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UNIVERSITY OF CAPE TOWN

FACULTY OF HUMANITIES

HOW LEARNERS PREFER TO BE TAUGHT AND ASSESSED IN BIOLOGY:
A STUDY IN EIGHT WESTERN CAPE SCHOOLS

A dissertation submitted to the University of Cape Town in fulfilment of the requirements for the degree of

MASTER OF EDUCATION

By

MELANIE BERNADETTE ASARY

BSc (Wits), BSc (Hons) (UCT) HDE (UCT)

September 2002
DECLARATION

I, Melanie Bernadette Asary, declare that this work is my original work and has not been submitted before, in any form whatsoever, by myself or anyone else to this university or any other educational institution for assessment purposes.

I understand that any breach of this declaration may result in non-acceptance of this work by those concerned.

Signed ________ MB Asary

Date ________ 04/09/2002
For my mother,
Joyce Aletta Asary
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ABSTRACT

This study aimed to investigate how high school learners in eight schools in Cape Town, South Africa, perceive how they prefer to be taught and assessed in biology.

The investigation sought to answer the following focus questions:

1. To what extent are teacher-centred methods of teaching and assessment perceived to be appropriate for biology as a school subject?
2. In what ways do diverse samples of learners perceive how biology should be taught and assessed?
3. Can the learners’ perceptions be reconciled to current curricular pronouncements and expectations in biology as a school subject?

The study engaged two research paradigms, qualitative and quantitative. The quantitative approach used a survey methodology to gauge if there were differences between learners’ preferences. Data were collected by means of two surveys. The total data collected were the responses of 911 biology learners for the questionnaire “How would you prefer to be taught biology?” and 1259 biology learners for the questionnaire “How would you prefer to be assessed in biology?”.

The data were analysed in three steps. Firstly, the learners’ most preferred and least favoured responses were summarised for each questionnaire. Secondly, the qualitative responses suggesting why the learners prefer particular methods of teaching and assessment, the most and least, were re-arranged and sorted into emerging indicators, descriptive categories, trends and themes presented at several levels of analysis.

In the final part, school-by-school comparisons were made. Chi-square tests were used to compare the frequencies of “yes” or “no” responses to each of the sixteen items on the questionnaire “How would you prefer to be taught biology?” and to the eighteen items on the questionnaire “How would you prefer to be assessed in biology?” Explanations for the similarities and differences between schools were then offered, derived from the qualitative data collected.
The evidence derived from the investigation suggests that:

a) Learners’ perceptions of methods of teaching were that:
   - most learners preferred methods of teaching that were learner-centred;
   - the learners associated learner-centred methods with social interaction, physical interaction with the environment, group-work, autonomy, freedom to explore and ask questions, moving out of the set classroom environment and personal interaction with the teacher;
   - most learners expressed feelings of positive motivation when exposed to methods that they associated with learner-centred methods of teaching;
   - most learners did not prefer methods of teaching that were teacher-centred;
   - learners associated teacher-centred methods with being controlled by the teacher and a restrictive classroom environment;
   - most learners felt less motivated when exposed to teacher-centred methods of teaching.

b) Learners’ perceptions of methods of assessment were that:
   - most learners appeared to be more circumspect or careful when considering their choice of assessment methods, and they preferred mainly teacher-centred methods of assessment;
   - most learners preferred methods of assessment that “guided” them to the correct answers;
   - most learners indicated that they preferred methods that would help them to prepare for the June and December examinations;
   - most learners preferred methods that were ‘easy’, so that they could get good marks, and they tended to avoid methods that would require synthesis of knowledge;
   - most learners took a surface approach to learning.

The study also suggests that the learners’ responses for the survey “How do you prefer to be taught biology?” support the education policy documents in South Africa, while the learners’ responses for the questionnaire “How would you prefer to be assessed in biology?” supported the policy documents only partly.
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<td>CASS</td>
<td>Continuous Assessment</td>
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<td>CO</td>
<td>Critical Outcome</td>
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<td>CRC</td>
<td>Curriculum Review Committee</td>
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<td>C2005</td>
<td>Curriculum 2005</td>
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<tr>
<td>DoE</td>
<td>Department of Education</td>
</tr>
<tr>
<td>Grade R</td>
<td>Reception Grade</td>
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<td>HG</td>
<td>Higher Grade</td>
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<td>MCQs</td>
<td>Multiple Choice Questions</td>
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<td>NDE</td>
<td>National Department of Education</td>
</tr>
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<td>OBE</td>
<td>Outcomes-Based Education</td>
</tr>
<tr>
<td>SAQA</td>
<td>South African Qualifications Authority</td>
</tr>
<tr>
<td>SG</td>
<td>Standard Grade</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>WCED</td>
<td>Western Cape Education Department</td>
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<td>ZDP</td>
<td>Zone of Proximal Development</td>
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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter describes the context, origin, background and importance of the investigation. It introduces the statement of the research problem, conceptual framework, questions to be answered, clarification of terms, research approach, list of dependent and independent variables, assumptions of the study, the delineation of the research and organisation of the dissertation.

1.2 Background and context of the study

For decades competent teachers of biology have used a variety of teaching methods varying from learner-centred, open-ended activities to closed investigations, as well as the normal teacher-led didactic exposition.

In biology lessons, there will always be a need for teacher-centred lessons to help learners understand content work such as, for example, the light and dark phases of photosynthesis. Another teaching approach that has been prominent for the last 20 years is constructivism. Constructivism, as expressed by Driver and Oldham (1986) and Leach and Scott (2000), has received positive attention by many authors in the literature, and has thus been included in the South African education policy documents.

At the beginning of 2000, the Department of Education (DoE) published Curriculum 2005: Towards a Theoretical Framework (DoE, 2000) in which the department looked explicitly at constructivism to provide the teaching and learning solutions required by outcomes-based education (OBE) in South African schools.

This document was significant because, for the first time, the Education Department had moved away from a position where it made prescriptions about teaching styles or
strategies, holding them to be a matter of choice on the part of the teachers. It was at this point that “constructivism” was to be the basis of the new teaching approach called OBE (page 11).

The Department of Education advocated a number of features of a “constructivist classroom” as the basis of a “paradigm shift” from the “old approach in the classroom” associated with Apartheid education to the “learner-centred approach” associated with OBE. Table 1.1 shows the intended differences between the “traditional classroom” and “a constructivist classroom” in South African schools.

Table 1.1: The Department of Education’s understanding of differences between a “traditional classroom” and a “constructivist classroom” (after DoE, 2000: 12, cited in Moll, 2002: 4)

<table>
<thead>
<tr>
<th>Traditional Classroom</th>
<th>Constructivist Classroom</th>
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<tr>
<td>Curriculum is presented part to whole, with emphasis on basic skills.</td>
<td>Curriculum is presented whole to part with emphasis on big concepts.</td>
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<td>Strict adherence to fixed curriculum is highly valued.</td>
<td>Pursuit of learner questions is highly valued.</td>
</tr>
<tr>
<td>Curricular activities rely heavily on textbooks and worksheets.</td>
<td>Curricular activities rely heavily on primary sources of data and manipulative materials.</td>
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<tr>
<td>Students are viewed as “blank slates” onto which information is etched by teachers.</td>
<td>Learners are viewed as thinkers with emerging theories about the world.</td>
</tr>
<tr>
<td>Teachers generally behave in a didactic manner, disseminating information to students.</td>
<td>Educators behave in an interactive manner, mediating the environment with learners.</td>
</tr>
<tr>
<td>Teachers seek the correct answer to validate student learning.</td>
<td>Educators seek the learners’ point of view in order to understand learners’ present conceptions for use in subsequent lessons.</td>
</tr>
<tr>
<td>Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing.</td>
<td>Assessment of learner learning is interwoven with teaching and occurs through educator observations of learners, learner observation of learners at work and through learner exhibitions and portfolios.</td>
</tr>
<tr>
<td>Students primarily work alone (i.e. individually).</td>
<td>Learners primarily work in groups.</td>
</tr>
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</table>

For constructivism and OBE to be implemented, a new curriculum was needed to accommodate the changes in classroom teaching. Thus, Curriculum 2005 was
implemented in 1998. After much criticism as well as reviews by the Curriculum Review Committee (Chisholm et al., 2000) and the public, the Department of Education’s Revised National Curriculum Statement (R-9) was accepted as policy in April 2002.

1.2.1 History and background to the Revised National Curriculum Statement

In 1994, before the South African democratic elections, there were a total of 19 different education departments. Each department administered its own syllabus and examinations. After the April 1994 elections, a transformation took place in the South African education system (Jeevanantham, 1999: 49). Syllabus revision and rationalisation occurred and the curricula of the 19 separate education departments were combined to form one ‘core’ curriculum. Therefore, segregated schooling was abolished from this point onward.

In 1998 Curriculum 2005 (C2005) was introduced to schools. The curriculum introduced many new terms and concepts associated with the new philosophy of learning in education, e.g. specific outcomes, range statements, assessment criteria, performance indicators etc. (Asmal, 2000), and these new terms were to be understood by both teachers and learners.

In 2000, C2005 was examined by the Curriculum Review Committee (CRC) (Chisholm et al., 2000), taking into account comments from the public. The Review Committee decided that the curriculum was over-designed and under-specified. The CRC made the following recommendations:

- C2005 must be streamlined in terms of its design features
- A National Curriculum Statement should be developed that:
  - uses clear and simple language
  - specifies the curriculum requirements at various levels and phases
  - addresses concerns around overload
  - gives a clear description of the kind of learner that has to develop in terms of knowledge, skills, values and attitudes.
The Department of Education’s *Revised National Curriculum Statement Draft* was introduced in 2001, and the final revised version, the *Revised National Curriculum Statement*, was accepted as policy in April 2002. A common thread running through all the above curricula was that teaching should be learner-centred and encompass the teaching theories and philosophies of constructivism and OBE.

