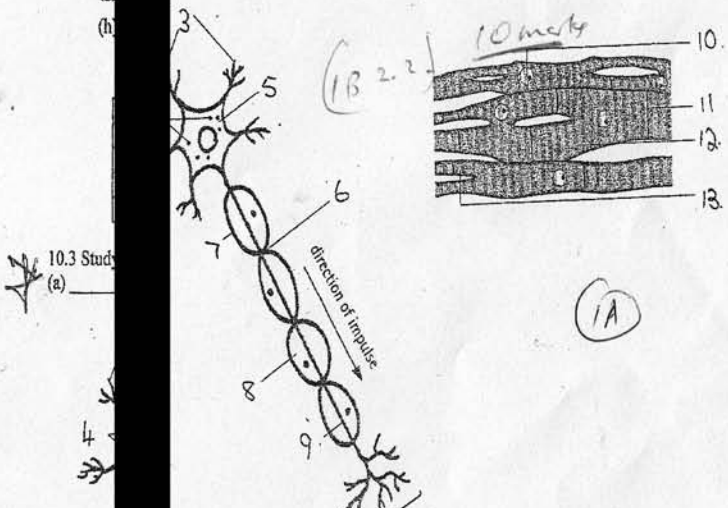
(h)[redacted] Complete the following table regarding the differences between the processes taking place in A and B. Write down only the number and your answer. Write each answer on a new line. (8)

	Process in A		Process in B	
1	Produces sugars.	2	(2) ~~2B~~	1B 2.2
3	(2)	4	Consumes O_2 2B	1B 2.2
5	Takes place in plants.	6	(2) 2B	1B 2.2
7	Takes place during daytime only.	8	(2) 2B	1B 2.2

10.3 Stud[redacted]y the following diagrams and supply the headings and labels asked for:

(a)[redacted](1)______ 1A (b)______(2)_______ 1B 2.2

10 marks



1B 2.2

1A

(10)

Appendix E Exemplar of end-of-year examinations

L03

MPUMALANGA PROVINCIAL GOVERNMENT

Department of Education

GERT SIBANDE REGION

LIFE SCIENCES

FINAL EXAMINATION 2007

GRADE 10

PAPER I

MARKS : 150

TIME : 2 $^1/_2$ HOURS

This paper consists of 14 pages. Please make sure that you have all the pages.

done

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Read the following carefully before answering the questions:

1 Answer ALL the questions
2 Start each section at the top of a new page.
3 Number the answers exactly as the questions are numbered.
4 Write neatly and legibly.
5 If answers are not presented according to the instructions of each question, marks will be deducted.
6 ALL drawings should be done in pencil and labelled in ink.
7 Draw only diagrams and flow charts when requested to do so.
8 The diagrams in the question paper may not necessarily be drawn to scale.
9 The use of graph paper is NOT permitted.
10 Non-programmable calculators and compasses may be used.
11 When you have completed the examination, make sure that your answer sheets are kept together correctly and submitted.

l is formed
ount of energy is li [redacted] e process
en is liberated.
l is produced.

[redacted] ption.
ellular respiration [redacted] rption
ion,
ption.

xide
Carbon Dioxide
Energy
Oxygen

uman includes thre [redacted]

Digestion and absor [redacted]
Digestion and Absor [redacted]
igestion and excret [redacted]
igestion and Absor [redacted]

[redacted] gested as answers to the following questions. Choose the correct
[redacted] ER BOOK , Write down ONLY the LETTER of the correct answer.

[redacted] uent of protoplasm is ....

2B
AS 2.2

A

1 : 1

ossibilities are sug [redacted] e only one not organic is ......
en in your ANSW [redacted]

2B
AS 2.2

n inorganic constit [redacted]

se
acid
ins

[redacted] process of photosynthesis?

[redacted] Energy = Glucose + Oxygen
[redacted] Dioxide +Energy + Glucose
owing examples th [redacted] Oxygen +Glucose + Water
ium [redacted] + NADH + Energy

2B
AS 2.2

[redacted] f yeast cell .....

2B
AS 2.2

[redacted] berated

ation describes the [redacted]

Carbon dioxide + [redacted]
+ Water = Carbon [redacted]
+ Carbon Dioxide= [redacted] include
+ Water = Carbon [redacted]

2B AS
AS 2.2

erobic respiration [redacted]

[redacted] ich of following shows correct path of air movement during exhalation,

[redacted] lveolus -bronchus-bronchiole-trachea
[redacted] Alveolus-bronchiole-bronchus-trachea
[redacted] Trachea-bronchus-bronchioles-alveolus,
[redacted] Bronchiole-bronchus-alveolus-trachea

AS
2B 3.2

Life Science [redacted] r normal cell division in the body cell is completed, the nucleus of each daughter
[redacted] will have

1.1.7. Wh [redacted] alf the number of chromosomes
[redacted] lf the number of chromosomes
A. A [redacted] o times the number of chromosomes
B. A [redacted] r times the number of chromosomes.
C. T [redacted]
D. E [redacted] sis is important in the ....