Thus, the *Revised National Curriculum Statement* emphasised learner-centred education in science, stating:

> The Natural Sciences Learning Area Statement envisages a teaching and learning milieu which recognises that the people of South Africa operate with a *variety of learning styles* as well as culturally-influenced perspectives....Meaningful education has to be learner-centred and help learners to understand not only scientific knowledge and how it is produced, but also contextual environmental and global issues that are intertwined with the learning area (2002: 6-7).

To accommodate a wider variety of learning styles, learner-centred education also allows for teachers to use a variety of constructivist-based methods of teaching to accomplish a learning outcome (Western Cape Education Department (WCED), 2002: 6-7).

1.3 Statement of the problem, purpose and key questions

Some studies have shown that offering a variety of teaching methods and assessment methods can motivate and encourage low achieving learners and those with learning disabilities (Black and Wiliam, 1998: 4). However, they emphasise that using new ways to assess learners requires new modes of pedagogy – which will require significant changes in classroom practice, especially since new approaches require an increased active involvement of learners.

Teachers and learners together drive learning in the classroom. The implementation of these “new” methods has to be accepted by both learners and teachers in order to determine whether the methods will work. According to Black and Wiliam (1998: 1), the classroom is treated as a “black box” because prescriptions from the outside (i.e. policymakers’ demands) must be applied on the inside (i.e. the classroom), sometimes without teachers’ and learners’ inputs.
This study therefore aims to investigate how learners in the classroom perceive how they ought to be taught and assessed in biology. If samples of learners were to be given a free choice as to how they would prefer to be taught and assessed, would they tend to prefer the government-prescribed learner-centred methods or teacher-centred methods? Are learners really willing to apply the "paradigm shift" prescribed by policy documents? If not, might we need to consider special intervention programmes to help them?

The study has three focus questions:

1. To what extent are teacher-centred methods of teaching and assessment perceived to be appropriate to biology as a school subject?

2. In what ways do diverse samples of learners perceive how biology should be taught and assessed?

3. Can the learners' perceptions be reconciled to current curricular pronouncements and expectations in biology as a school subject?

1.4 Origin and purpose of the problem

The Revised National Curriculum Statement for Grades R-9 (Schools) (DoE, 2002: 7) has chosen learning outcomes that emphasise a learner's ability to use science knowledge, not just acquire it. The three learning outcomes are presented in Figure 1.1 below.
Learning Outcome 1: Scientific Investigations
The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Learning Outcome 2: Constructing Science Knowledge
The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Learning Outcome 3: Science, Society and Environment
The learner will be able to demonstrate an understanding of the inter-relationship between science and technology, society and the environment.

Figure 1.1: The three learning outcomes as defined by the Revised National Curriculum Statement for Grades R-9 (Schools) (2002:7)

Thus, in the Revised National Curriculum Statement for Grades R-9 (Schools) (2002), progression is not reflected solely in terms of the amount of knowledge a learner can recall. Rather, learning outcomes 1, 2 and 3 are used to assess progress in the learner’s ability to plan and carry out investigations involving knowledge, and the ability to interpret and apply that knowledge in the classroom as well as in situations affecting the learner as a member of the changing society (p7).

The Revised National Curriculum Statement for Grades R-9 (Schools) (2002: 9) reduced the number of concepts that organise the curriculum. Only two concepts, namely learning outcomes and assessment standards are used. Learning outcomes express the broad expectations of what is to be achieved by learners in the General Education and Training band (Kotze, 2002: 77). The assessment standards are more specific and indicate how the outcomes are to be achieved in each grade.

The relationship between the learning outcomes and assessment standards are that learning outcomes are the operations that the learner must be able to do on a certain range of scientific knowledge. The assessment standards define the levels at which the learner operates in an outcome, while the content areas (knowledge strands) define the breadth over which the learner can operate at a particular level (Kotze, 2002: 78).
The *Revised National Curriculum Statement for Grades R-9 (Schools)* has set out learning outcomes and assessment standards only for learners from Grade R to Grade 9 where, at high school level, biology forms part of the learning area Natural Science in Grades 8 and 9. However, Grades 10, 11 and 12 do not form part of these outcomes.

Nevertheless, the WCED has introduced a policy framework for Grades 10, 11 and 12 senior biology learners called *Guidelines for Continuous Assessment in Biology HG and SG* (WCED, 2002). All full-time learners must have a continuous assessment (CASS) mark for each of their subjects, otherwise their results will be declared incomplete (WCED, 2002:3).

The document sets out clear guidelines for the composition of the final matriculation mark for the end of the year. It is clearly moving away from examinations and tests comprising a major part of the final mark, and moving toward implementing a variety of methods of teaching and assessment. Most assessment methods are activity-based.

The document also stresses that CASS should become part of a teaching strategy and should not be considered as removed from the syllabus. Furthermore, when preparing a programme for the year, the planning of the assessment tasks, teaching strategies, learning strategies as well as the development of the required skills should take place simultaneously. The lessons should be prepared in conjunction with and informed by the twelve critical outcomes (COs) approved by the South African Qualifications Authority (SAQA) (*Revised National Curriculum Statement Grades R-9 (Schools)*: 8).

Evidence for assessment in Grades 10, 11 and 12 should be in the form of a portfolio, which is a collection of a learner's work used to calculate his or her CASS mark for the particular year, as shown in Table 1.2. The requirements of the portfolio are proposed for each year from 2001 to 2004 (Table 1.2). A more detailed description of the requirements for each portfolio method is given in *Chapter 3*. 
Studies of classroom environments have tried to identify localised factors that affect learner progress. Some of these studies have focused on how learners perceive the classroom environment when exposed to different teaching methods. According to Hanrahan (1998: 740), a study of the structure and processes of the microculture of a given setting (e.g. the classroom) can help us understand “the way in which teachers and students, in their actions together, constitute environments for one another and produce an enacted curriculum”.

For example, McRobbie and Tobin (1995) studied year 11 chemistry learners, of average intelligence, at an urban high in Australia. The class consisted of nine girls and six boys, being taught by an experienced teacher with twenty years teaching experience. An interpretative methodology was employed to examine the interrelations between teacher and learner actions, in the context of teaching and learning. Data sources included teacher and learner interviews, direct observation and responses to a classroom survey. Three narratives were constructed for a typical lesson, which included the perspectives of the teacher and learner. These narratives described what had happened in the study.
The narratives revealed that the teacher taught mainly through transmission teaching. It was also found that the learners had no problem with the way they were taught. Both the teacher and the learners were congruent in their way of thinking. Their beliefs about their roles in the classroom, goals and constructions of the contexts were coherent. This indicated that there was no impetus for change. Thus, it would be difficult to initiate or sustain change when teachers and learners are satisfied with what is happening in the classroom.

McRobbie and Tobin (1997) then extended the above study. This study tried to determine which methods learners, who were exposed to both constructivist methods of teaching as well as traditional methods, would prefer. The learners were exposed to a limited number of lessons using constructivist methods, but were mainly taught using traditional methods throughout their high school careers. Teachers and learners completed surveys related to learner involvement in discussion, autonomy in the classroom, the relevance of the course for learner needs, commitment to learning and inhibitors to learning. They were interviewed on the nature of the learning environments, and about their views on science teaching and learning.

The surveys revealed that the teacher used traditional methods of teaching in the classroom, which was consistent with the transmission of knowledge, and a high level of control. Little autonomy was provided for the learners to decide what or how they should learn, and chemistry was perceived to be of limited relevance.

To a significant extent, learners accepted their learning environment and their views were consistent with that of objectivist semantics. Hence there was no impetus for change; the principle concern was to cover the work in the most efficient way. Efforts to bring about change in the classroom will need to address the learning environments that learners are exposed to.

Hanrahan (1998) followed up the above studies by trying to determine how Grade 11 biology learners at an Australian public school would react to a choice between traditional methods of teaching or constructivist methods of teaching. Through extensive and thorough interviews, she found that these learners also preferred traditional methods of being taught biology. Hanrahan's research interviews with the learners and teachers
found that both groups were strongly influenced by curricular restraints in teaching and assessment. However, learners did state they wished that they “could have some say in what and how they were assessed” (Hanrahan, 1998: 744).

It was also found that, even though the learners viewed the classroom positively, and described themselves as highly motivated to learn, the level of cognitive engagement was affected by two interrelated factors: the control the teacher had over almost all activities, and learner beliefs about learning. The data suggest that both intrinsic and extrinsic motivation that could lead to deep involvement in learning is constrained by the preponderance of teacher-centred methods of instruction. A model was proposed, relating motivation to cognitive engagement. It was concluded that more activities should be used which either implicitly or explicitly reinforce positive beliefs in learning.

Hanrahan (1998) emphasised that, if constructivist approaches were to be engaged in the classroom, a supportive environment would be required as well. The teacher should provide this kind of extra support in the classroom (micro-environment) and the curriculum should provide it outside the classroom (macro-environment).

In the United Kingdom (UK), Lock (1998a) compared science teaching methods at two schools, A and B. Teacher-centred approaches were common at School A whilst, at School B, a balanced approach of both teacher and learner-centred approaches was used.

The characteristic teaching style of School A is apparently not uncommon in high schools in the UK (Lock, 1998a: 3). The use of lecture-mode teaching and “chalk and talk” teaching sometimes produces learners who are passive and not always involved in their learning. They tend to have limited opportunities for developing a range of skills, teamwork, or adapting a problem solving approach in their learning (Lock, 1998a: 4). Learners are not always offered opportunities for discussion or debate, or to work with computers and research a topic. Massive textbooks tend to encourage teaching and learning with little insight. Whilst the importance of learning scientific vocabulary, especially in biology, should not be underestimated, this should not dominate methods (Lock, 1998a: 3).
In South Africa, learners’ perceptions of classroom teaching influence their views on classroom assessment. Kotze (2002: 77) states the following about learners’ perceptions of assessment:

> The responses of learners concerning classroom assessment practices often reveal more than what is written in the assessment theory. The beliefs of learners and teachers concerning assessment are indications that assessment has often become an end in itself without any link to particular needs in education. Traditionally assessment has been an unpleasant burden resented by learners while interrupting the main activity of teachers, that is, teaching or learning mediation. Learners often see assessment as an instrument for identifying failure rather than for documenting development and success. To them, the scope of learning is primarily seated in identifying and reproducing the correct answer to a well-defined problem. Learners often see assessment as a neutral isolated element in teaching.

### 1.5 Clarification of terms

**Biology** – The branch of science dealing with properties and interactions of physico-chemical systems of sufficient complexity for the term ‘living’ (or dead) to be applied (Thain and Hickman, 1996: 68).

**Assessment** – The main purpose of assessment in our school system is to track the progress of learners in order to help them achieve the learning outcomes (Independent Examinations Board (IEB), 2002: 9).

**Continuous assessment** – Learners are assessed on an on-going basis, to guide both learners and teachers to find ways to ensure steady progress toward the achievement of outcomes (IEB, 2002: 11).

**Natural Science learning area** – A collection of disciplines spanning the physical (physics and chemistry), life sciences (biology) and earth sciences (physical geography) (WCED, 2002: 3).

### 1.6 Delineation of the research

This study is restricted to:

- Participants in the age range 12-19 years old.
• Conveniently available groups of learners in the Western Cape Province in eight schools.
• A data gathering time period of about 10 minutes for learners to complete the questionnaires.

1.7 Assumptions of the study

The study assumes that the learners have an interest in completing both of the questionnaires. It also assumes that, even if learners were not exposed to the methods of teaching and assessment described in the questionnaires, they will be able to judge whether or not they would prefer a method by its designated description. The study also assumes that the learners were able to understand the instructions on the questionnaires, and able to fill them accordingly.

1.8 Research approach

The research approach adopted is a combination of qualitative and quantitative methodology. Chapter 3 elucidates the issues around the selection, development, validation and classification of the various methods of teaching and assessment, guided by current learning theories and theoretical frameworks. The relevance of these theories and frameworks are explained in Chapter 2. In Chapter 4 the quantitative approach employs the use of chi-square analyses as well as ranking data to compare the scores and response frequencies of different sample groups on individual items and on the surveys as a whole. In Chapter 5, the qualitative approach involves an in-depth analysis of the levels of recorded observations of the respondents.

For the purpose of this research, the responses have been collected by means of surveys developed through several pilot trials, and have included conversations with participants during the developmental stages.

The following variables have been selected for both qualitative and quantitative investigation in this study: -
Dependent variables for each participant:
- Preferred and less favoured methods of teaching and assessment to which they were exposed.

Independent variables for each participant
- Gender (Male or Female).
- Primary language (English, Afrikaans, Xhosa or others).
- Grade level (Intermediate phase, Senior phase).
- School in which participants are based.

1.9 Chapter summary

In this introductory chapter the purpose of the research has been presented, the research problem has been clarified, and its origin, context, importance and background stated. The aims of the research, key items, assumptions and variables have been clarified. The research approach and its delineation stated.

In the next chapter the relevant literature will be reviewed and the theoretical framework and categories for classification for the methods of teaching and assessment will be provided.

1.10 Organisation of the remainder of the dissertation

The next five chapters are arranged as follows:

Chapter 2 introduces the relevant literature review; chapter 3 explains in detail the methodology of the research and the development, refinement and statistical parameters of the final versions of the two questionnaires; chapter 4 tests the hypotheses and presents the results of the study; chapter 5 discusses the quantitative and qualitative results; and chapter 6 draws conclusions and implications and makes recommendations based on the findings and the discussion of these results.
CHAPTER 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

The ways in which learners prefer to be taught and assessed in biology can be influenced at three levels, i.e. at the curricular level, the classroom level and the personal level. This chapter therefore discusses how the published literature indicates that learners prefer to be taught and assessed in biology.

In section 2.2, the curricular level is examined by describing biology teaching methodologies and assessment methodologies as proposed by the present curriculum in South Africa – C2005. It addresses the two key issues of: "What is assessment?" and "What is instructional methodology?" in the context of South Africa's modern classrooms.

Section 2.3 describes how learning is encouraged at the classroom level. This section also focuses on the differences between teacher-centred and learner-centred methods of teaching and assessment. A detailed description of the learning theories that influence teacher-centredness and learner-centredness is also presented.

Section 2.4 describes the personal factors that may influence individual learners in particular ways when choosing methods of teaching and assessment.

Finally, section 2.5 presents a summary of the chapter.
2.2 The curricular level

2.2.1 Teaching and assessment issues

Biology is a subject that is unique because it is described as the "science of life" (Barenholz and Tamir, 1997:71). It provides us with opportunities to learn about the living environment and ourselves. Thus, it contributes to the provision of breadth, balance and coherence as a component of the science curriculum (Brown, 1995: 270).

The described purpose of biology teaching was abstract and theoretical during the 1960s and the 1970s (Killerman, 1996: 340), and teachers used mainly teacher-centred approaches to teach biology. In the 1980s teaching became more student-centred, and one stated goal of biology teaching was to educate a select group of pupils for further studies. More recently, the purpose has been to make all citizens biologically literate (Brown, 1995: 272).

The process of transformation currently being experienced in South Africa is described as a 'paradigm shift' in the thinking about education (National Department of Education (NDE), 1996, cited in Wilmot, 1999: 257). The shift signifies a move away from the previous system based within the ambit of behaviourism (e.g. Brady, 1985; Slavin, 1994) to one located within the tenets of social constructivism (e.g., Resnick, 1987; Brown, Collins and Duiguid, 1989; Kahn and Volmink, 1999:10), as shown in Table 1.1 in Chapter 1. An outcomes-based education (OBE) model has been adopted to hopefully achieve the type of transformation seen as necessary and desirable for the fledgling democratic South Africa (Wilmot, 1999:257). Furthermore, Wilmot argues that OBE not only challenges existing views of knowledge, teaching and learning, it also calls for new approaches to assessment and teaching.

To embrace the benefits of OBE, and to celebrate the learner as a multi-skilled individual, one has to change one's perception of assessment. Wilmot (1999) describes this shift from our narrow view of assessment to the more broadminded view of assessment in Figure 2.1. This change in our ways of thinking is described as a 'paradigm shift'.
Figure 2.1 shows how we should be broadening our perceptions of assessment by applying the 'paradigm shift' proposed by the National Department of Education (NDE) (1996). Firstly it examines the narrow view of assessment and proposes how we should be applying the 'paradigm shift' to accept the broad view of assessment.

Thus it shows that the previous curriculum encouraged the comparisons of individual learners' performances with others in the group. Their abilities were measured through tests and examinations, which comprised summative assessment. Summative assessment attempts to summarize student learning at a point in time, e.g. at the end of a topic (Black and Wiliam, 1998: 10). Most standardized tests comprise summative assessment. The Western Cape Education Department (WCED) (2002: 11) states that this type of assessment can sometimes give a false impression of a learner's true ability.

Emphasis was also placed on norm-referencing (Atherton, 2002: 2), where learners' marks were compared with those of other learners in the group. This encouraged competition amongst learners, where the top marks go to the best learners and the low marks usually go to learners who struggle academically.

In theory C2005, differs appreciably from the previous curriculum in that it encourages continuous assessment, which exposes learners to a variety of methods of teaching and assessment. The intention is to create a more comprehensive 'picture' of the learner's true ability by exposing them to a variety of tasks. Curriculum 2005 will place little emphasis on norm-referencing, and more on criterion-referencing, as well as individual performance-based referencing.

Criterion-based referencing is set in relation to a list of standards at a particular point in time, thus preventing the immediate comparison of learners (Atherton, 2002: 2). Performance-based referencing is linked to the individual learners themselves, where it can be a form of self-assessment and a self-reflection by the learner. The over-riding philosophy of performance-based referencing is that teachers should have access to information that can provide ways to improve achievement, demonstrate exactly what
the student does or does not understand, relate experiences to instruction and combine assessment with teaching (Atherton, 2002: 3).

The intention of Curriculum 2005 is to allow learners to display a wide array of skills, not how much knowledge they are able to recall (which was encouraged by the previous curriculum) (Wilmot, 1999: 258). Learners' and teachers' narrow views of assessment should be changed to a more broad-minded view of assessment. The broad-minded view of assessment (Figure 2.1) intends that learners be exposed to a wide array of methods that may be used for summative or formative purposes. The summative assessment methods most often used in the classroom are class tests, examinations and formal assignments. Some teachers using this type of assessment do not give learners constructive feedback and, as a result, the learners are not engaging in true learning. Formative assessment is a use of assessment to assist learning through feedback (Black and Wiliam, 1998: 4). Curriculum 2005 puts emphasis on continuous formative assessment (commonly referred to continuous assessment) (Malcolm, Long and Chamberlain., 1999: 2) because this type of assessment should be part of the everyday activities.