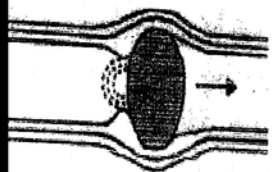
2B
2.2

1.1.8. Afte [redacted] nation of the new body cell
cell [redacted] nation of oxygen
[redacted] rption of carbon dioxide
[redacted] nation of sex cells

2B
2.2

A. Ha [redacted]
B. Ha [redacted] process which is illustrated by the diagram below is
C. Two [redacted] own as .....
D. Fou [redacted]

1.1.9. Mitos [redacted]



A. Form [redacted]
B. Form [redacted]
C. Abso [redacted]
D. Form [redacted]

1.1.10. The [redacted] alsis
kn [redacted] tion
[redacted] olism
[redacted] ption.

2B
3.2

2B associate of metal scheme with new information.

10 × 2 = 20

A. Perist [redacted]
B. Diges [redacted]
C. Metab [redacted]
D. Absor [redacted]

.2. Write down ONLY the correct Li[redacted]fe Sciences term for each of the following escriptions

1.2.1. Essential inorganic which plan[redacted]ts and animals in small quantities.

1.2.2. A deficiency disease in young [redacted]children resulting from insufficient protein in the diet.

1.2.3. Respiration which takes place [redacted] in the absence of oxygen

1.2.4. The general energy carrier in t[redacted]he cell of the living organism.

1.2.5. Form of energy released from [redacted] the sun

1.2.6. The compound containing iro[redacted]n that carries oxygen in the human blood.

1.2.7. The injection of solid waste fr[redacted]om the body.

1 × 7 = 7

1.3. For each of the phrases in Colu[redacted]mn A, state whether it applies to A only, B only, both A and B in Column B. Write down A [redacted]only, B only, both A and B or None in your answer book.

COLOUMN A		COLOUMN B
1.3.1. Deficiency may cause rick[redacted]ets		A. Calcium B. Vitamin D
1.3.2. Essential in hydrolytic re[redacted]actions		A. Carbon Dioxide B. Water
1.3.3. Plays a role in synthesis o[redacted]f chlorophyll		A. Iron. B. Magnesium

3 × 2 = 6

1.4. Read the passage below and th[redacted]en answer the questions that follow :

The short term effects of smo[redacted]king cause the bronchioles to constrict and the cilia lining the air passage to stop [redacted] beating. The smoke also makes the lining produce more [redacted]e component of tobacco smoke, produces an increase in [redacted]e in blood pressure. It may, in some cases cause an [redacted]t. The long-term effects of smoking may take many years [redacted]e and often lethal.

1.4.1. State O[redacted]NE effect that each of the following will have on gaseous exchange :

(a) Co[redacted]nstriction of the bronchioles (2)

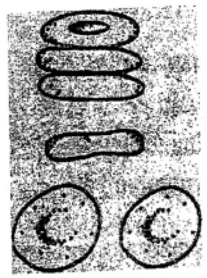
(b) Non[redacted]-beating of cilia (2)

(c) Incr[redacted]ease in the heartbeat rate (2)

1.4.2. Does sm[redacted]oking cause the cells to be starved of oxygen ? (1)
Explain [redacted] your answer. (3)

1.4.3. Define t[redacted]he term 'Homeostasis' (2)
[12]

1.5. Study the [redacted] diagram below of cells in mammalian tissues and answer the questions :



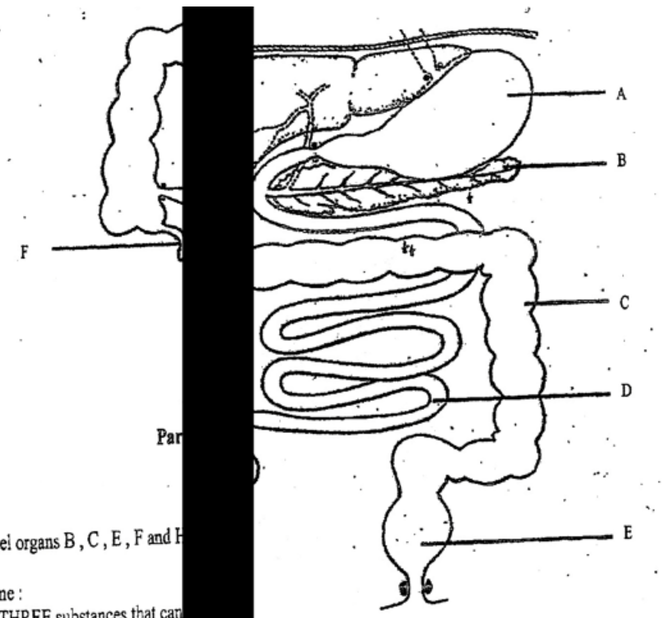
1.5.1. Identif[redacted]y the cells in this tissue. (1)