Formative, as well as performance-based assessment can comprise a variety of methods that would suit the particular learning styles of different individuals (Kolb, 1984), e.g. portfolios, profiles, presentations, games, oral reports, problem-solving, performances, practical work etc. These methods are valuable to learners because through formative assessment they will constantly be given constructive feedback to monitor their progress.

Top achievers and conscientious learners tend to do well from summative assessment methods. However, Black and Wiliam (1998: 1-10) supplied powerful evidence that formative assessment could be a better form of assessment than standardized tests through summative assessment because of the continuous feedback learners acquire from these methods. They conducted an extensive survey of the literature, checking through many books, over 160 journals and reviews of research papers. The conclusions they reached were that improving formative assessment would raise standards in classroom assessment. Some studies have shown that improved formative assessment helps low achievers more than the rest, and that it reduces the spread of attainment whilst also
raising it overall. This is supported by Fuchs, Fuchs, Karns, Hamlett, Katzaroff and Dutka (1997: 540), who stated that frequent assessment feedback helped low achievers.

Unfortunately, the research shows that high-quality formative assessment is relatively rare in classrooms and that teachers do not know how to engage in such assessment (Black and Wiliam, 1998: 14). Furthermore, Black and Wiliam (1998) found that classroom testing encourages rote and superficial learning. Kotze (2002: 77) argues that learners in South Africa believe that knowledge is rigid and inflexible, and that they tend to prefer summative to formative assessment.
Figure 2.1 The notion of a paradigm shift in assessment (after Wilmot, 1999: 258)
2.2.2 Biology teaching in South Africa

In South Africa, the stated aims of biology teaching are to heighten biological awareness, improve one’s self-image, understand the applications of biology in daily living and promote participation in societal decision-making in areas such as science policy and socially significant matters (Western Cape Education Department (WCED), 2000:52). Furthermore, the Western Cape Education Department documents emphasise that learners should develop skills, knowledge and attitudes which reflect the twelve critical outcomes expressing South Africa’s constitutional values (WCED, 1997:8; WCED, 2002: 3-4).

Table 2.1 shows the methods of teaching that are encouraged by the WCED (2002: 1-26). Each of these methods is explained below in more detail under the following three headings: classwork, practical work and assignments.

A Classwork

Classwork is a collection of evidence that reflects the learning process in the ambit of class time (WCED, 2002: 14). The purposes of classwork are to lead to discussion, gauge whether the learner understands a concept, prepare for the final examination and develop higher order cognitive skills.

Some of the methods used in the classroom are described below. Emphasis will be placed on methods used in this study.

• Essays

Van Huyssteen (1979: 48) states that the aim of the essay question is to evaluate higher cognitive abilities in the above average candidate, i.e. the ability to present facts in a logical manner, formulate answers independently with the use of appropriate language, show creativity and make meaning of facts that are relevant to a topic. Thus, it can give high achievers the opportunity to get good results (Degenaar, 1985: 272).
Essays answers should also reveal insight, analysis of facts and synthesis. They should combine skills, where learners can simply gather facts (simple knowledge acquisition), to synthesising facts (complex knowledge acquisition) (Bloom, 1956: 4). In Bloom's levels of knowledge acquisition, it is at the last levels, i.e. at the evaluation and synthesis stages of the gathered knowledge, that many learners struggle (Slavin, 1994: 222).

In the pre-1994 annual biology examinations, the essay question constituted between 45 to 60 marks of the total 400 mark examination. Though essay questions have always comprised a large component of the final examination, Degenaar (1985: 269) maintained that the effectiveness of essay writing had not yet been established. Examiners differ in their opinions regarding the effectiveness and significance of the essay question as an evaluation method. The indistinct formulation of a given question, inappropriate marking memorandum and the subjective element in the marking, are a few of the problems associated with the essay question (Degenaar, 1985: 270). The under-developed ability of learners to express their ideas with the appropriate language is also considered to be a handicap by some (Degenaar, 1985: 273).

The WCED (2002: 5) states that the learner's portfolio should include essay questions. According to the WCED, the value of the essay lies in the higher cognitive skills that it tests, as well as the communication, reasoning, time management, organisation of writing, and application that it encourages in the learner.

- **Worksheets**

Worksheets allow the learner to consolidate work during class time, and they allow the teacher to assist the learner if there is any misunderstanding with concepts in the class (Degenaar, 1985: 273). The value of a worksheet is that it can test a variety of skills (WCED, 2002: 13). Teachers can vary the format and allow learners to acquire knowledge through simple recall; or to test higher cognitive skills, encouraging the learner to research the work and synthesise knowledge (Slabbert, 1990: 55).
• **Diagrams and drawings**

Soyiba (1999: 75) states that "diagrams and drawings are used in biology textbooks to help in the graphic explanation of the nature and functioning of biochemical and physical processes as well as experimental apparatus". Graphic explanations in biology are important for the understanding of processes. It is therefore essential that learners use diagrams to apply knowledge in a diagrammatic format (WCED, 2002: 15). Jacobs (2000: 44) investigated Cape Town learners’ evaluations, perceptions and understandings of 80 drawings in a new OBE textbook, comparing learners from advantaged and disadvantaged backgrounds. His findings suggested that advantaged and disadvantaged learners have different preferences for drawings and diagrams in biology textbooks. Overall, however, Jacobs (2000: 45) found that in both advantaged and disadvantaged schools well-drawn drawings can motivate learners, while badly drawn ones can de-motivate them.

Good textbook diagrams and drawings will encourage learners to produce their own well-drawn diagrams and drawings. It is important that learners are able to draw good scientific drawings of their observations, so that as a scientist, they are able to communicate their ideas effectively, both verbally and visually.

• **Classroom discussions**

Classroom discussions allow learners to talk about their observations and opinions with their peers under the guidance of their teacher. Discussions in which pupils are led to talk about understanding in their own ways of thinking, are important aids to improve knowledge (Black and Wiliam, 1998: 11). Dialogue with the teacher allows the opportunity for the teacher to respond and re-orientate the pupil’s thinking. But, teachers should be careful that they do not respond in a way that inhibits pupil discussion – especially if they lack flexibility to deal with particular unexpected answers (Black and Wiliam, 1998: 13).
• **Mind maps**

Mind maps give the learners an overview of the topic and allow them to pick out problem areas. Skills that are tested are interpretive skills, reasoning, organisational, time management and motor skills (WCED, 2002: 18). Rollnick and Davidowitz (2000: 16) performed a study on a group of chemistry learners in Johannesburg, South Africa, where learners were to construct flow diagrams for each experimental procedure. The use of this method encouraged learners to prepare in advance, helped them link experiment to theory and helped them “see the bigger picture”.

• **Oral classwork**

Through oral presentations, learners are able to express their researched ideas verbally and to gain confidence in communication, presentation, language proficiency and pronunciation, contact with the audience and contact delivery (WCED, 2002: 15).

• **Computers**

Learners will learn to communicate electronically more than any previous generation. While many embrace this technology, others experience confusion and frustration.

There are many factors that influence learners’ attitudes toward computers. One is computer access, i.e. whether or not learners have a computer at home or use computer laboratories. McMahon, Gardner, Gray and Mulhern (1999: 302) reported that computer access accounts for 50% of the variance that exists among learners’ attitudes. Learners who have computers at home are more experienced and therefore have less anxiety (McMahon et al., 1999: 302). Ropps’ (1999: 403) review of the literature suggests that most research concludes that learners experience more computer anxiety when they are relatively inexperienced with this form of technology.

Time factors also play an important role in learners’ reported attitudes toward computers. For example, learners who do not have computers in their homes say they are often irritated by additional factors when visiting computer laboratories (Carr, 2000: 32).
Complaints about periodic slowness of the internet connections and server problems indicate that such difficulties frustrate learners (Harrell, 1999: 270). This hinders learning.

Another factor that influences some learners' attitudes and perceptions toward a computer is its lack of personal contact. A number of learners have reported feelings of loneliness and isolation. They miss social contact and face-to-face interaction. Some learners report that they lack self-motivation and begin to dislike the work (Harrell, 1999: 272).

Learners who prefer computers, however, tend to place greater value on their control of the pace of learning than on face-to-face interaction (Roblyer, 1999: 157). These learners say they find computers more enjoyable, interesting and productive (Edwards and Fritz, 1997: 17).

- **Teacher-in-charge**

When using this method, the teacher must be able to justify this method above others. The information presented to the learners must be meaningful and interesting. Through lecturing to the learners, it should be the teacher's responsibility to make the lessons interesting. However, this method can be misused.

Ausubel (1968: 23) stated that an important consideration, when using this method, is whether information that is received by the learner is rote reception or meaningful reception. Rote memorization involves the learning of isolated facts, but teachers should employ other methods to help make lectures more meaningful (e.g. demonstrations, audiovisual materials and models) (Ausubel, 1968: 55). Furthermore, Ausubel (1968:56) stated that whatever weaknesses are attributed to the teacher-in-charge as a method are not due to the method itself, but due to the abuse of the method.

The immediate advantage of this method is that a large amount of material can be covered in a short period of time. But, the "pouring in" of information is unsound unless it can be done in a meaningful way, and not all teachers have this ability (Collette and
Chiappetta, 1984: 55). Also, lectures should not last an entire period, as learners - especially adolescents - become bored and mischievous, which ultimately results in discipline problems (Slavin, 1994: 305).

- **Textbook summaries**

The textbook can be used as a comprehensive source of information and presentation of material (Collette and Chiappetta, 1984: 244). In the past, biology textbooks were very detailed and contained exhaustive descriptions of both plants and animals, and learners were encouraged to absorb substantive content of the texts. Today, textbooks should initiate enquiry, and the learner should become an active participant in the learning process (Collette and Chiappetta, 1984: 285; Leonard and Penick, 1993: 14).

The need for learners to learn independently from texts, especially at tertiary level, is rapidly increasing. These learners need skilled reading and comprehension skills to cope with the vast volume of subject-specific information. Successful reading implies the ability to interpret and integrate the text meaningfully, i.e. to read with understanding (Dole, Duffy, Roehler and Pearson, 1991: 260). The ability to learn effectively depends on the interaction with the text.

Naidoo (2000: 99) compared the comprehension abilities of first language (advantaged) and second/third language (disadvantaged) learners in South Africa. It was found that the disadvantaged learners struggled with the comprehension process. Learning for this group consisted of uncritical reproduction of text content, and these learners were not able to organise or synthesise information. Naidoo (2002) stated that a possible reason for this could be the learners' lack of ability, since they came from an educationally disadvantaged environments, bringing with them underdeveloped reading skills. This would affect their procedural, declarative and conditional knowledge bases. The overload of content, especially in the natural sciences, leaves little opportunity for the reader to interact with texts. The advantaged learners were able to cope better because they had well-developed reading and comprehension skills.
It is unwise to use the science textbook exclusively as the preferred teaching tool in the classroom (Collette and Chiappetta, 1984: 247; Leonard and Penick, 1993: 18). Some science teachers begin on the first page of a chapter and lecture through the contents of the chapter. They often assign the chapter to be read and summarised, and for the learners to answer questions at the end of the chapter. This type of teaching can be over-utilised. Working through the textbook chapter by chapter and covering its contents can be detrimental to the interests, attitudes and even achievements of science learners (Collette and Chiappetta, 1984: 249). Teachers should use textbooks as a tool, but not as an exclusive teaching method.

B Practical work

Since the 1960s, enthusiasts have believed that discovery work is an interesting and effective way of learning science (Hodson, 1990: 33). As research evidence on practical work began to accumulate, it was found that there were two schools of thought – one supporting practical work (e.g. Clarkson and Wright, 1992) and one against practical work (e.g. Hodson, 1990).

Clarkson and Wright (1992: 40) believed that practical work aids in the teaching of measuring techniques and improving the manual dexterity of learners. Hodson (1990) believed that, based on twenty years of teaching and teacher training experience, practical work, as conducted in schools, is ill-conceived, confused and unproductive. He continued by stating: “the suggestion that children can readily acquire new concepts by engaging in open-ended discovery learning activities is absurd” (p38). In real classroom situations, in the absence of guidance, it is unlikely that children will reach the particular goals that the teacher has in mind, he concluded.

Chacko (1997: 42) believed that practical work can be conducted in a variety of ways, i.e. either in groups or individually; through teacher-pupil demonstrations or pupil experiments. Thus, it can be controlled either by the teacher (teacher-centred) or by the learners (learner-centred).
In South Africa the Revised National Curriculum Statement (R-9) (2002:4) places emphasis on the use of practical work as an essential tool in the learning of Natural Science by stating:

To be accepted as science, certain methods of inquiry are generally used. They promote reproducibility, attempts at objectivity, and a systematic approach to scientific inquiry. These methods include formulating hypotheses and designing and carrying out experiments to test the hypotheses.

The WCED (2002: 8) states that practical work in biology develops scientific methods or process skills, verification of data and application of concepts in unknown or new situations. There should be at least three practical experiments annually and two worksheets on practical skills in the assessment of portfolios for grades 10-12.

According to the WCED (2002: 1-26), practical work can be divided into three components namely: experiments, excursions and demonstrations.

- **Experiments**

  Learning skills gained in the laboratory are of particular importance since the learners are offered the opportunity to acquire certain psychomotor and intellectual skills unique to biology, by handling apparatus during experimentation and scientific investigation (Degenaar, 1985: 135). Johnstone and Wham (1982: 71) state that learners appreciate practical work more because they can engage in active, personal discovery learning rather than learning by merely watching demonstrations.

  Practical work in biology teaching can be multi-faceted in that teachers can allow learners to discover and handle live specimens on their own, but it can also be used as a means of letting learners learn how to handle apparatus. For example, the skilled handling of a compound light microscope might be used as an objective to a lesson, with the emphasis on correct usage (Degenaar, 1985: 136).

  The WCED (2002: 13) asserts that these intellectual and psychomotor skills gained by learners can help them in other spheres of life.
• **Demonstrations**

Degenaar (1985: 81) explains that various people may conduct demonstrations differently in a classroom situation. For example, there are teacher demonstrations, teacher-pupil demonstrations, individual demonstrations, group demonstrations and demonstrations given by guest speakers. He also identified a variety of demonstration types namely:- experimental demonstrations, investigative demonstrations, still demonstrations, lecture demonstrations, illustrated demonstrations, discovery demonstrations, inductive demonstrations and time-lapse demonstrations (Degenaar, 1985: 81-82).

From the above it is clear that various demonstrations may be utilised in the teaching of biology. The learners’ past experiences of these methods might also influence whether they prefer this method or not.

Dallas (1980: 73-77) suggested that, for a demonstration to be successful, it should be clear and visible to all the learners. Degenaar (1985: 66) stated that a demonstration could be employed strategically in lesson preparation, since it can be used to save time. It also avoids accidents if the experiments require the use of poisonous chemicals or live animals. An added advantage is that learners can acquire listening and observational skills.

• **Biology excursions**

Degenaar (1985: 77) stated that one of the purposes of field trips is to expose learners to real life situations. A practical study of living organisms in their natural habitat provides learning experiences with a more long-lasting or permanent effect and often stimulates pupils to undertake further independent study of the topic. The very nature and structure of biology demands direct observation of living organisms and other biological phenomena in the natural habitat or bio-physical environment.

Lock (1998a: 635) stated that biology is taught too frequently without the presence of living material. Furthermore, the hypocrisy of teaching biology, the study of living
things, without recourse to living organisms as the central focus of the work is felt by many to have gone unchallenged for far too long.

Therefore, the choice that the WCED (2002) is giving teachers as to which methods they might use in the classrooms, could lead to the amount of fieldwork being reduced or avoided completely in the future.

C Assignments and Projects

The WCED (2002: 21) requires that learners develop skills in doing projects and assignments, while teachers should guide this development. By the time learners reach grade 12, they should be able to work independently.

This form of independent work creates a specific type of experience in which learners develop important skills that will prove useful in adult years.

Learners must use media in the form of textbooks, encyclopaedias, interviews, magazines, newspapers etc., to collect information. This information must be understood in such a way that learners can express their view succinctly. This requires higher order cognitive skills (Bloom, 1956) that must be acquired over time (Degenaar, 1985: 274).

2.2.3 Biology assessment in South Africa

Translating the new vision into practice requires the utilisation of alternate tools of assessment (Figure 2.1), to create a rich picture of what learners know and can do. To achieve this, Wilmot (1999:258) states that a portfolio could be used as a performance-based assessment tool.

According to the policy documents for biology (e.g. WCED, 1999; WCED, 2002:4), all learners should possess an assessment portfolio. A portfolio is a collection of a learner’s work used to calculate his or her continuous assessment mark (Malcolm, Long and Chamberlain, 1999:93; WCED, 2002: 5). A learner’s portfolio must consist of classwork, assignments, projects, practical work, tests and examinations (WCED, 2002:6).
Tables 2.1 and 2.2, present lists of methods of teaching and assessment advocated by the present South African curriculum policy documents. The purposes of the methods are mentioned in the table, and the skills that the WCED documents state that the learners should gain are shown. This information has been adapted and summarised from the WCED policy document (2002: 1-26).

Table 2.2 shows the methods of assessment encouraged by the WCED (2002: 1-26). Each of the methods will be explained in more detail below under the heading: tests and examinations.

I will list some of the methods used in the classroom, placing emphasis on methods that are used in this study.

A Examinations

The WCED (2002: 11) states that the portfolio should include four class tests and two standardised tests.

The previous curriculum used examinations as a major part of the assessment criteria for the final year mark. Together with summative assessment, Curriculum 2005 encourages formative assessment and performance-based assessment (Kotze, 2002: 79). By contrast, Degenaar (1985: 254) stated that the purpose of the examination was to promote pupils on the basis of uniform standards.

The current examination is divided into Higher Grade (HG) and Standard Grade (SG) papers, normally written over a period of two to three hours. The total maximum marks for HG biology papers is 400, and for SG, 300.

The approach to the HG paper is to evaluate the higher cognitive faculties such as analysis, synthesis and evaluation of above-average learners. Learners who complete the HG examination are allowed to proceed to biology at university level.
The SG paper allows for a greater percentage of knowledge type questions, which are based chiefly on learning content and recall of facts; thus it promotes memorisation. Questions that evaluate insight, understanding and higher cognitive skills are included, but to a lesser extent than in the HG paper.