1.5.2. Name [redacted] the pigment in these cells (1)

1.5.3. What i[redacted]s the main function of these cells. (1)

1.5.4. Menti[redacted]on TWO adaptations of the cells mentioned in 1.5.1. to their function. (2)
[5]

TOTAL SECTION A = 50



Par[redacted]t of the human digestive system

Label organs B , C , E , F and H[redacted] (5)

Name :
(1) THREE substances that can[redacted] be stored in G. (3)

ii) ONE hormone secreted by [redacted]B (1)

iii) The chemical substance wh[redacted]ich creates an acidic pH in A. (1)

List TWO functions of C. (2)
[12]

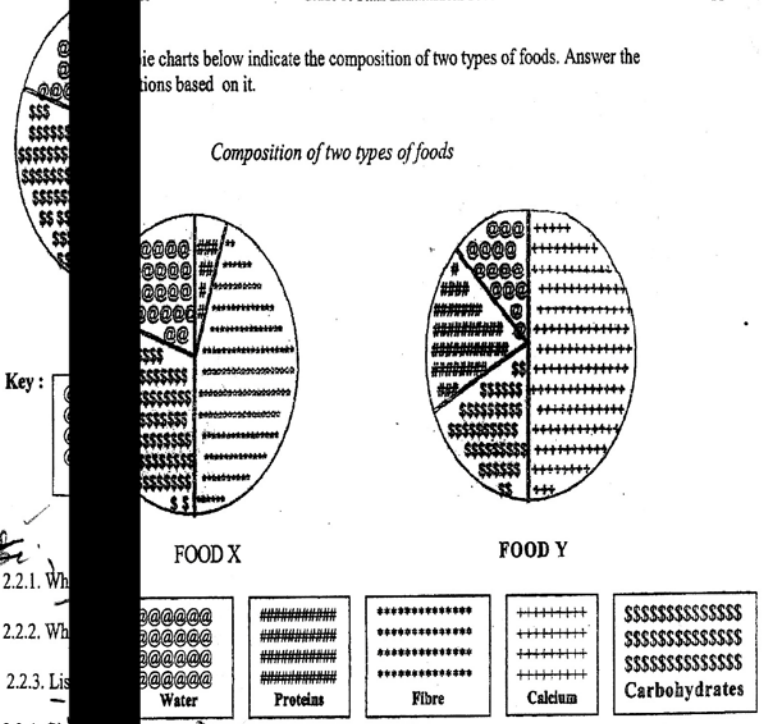
ON : B

ION : 2

dy the diagram below and answ[redacted]

2.2. The p[redacted]ie charts below indicate the composition of two types of foods. Answer the ques[redacted]tions based on it.

Composition of two types of foods



2.2.1. Wh[redacted]ich food is best suited to prevent constipation ? Give a reason for the answer. (2)

2.2.2. Wh[redacted]at percentage of food Y consists of calcium ? (2)

2.2.3. Lis[redacted]t three functions of water in nutrition. (3)

2.2.4. Giv[redacted]e one function of carbohydrates. (1)
[8]

TOTAL QUESTION 2 : 20

pcess named in Question 3.1.1. above ... (2)

cess illustrated by [redacted] ned in Question 3.1.1. differ from respiration. (8)
[14]

ollowing : [redacted] 3.1 2B 3.2

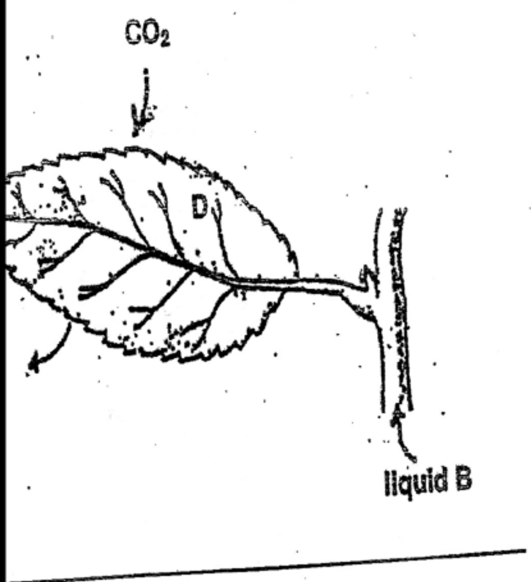
3
oduct D [redacted] hloroplast. (6)
[6]