Presently, biology examinations form only part of the final year mark for the matriculation examination (Tables 2.1 and 2.2) (WCED, 2002: 1-26). The format of the 2002 examination is different from the past in that the paper is divided into two parts, Paper 1 and Paper 2, each 200 marks for HG, and 150 marks for SG.

B Tests

- **Class tests**

Class tests can be used by subject teachers to determine the progress of learners at a particular point in time (Degenaar, 1985: 253). Testing serves to prepare the learners for formal, external examinations. Consequently, the type of question composition required officially should be incorporated into class tests to afford learners the opportunity to become familiar with official format (WCED, 2002: 15).

It is better to have frequent short tests than infrequent longer ones; infrequent long tests are counter-productive (Black and Wiliam, 1998: 12). Research studies show that learners in all subjects benefit from frequent feedback to identify their strengths and weaknesses (Black and Wiliam, 1998: 12).

- **Revision tests**

Revision involves a learner repeating and re-examining a unit of teaching and is directed toward achieving a stronger understanding of concepts, eliminating misconceptions, and acquiring greater clarity (Brady, 1985:33).

However, some learners simply rote learn work, which is a form of drill and practice (Brady, 1985: 32). This is also interpreted as revision exercises and can be detrimental to
learners since they take a surface instead of a deep approach to learning (Gibbs and Habeshaw, 1989).

Revision tests can be advantageous if used in the proper context (Slavin, 1994:216).

- **Multiple choice tests (MCQs)**

There are two schools of thought about both open-book examinations and multiple-choice tests.

Firstly, with MCQs, many teachers and learners consider this method to be an easy method of assessment. From the learner’s point of view, it does not require expressing ideas in long sentences and, from the teacher’s point of view it requires less marking. This statement is supported by Race (1997: 11) who claimed that it is a means of testing learners understanding of a cross-section of the syllabus, and it does not require long detailed answers.

Other researchers, however, believe that MCQs are poor tools for measuring the ability to synthesise and evaluate information and apply knowledge to complex problems (Fairtest, 2002).

- **Open-book examinations**

Race (1997:10) claims that open-book examinations are relatively ‘relaxed’, allowing learners to answer questions with the aid of their chosen material and at their own pace.

However, open-book examinations test a wide range of higher-order abilities, while closed book examinations test memorisation (Mohanan, 2002). In order to implement open-book examinations as a method of assessment, it would be required that lecture-mode type teaching be replaced by more interactive teaching.

Learners should realise that this is not a soft option (Mohanan, 2002); rather it will test the ability to process and use information and to deliver well-structured and well-
presented arguments and solutions. Marking will be more rigorous. What is considered a good answer in a traditional examination might be judged as mediocre in an open-book examination.

That "there is no need to learn anything since all the answers are in the book" is a delusion leading to failure (Mohanan, 2002). You need to understand and be familiar with your method in order to locate and use the answer appropriately.

2.2.4 Implications for the role of biology teaching and assessment in this study

Although information about the importance of using different methods of teaching and assessment has been presented in many government policy documents, it seems that teacher-centred methods of biology are still prominent in my school and in neighbouring schools.

To achieve the specific outcomes expressed in the Natural Science policy documents (WCED, 1997: 6), learners should be exposed to a variety of methods of teaching and assessment in biology (Tables 2.1 and 2.2) (WCED, 2002: 1-26). A recent article in BIONEWS (2000:54), a quarterly magazine published by the Western Cape Education Department, stated that:

...teachers should move away from spending 80% of their time in front of the chalkboard and overhead projector, and spend more time on methods of teaching that engage the learners in discovering for themselves...emphasis is always placed on the importance of the final matriculation examination – which encourages the regurgitation of facts...

The above statement implies that, even though numerous approaches to methods of teaching and assessment are described in the literature, many teachers may still be using only one style of teaching that is mainly teacher-centred.

Therefore, by offering learners an open choice of methods of teaching and assessment in biology, this study aims to determine whether they noticeably desire or prefer a diversity of teaching and assessment methods in the classroom, and whether they say they are
ready to implement the 'paradigm shift' suggested by the WCED policy documents (WCED, 1999; 2000 and 2002).

In the next part of this chapter I will examine how teacher-centred and learner-centred theories of learning developed and how it was decided that more learner-centred methods should be adopted in the new Curriculum 2005.
Table 2.1: An adapted summary of the methods of teaching in biology suggested by the WCED (2002: 1-26) for Grades 10-12.

<table>
<thead>
<tr>
<th>METHOD</th>
<th>DESCRIPTION</th>
<th>PURPOSE</th>
<th>SKILLS GAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CLASSWORK</td>
<td>A collection of evidence that reflects the learning process in the ambit of class time.</td>
<td>Must lead to:</td>
<td>- measurement</td>
</tr>
<tr>
<td></td>
<td>- Essays</td>
<td>- discussion</td>
<td>- observation</td>
</tr>
<tr>
<td></td>
<td>- Worksheets</td>
<td>- assessing prior knowledge</td>
<td>- handling apparatus</td>
</tr>
<tr>
<td></td>
<td>- Drawings and diagrams</td>
<td>- checking progress and ongoing development</td>
<td>- recording of data</td>
</tr>
<tr>
<td></td>
<td>- Class discussions</td>
<td>- preparing for examinations</td>
<td>- interpretation of data</td>
</tr>
<tr>
<td></td>
<td>- Investigations</td>
<td>- developing higher cognitive skills</td>
<td>- experimental design</td>
</tr>
<tr>
<td></td>
<td>- Groupwork</td>
<td>- interpreting data</td>
<td>- communicating</td>
</tr>
<tr>
<td></td>
<td>- Problem-solving</td>
<td>- experimental design</td>
<td>- reasoning skills</td>
</tr>
<tr>
<td></td>
<td>- Mind maps</td>
<td>- investigative management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Orals</td>
<td>- management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Interviews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. PRACTICAL WORK</td>
<td>Practical work develops scientific methods or process skills, verification of data and application of concepts in unknown or new situations</td>
<td>Must lead to:</td>
<td>- observation</td>
</tr>
<tr>
<td></td>
<td>- Class practicals</td>
<td>- application of scientific method</td>
<td>- measurement</td>
</tr>
<tr>
<td></td>
<td>- Excursions</td>
<td>- using experimental design</td>
<td>- recording</td>
</tr>
<tr>
<td></td>
<td>- Teacher</td>
<td>- identifying apparatus</td>
<td>- manipulation</td>
</tr>
<tr>
<td></td>
<td>Demonstration</td>
<td></td>
<td>- inference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- investigative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- management</td>
</tr>
<tr>
<td>3. ASSIGNMENTS AND PROJECTS</td>
<td>Investigative tasks given to learners. May include a model and /or display or practical investigation accompanied by a written presentation.</td>
<td>Must lead to</td>
<td>- cognitive thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- brain storming information</td>
<td>- skills and application of knowledge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- collecting information from various sources, e.g. newspapers, interviews</td>
<td>- motor skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>encyclopaedias etc.</td>
<td>- study skills</td>
</tr>
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<td></td>
<td></td>
<td>- planning</td>
<td>- life skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- teamwork</td>
<td>- entrepreneurship skills</td>
</tr>
</tbody>
</table>
Table 2.2: An adapted summary of the methods of assessment in biology as suggested by the WCED (2002: 1-26) for Grades 10-12.

<table>
<thead>
<tr>
<th>METHOD</th>
<th>DESCRIPTION</th>
<th>PURPOSE</th>
<th>SKILLS GAINED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TESTS</td>
<td>Testing the knowledge gained by the learner.</td>
<td>Tests Bloom's Taxonomy:</td>
<td>- cognitive skills</td>
</tr>
<tr>
<td></td>
<td>- picture tests</td>
<td>- Knowledge</td>
<td>- thinking skills</td>
</tr>
<tr>
<td></td>
<td>- quizzes</td>
<td>- Comprehension</td>
<td>- motor skills</td>
</tr>
<tr>
<td></td>
<td>- terminology</td>
<td>- Application</td>
<td>- following instruction</td>
</tr>
<tr>
<td></td>
<td>- essays</td>
<td>- Analysis</td>
<td>- observing</td>
</tr>
<tr>
<td></td>
<td>- single word answers</td>
<td>- Synthesis</td>
<td>- drawing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Evaluation</td>
<td>- communicating</td>
</tr>
<tr>
<td>2. EXAMINATIONS</td>
<td>Testing the knowledge gained by the learner.</td>
<td>Tests Bloom’s Taxonomy:</td>
<td>- reasoning skills</td>
</tr>
<tr>
<td></td>
<td>- written</td>
<td>- Knowledge</td>
<td>- organizing data</td>
</tr>
<tr>
<td></td>
<td>- picture</td>
<td>- Comprehension</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- open book</td>
<td>- Application</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- oral</td>
<td>- Analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Synthesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Evaluation</td>
<td></td>
</tr>
</tbody>
</table>
2.3 The Classroom Level

2.3.1 Introduction

Learning is usually defined as a change in an individual caused by an experience (Rocklin, 1997: 229). Children learn many higher cognitive skills before entering school and, while at school, they can receive guidance and engage in levels of thinking that they could not manage on their own.

When learning in the classroom, children try to create meaning for a particular concept. They tend to draw on their social experiences to try to make them understand the concept. Donald, Lazarus and Lolwana (1997: 49) state that meanings themselves cannot be separated from their social context and cultures: they are social constructions (built up and passed on in the interactions between people). Vygotsky also pointed out that other factors playing a very important role in the development of meaning are language, the historical background of the child and mediation. The psychological process by which the learner uses the social is called internalisation (Tharp and Gallimore, 1988:101).

Assisted performance defines what a child can do with help, with the support of the environment, of others, and of the self (Tharp and Gallimore, 1988:102). For Vygotsky, the contrast between the assisted performance and the unassisted performance identified the nexus of development and learning that he called the zone of proximal development (ZPD). Donald et al. (1997:50) define the ZPD as the space that lies just beyond a child’s (or anyone’s) present understanding. It is the critical space where the child cannot quite understand on his/her own, but has the potential capacity. A mediator (parent, teacher or peer) can aid in shifting the child’s present understanding to a new level.

In this section, two major theories of learning will be presented – behaviourist theories of learning and cognitive theories of learning. The best way to describe the relationship between these theories would be that if they were placed on a continuum, they would make up the two extremes of the continuum. Behaviourist learning theories are described by many authors (e.g. Brady, 1985; Slavin, 1994) as teacher-centred – where the teacher plays a powerful role in controlling the content and progression of the
lesson. On the other hand, **cognitive learning theories**, have been described by many authors (e.g. Slavin, 1994) as mainly **learner-centred**, since the degree of involvement of the learner in the lesson is much more prominent, and the learners play a powerful role in constructing their own knowledge (e.g. Slavin, 1994; Malcolm, Long and Chamberlain, 1999). In this part of the chapter the two learning theories will be examined in more detail.

### 2.3.2 Teacher-centred theories of learning

The Apartheid education system based its theories of learning on the premise that black children were to be schooled as workers, learning basic and manual skills at school (WCED, 2000: 1). The role of the teacher was to control the minds of the developing child.

Thus, teaching and learning theories were adopted by the WCED that would support this type of control by the teacher. Two of these theories of learning associated with teacher-centred learning, psychopedagogics and behaviouralism, will be described below:

**Psychopedagogics (Innatism)**

This is widely acknowledged to be the theory of Apartheid. Psychopedagogicians placed emphasis on innate ideas to describe learning (in the most extreme versions of which, blacks had fewer innate ideas than whites!) (WCED, 2000: 1). Classroom teaching was thus a means of attaining well-established facts, exercises and mental drills which would embed these ideas in the learner’s cognitive functioning. Knowledge was fixed, innately known, and learning involved repetition (Slavin, 1994: 54).

**Behaviourism**

In the early twentieth century behaviourist learning theories developed through the work of psychologists Ivan Pavlov (classical conditioning theory); E.L. Thorndike (theory of law and effect) and B.F. Skinner (theory of operant conditioning). These theories of teacher-centred methods of learning have been described by many authors (e.g. Mosston,
Behaviourists believed that learning was defined in terms of observable behaviours. The role of the education system and educators was to help change the behaviour of the learner. Learners were not encouraged to make their own interpretations of what they perceived; instead it was the role of the teacher to give instructions as to how information should be interpreted.

In a teacher-centred approach to teaching and assessment in biology, the teacher explained a section of work to the class, after which it was the responsibility of the class to "learn" the work (often rote learning). The teacher would then test the learners' knowledge through a revision test, which usually involved the reproduction or repetition of the facts learnt.

This type of teaching was typically described as an expository model of teaching (Brady, 1985:17). The model described the teacher's behaviour during the teaching of a concept. For example, when the teacher explained the whole lesson, Brady (1985:17-19) described this approach as narration and explanation. Hogg and Foster (1973) explained that the teacher acted as a storyteller and had to be creative in expressing ideas aptly. This was an uninterrupted method of expressing ideas to the class, although explanation was not necessarily an uninterrupted presentation by the teacher - at some point teacher demonstration and questioning could be used to help with explanations.

Behaviourism also formed the theoretical foundation for drill and practice (Brady, 1985:32). For example, once learners had memorised the multiplication tables (drill), they could practice the sums using various methods, e.g. revision tests. Revision involved a learner repeating and re-examining a unit of teaching and was directed toward achieving a stronger understanding of concepts, eliminating misconceptions, and acquiring greater clarity (Brady, 1985:33).

One important consequence of behavioural theories of learning was that behaviour changed according to the immediate consequences. For example, pleasurable
consequences (reinforcers), "strengthened" behaviour – thus increasing the frequency of the behaviour. For example, if the learner performed well, a teacher could praise the learner either verbally or by giving a star or a stamp (Slavin, 1994: 158). Alternatively, the learners could observe an adult, or pupil models that had positive influences and try to imitate their behaviour (Slavin, 1994:159). Unpleasant consequences (punishers) "weakened" behaviour and reduced the frequency of the behaviour (Slavin, 1994:158), e.g. punishing the learners by sending them to detention.

2.3.3 Problems associated with the teacher-centred learning theories

One of the major criticisms associated with the behavioural theories of learning was that they did not necessarily result in meaningful learning, but more rote learning (Slavin, 1994: 213). Ausubel (1963) discussed the distinction between rote and meaningful learning. He claimed that rote learning refers to the memorisation of facts or associations, e.g. learning the multiplication tables off by heart – these associations are fairly arbitrary. Meaningful learning is not arbitrary (Slavin, 1994: 213). It relates to information or concepts that the learner already has. Rote learning can be perceived as "bad" and meaningful learning "good". However, Slavin (1994: 215) states that it depends on the context. The reason why rote learning has acquired a bad name in education is because it is probably overused or not used in the proper context by learners and teachers.

Another problem is that students are assessment driven (Kemp and Smellie, 1994:23). Assessment has a powerful influence over how and what students learn. Students do not necessarily realise that there are deep and surface approaches to learning (Gibbs and Habeshaw, 1989). If they learn work that is not examinable via the surface method of learning, they will not necessarily retain such instructional content.

Finally, learners have a limited attention span, and teaching via the expository method might result in learners becoming bored during a lesson and losing concentration. It is the teacher's responsibility to ensure that the narration and explanation of the work remains interesting.
2.3.4 Learner-centred theories of learning

Curriculum 2005 seeks to find a balance between a common curriculum for all, and variation from one school to another. It does so by bringing together two ideas: learner-centred education and OBE.

In a learner-centred classroom, responsibility is shared with the learners (Malcolm, 1998b: 40). Learners take responsibility for decisions, as well as researching and contributing toward knowledge. They spend more time talking and the teacher less (WCED, 2000: 5). The learner and teacher roles can vary during the course of the lesson. Sometimes learners will speak to the whole class, sometimes only to the teacher or a group; on the other hand, sometimes the teacher will speak to the whole class or a group, and other times they will not speak at all.

Learner-centred education calls for a curriculum that links to learners as individuals and members of a community (Malcolm, 1998b: 43). What is relevant in the classroom are their experiences, culture, learning styles, abilities and dreams. The people best to implement this curriculum are teachers – who know the learners and their local communities.

Due to the diversity of communities in South Africa, the government have prescribed outcomes to standardize the skills that the learners should gain during teaching and assessment practices. Thus, learner-centred education and OBE are important components of C2005.

Constructivist learning theories have made significant contributions toward the emergence of OBE (WCED, 2000: 7). The essence of the constructivist learning theories is the notion that learners must individually discover information through constantly checking new information against old rules, and then revising the rules when they no longer work (Slavin, 1994: 225). Authors have described constructivism world-wide (e.g. Driver and Oldham, 1986; Anderson, 1992; Leach and Scott, 2000) and in South Africa (e.g. Malcolm, 1998b; Malcolm et al., 1999; WCED, 1999 and WCED, 2000; WCED, 2002). These authors describe two main theoretical tendencies in constructivism,
namely radical and social constructivism. Curriculum 2005 is mainly based on the
theories of social constructivism.

Instructional models that are based on constructivist principles will be described below:

**Discovery learning**

Bruner (1966) described discovery learning, which is a teaching method in which
learners are encouraged to discover principles for themselves. Learners learn through
active involvement with concepts and principles, and teachers should encourage learners
to play a more active role in their learning through experiences and conducting
experiments (Slavin, 1994: 258).

Discovery learning has several advantages in that it arouses learners’ curiosity, and
motivates by giving them the perseverance to continue working on a problem until they
find a solution. Learners also learn independent problem-solving and critical thinking
skills (Donald *et al.*, 1997: 40). One of the principle disadvantages of discovery learning
is that learners who prefer constant guidance and structure will be feel insecure about the
lack of teacher guidance.

**Reception learning**

Ausubel (1968) criticised discovery learning. He argued that learners do not always
know what is important or relevant, and that many learners need external motivation to
do the cognitive work necessary to learn what is taught at school (Slavin, 1994: 230).
Thus he described an alternative model of learning called reception learning. It proposes
that the job of the teacher is to structure the learning environment, to select materials that
are appropriate for the learner – then to present it in a well-organised way (Slavin, 1994:
233). This approach is called expository teaching (Brady, 1985), where the role of the
teacher is to guide the learner.

Though discovery learning and reception learning seem different due to the role of the
teacher, they have common themes. Both require that learners be actively involved; both
place emphasis on learner’s prior knowledge and both assume that knowledge changes continually within the learners mind (Slavin, 1994: 233).

**Assisted learning (scaffolding)**

Vygotsky proposed scaffolding. According to Vygotsky, higher mental functions, including the ability to direct memory and attention in a purposeful way and to think in symbols are mediated behaviours (Slavin, 1994: 231). The behaviours can be mediated by culture, and scaffolding lets the teacher be the cultural agent who guides instruction so that learners will master and internalise skills. In practical terms, scaffolding may include giving learners more structure at the beginning of the lesson and gradually turning responsibility to the learners so that they are able to operate on their own (Rosenshine and Meister, 1992: 28).