TOTAL QUESTION 3 : 20

easons why the pr[redacted]
ally important.
he process mentio[redacted] es a process taking place in plant cells and answer the questions

4B
d structure of a c[redacted]

elow that illustrat[redacted]



A[redacted] the diagram. 1B 2.2 (1)

1B 2.2 (1)
1B 2.2 (1)
1B 2.2 (1)
2B 2.2

... Question 3.1.1 above is regarded

repres[redacted]

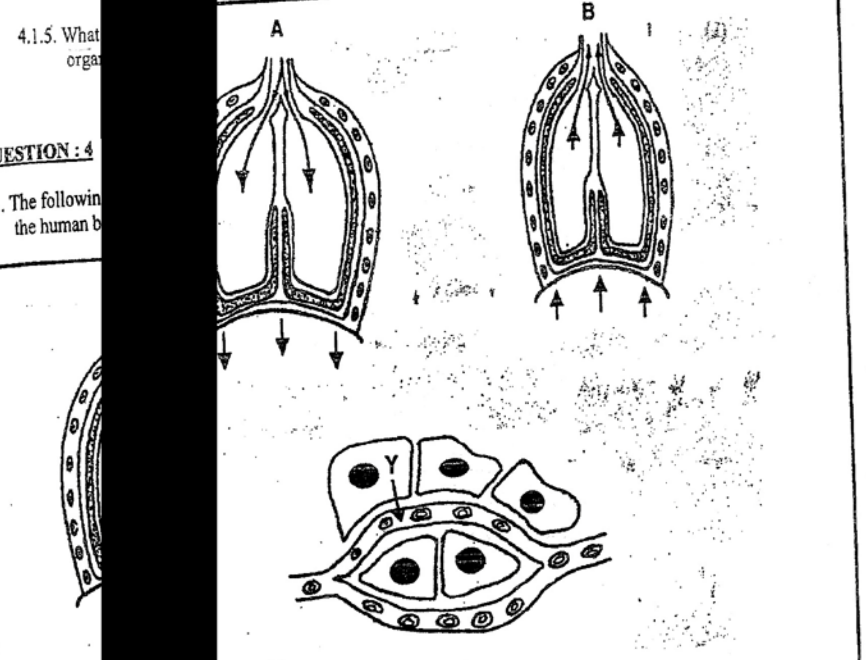
4.1.3. Defin[redacted]

4.1.4. Give [redacted]

4.1.5. What[redacted]
orga[redacted]

QUESTION : 4

4.1. The followin[redacted] g diagrams are based on the breathing mechanism and gaseous exchange in the human b[redacted] ody. Study the diagrams and answer the questions that follow



Breathi[redacted] ng mechanism and gaseous exchange in the human body

4.1.1. Identif[redacted] y the phases in the breathing mechanism as represented by :
(a) A [redacted] 1A 2.2 (1)
(b) B [redacted] 1B 2.2 (1)

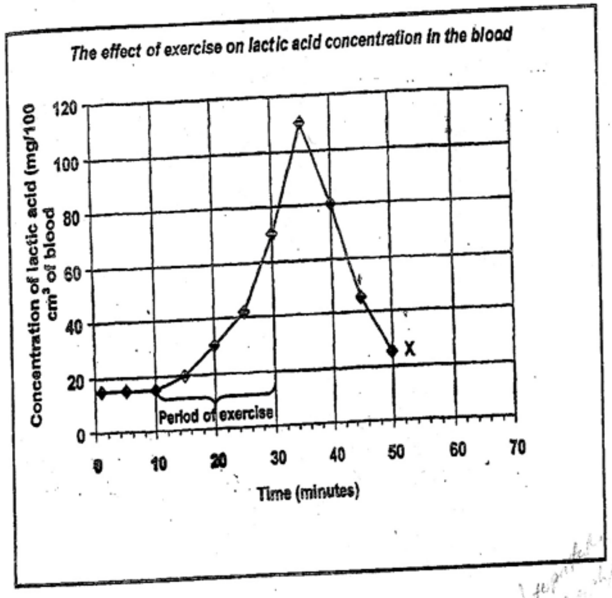
4.1.2. State t[redacted] he muscular activities that occur to bring about the process
[redacted] sented by B. 1B 2.2 (2)

[redacted] e the term gaseous exchange. 1B 2.2 (2)

[redacted] TWO ways in which gas Y is transported in blood. 2B 3.2 (2)

[redacted] are the FIVE requirements for an efficient gaseous exchange (5)
[redacted] n.
2B 3.2

4.2. The following graph shows the effect of exercise by humans on the lactic acid concentration in the blood. Study the graph and answer the questions that follow :



4.2.1. What was the concentration of lactic acid in the blood before exercise ? (1)

4.2.2. How long did it take for the concentration of lactic acid to drop from the highest point to point X on the graph ? 2B (2)

4.2.3. If the rate of decline continued from X at the same rate, predict the time at which the lactic acid level in the blood would have gone back to initial level. 2B (2)

4.2.4. Explain the continued rise in the concentration of lactic acid just after the exercise had stopped. 2B (2)
[7]

TOTAL QUESTION 4 : 20

TOTAL SECTION B : 60

SECTION : C

QUESTION : 5

5.1. Read the following extract and answer the questions below :

On 26 August 1976, in a little mission hospital in the village of Yambuk in the Bumba Zone, a 30-year-old man, Mabalo Lokela, complained about terrible diarrhea. Another man complained about severe nose bleeds, bleeding gums, cramps and diarrhea. The mission sisters treated them with antibiotics and vitamin injections, and the patients left the hospital.

On 5 September, one of the man returned to hospital with severe symptoms and a fever that progressively worsened. The sisters injected him with medicine to cure malaria and sent him home to his family. On 8 September, Mabalo Lokela died. His wife had started to get headaches and cramps. The nurses had seen a few more visitors in the hospital that had similar symptoms and treated them for yellow fever and malaria. By 17 September, 28 people had died of a mysterious disease including nursing staff.

The World Health Organisation sent many scientists to the area to obtain blood tissue specimens. Tissue cultures and microscopic studies were made and a new virus was identified. The infectious organism was named the Ebola virus. Tissue culture studies and tissue biopsies (tissue samples taken from people who have died) assisted in the study and control of this disease.

5.1.1. Where was the Ebola virus first found? 2B (1)

5.1.2. What is tissue culture? (2)

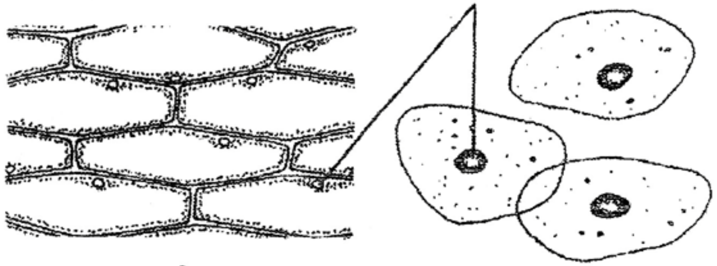
5.1.3. What is the term for tissue samples taken from people who had died ? (1)

5.1.4. What does a pathologist do? 1B (1)

5.1.5. State ONE function of:
(a) Erythrocytes 1B (2)
(b) White blood cells 1B (2)

5.1.6. What do 'HIV' and 'AIDS' stand for? (2)
[11]

5.2 A grade 10 learner submitted the following drawing of animal cells and plant cells that he viewed under light microscope.



A B

2.2.1. Which one of the drawings (A or B) represents: B

(a) Plant cells 1B 2.2 (1)

(b) Animal cells 1B 2.2 (1)

2.2.2. State two visible differences between cell A and cell B. 2B 2.2 (4)

2.2.3. List two visible similarities between cell A and B. 2B 2.2 (4)

2.2.4. Mitochondria and chloroplasts are not easily visible under microscope.

Explain your answer. 2 B 2.2 (2)

2.2.5. State two functions of the part labeled C. (2)

2B 2.2

[14]

5.3 In your area, there is a mobile clinic where most babies/young children are treated for the following external symptoms:

6B

These symptoms are as a result of a particular diet that is most common to the area i.e. mostly maize porridg

6 - Write an essay in which you: 2B 3.2

- Mention the deficiency disease that the babies are suffering from 2B 3.2
- Mention the external symptoms of the disease that the babies are suffering from 1B
- Include the internal symptoms of the disease you mentioned 2B 3.2
- Discuss the biological importance of the nutrient that is lacking 2B 3.2
- Discuss the cause of this disease in terms of the dietary needs of the babies 2B 3.2
- Suggest what advise could be given to the mothers of these babies to prevent or cure their children of this disease

2B 3.2 (15)

TOTAL QUESTION 5 : 40

TOTAL SECTION C : 40

GRAND TOTAL : 150