Teaching models that support the above constructivist approaches are the Cognitive Developmental Model, the Interaction Model and the Transaction Model (Brady, 1985: 141-160). These models encourage learners to undertake learner-centred learning by always encouraging them to construct their own knowledge, with the teacher’s guidance and support.

Kemp and Smellie (1994: 34) describe some of the potential or actual advantages of learner-centred teaching:

- Learners may be motivated since they are fully engaged in learning.
- The pre-stated learning objectives keep learners informed concerning what they can expect to learn.
- Learners tend to take responsibility for their own learning.
- Learners can learn from one another.
- Learners can link their own knowledge with current knowledge.

However, these five “advantages” can also occur with attractive, enjoyable rote learning led by an efficient, enthusiastic conventional teacher, so learner-centred theories of learning are not necessarily preferred.
2.3.5 Problems associated with constructivist learning theories

Woods (1994:2) observed that learners who have to take responsibility for their own learning might go through some or all the steps psychologists associate with trauma or grief. For example: shock, denial, strong emotion, resistance and withdrawal, surrender and acceptance, struggle and exploration. However, others experience a confidence-building experience or a feeling of success.

Brent (1996: 2) states that resistance to encounter is a natural part of the learning process from dependence to intellectual autonomy. This progression will occur only if the teacher gives proper guidance. Teachers also experience problems with methodologies for implementing learner-centred teaching (e.g. Brent, 1996). Teachers will have to be prepared for the initial negative responses of some learners. They will require confidence and patience to make their designed methods work in the classroom, and should hope that learners will not become more negative if their methods fail.

2.4 The Personal Level

2.4.1 Introduction

All teachers have their own personal theory of teaching and learning, influenced by former experiences as learners and perhaps as teachers (Kolari and Savander-Ranne, 2002: 62). Learners, on the other hand, are influenced by their past experiences as well as how they are taught in the classroom, and inherently they will different learning styles. Together these factors affect learner motivation.

Motivation is a pivotal concept in most of the theories of learning. Pintrich and De Groot (1990) and Perry, Menec and Struthers (1996) state that motivation is influenced by classroom environmental factors, as well as by the internal characteristics of learners. Student beliefs and perceptions do influence their ability to learn. Many factors impact on motivation, e.g. the ability to have some input in the learning environment, an understanding of expectations and goals of the topic and teacher, and the use of suitable and varied instructional strategies.
The instructor can create the learning environment. Teachers who allow learners to express their ideas and ask questions encourage learning. Those who do not offer opportunity for interaction with learners can create an environment of superficial learning, which is de-motivating.

In the next section I will examine the theories behind the above factors in more detail.

2.4.2 Motivation and the learning theories

Teaching practices based on behaviourist theories (teacher-centredness) may condition learners to become dependent on external motivators to activate lower order states of motivation (Slavin, 1994: 158). External motivators (e.g. rewards, stars etc.), can be perceived as a bribe to the learner, which does not result in long-term changes in behaviour.

Cognitive theories deal with intrinsic motivation (i.e. goals). Goal setting is an integral component of self-regulation. Self-regulation describes the metacognitive strategies employed to plan, monitor and modify cognition (Zimmerman and Schunk, 1989: 284). It also refers to learner management and control of effort on learning tasks, as well as approaches used to learn, understand and remember (Pintrich and De Groot, 1990: 33). It implies that the learner actively searches for meaning by using various feedback mechanisms to assess the status of understanding. It is, therefore, reasonable to believe that learner perceptions of control facilitate the self-initiated application of effort to perform the learning task which constitute self-regulated performance (Zimmerman, 2000: 23).

Adar, 1969 (cited in Thompson, 1997: 239), states that there are four different types of motivational styles. Firstly, *achievers* are people who are always competing. They prefer *problem-solving* and *tests* as part of their teaching and assessment. Secondly, *conscientious* learners prefer clear instructions and to be told what to do. They prefer *worksheets, multiple choice questions* and *examinations* as their choice of methods of being taught and assessed. Thirdly, *social* learners prefer working in groups. They *dislike examinations*. Lastly, *curious* learners keep asking why and prefer *practical*
investigations and open-ended questions. Some of these categories of course may overlap. The present curricular expectations in biology teaching in the Department of Education stress implementing a variety of methods of teaching and assessment in the biology classroom.

2.4.3 Perceptions of control

A function of the self-system is the maintenance of the illusion of control – it sustains the self-esteem. Lacking the perceptions of control, reduces the motivation to engage in self-regulated learning. External rewards and a highly structured environment contribute to the internal locus of control (Clark, 1988: 138). Thus, it will reduce the freedom of the learner to explore learner control (self-regulated strategies) (Thomas, 1980: 236). (Kinzie, 1989: 14) pointed out that learners will choose to engage in activities that facilitate self-control.

When a learner is in control, it is the degree to which a learner can direct his/her learning experience (Shyu and Brown, 1992: 87). Learner control may be a continuum of instructional strategies in which the learner is provided with the option for controlling one or more of the parameters of the learning environment (Reeves, 1993: 60). When instruction incorporates learner-controlled features, learners will be more autonomous, ask more questions, and participate in more conceptually based information exchanges than learners in traditional classrooms (Kinzie, 1989: 13). Furthermore, learner-controlled behaviour is a complex area of research because it is associated with multiple theoretical perspectives and has produced more questions than answers. During teacher-controlled lessons, on the other hand, the learners have very little autonomy and freedom to explore. The teacher controls the lesson progression.

2.4.4 Individual differences in learners: learning style theories

Kolb (1984) proposed a model of individual learning styles and corresponding structures of knowledge. Kolari and Savander-Ranne (2002) summarised Kolb's theory as presented in Table 2.3.
Table 2.3: Models of individual learning styles and corresponding structures of knowledge (after Kolari and Savander-Ranne, 2002: 65)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete experience</td>
<td>Learners function well in unstructured situations and have an open-minded approach to life. They deal with problems intuitively rather than scientifically.</td>
</tr>
<tr>
<td>Reflective experience</td>
<td>Learners understand ideas and situations by observing and describing. They enjoy reflection rather than action and appreciate different points of view.</td>
</tr>
<tr>
<td>Abstract conceptualisation</td>
<td>Learners use logic, ideas and concepts. They emphasise thinking rather than feeling and prefer general theories. These learners like manipulating abstract symbols and quantitative analysis.</td>
</tr>
<tr>
<td>Active experimentation</td>
<td>Learners actively influence people and change situations. They prefer practical application rather than reflective understanding. They value being influential and getting results.</td>
</tr>
</tbody>
</table>

Most learners do not fit perfectly into a category, but can fit into a combination of two or more. As a combination of these learning modes, there are four different learning styles i.e. convergent, divergent assimilative and accommodative learning modes.

Convergent learning modes rely on abstract conceptualisation and active experimentation. They prefer solving problems than dealing with social or interpersonal issues. The opposite of convergent learners are **divergent learners**, who engage in concrete experiences and reflective observation. These learners are interested in people and they prefer observation as well as generating ideas.

**Assimilative** learners can create theoretical models. Their dominant learning abilities are abstract conceptualisation and reflective observation. The opposite of assimilative learners are **accommodative learners**. These learners prefer concrete experiences and active experimentation. They tend to solve problems intuitively by trial and error.
The appreciation of Kolb’s learning styles means that no one teaching style can serve all learners. It can no longer be assumed that learners represent just one learning style (Kolari and Savander-Ranne, 2002: 67). Teaching styles need to be chosen that serve various learners and several purposes. The constructivist approach gives space and opportunity for various learning styles.

The fact that different learners have different learning styles can influence their motivation to learn. Of course, some learners excel with teacher-centred approaches of teaching, together with a traditional written examination as a method of assessment in biology. However, those who do not prefer these methods may sometimes suffer the humiliation of underachieving. Thus, because we are always faced with learners who have different learning and motivational styles (e.g. Thompson, 1997), as well as multiple intelligences (Gardner, 1983 cited in Slavin, 1994: 45), it may be best to try to accommodate many or all types of learning and assessment approaches in the classroom.

Furthermore, various types of teaching motivate different learners. Fox (1983) introduced four theories of teaching that will be summarised and adapted from Kolari and Savander-Ranne (2002: 68.) in the Table 2.4 below.

Table 2.4: The theories of teaching as proposed by Fox (1983) (after Kolari and Savander-Ranne, 2002: 65)

<table>
<thead>
<tr>
<th>THEORY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer theory</td>
<td>Knowledge is treated as a commodity and transferred from teacher to learner.</td>
</tr>
<tr>
<td>Shaping theory</td>
<td>Respected by behavioural psychologists. Learners are perceived as raw materials that can be shaped and moulded.</td>
</tr>
<tr>
<td>Travelling theory</td>
<td>Features of more constructivist teaching. Learners are viewed as contributing partners in their own learning.</td>
</tr>
<tr>
<td>Growing theory</td>
<td>Places emphasis on constructivist teaching. Places emphasis on the learner as a growing person.</td>
</tr>
</tbody>
</table>
Different teachers will adopt different teaching styles that will tie in with the above theories.

2.5 Chapter Summary

In this chapter the theoretical frameworks and the literature review for this investigation has been presented. The chapter is divided into three sections, the curricular level, classroom level and personal level. The chapter then describes how the learner's choices of methods of teaching and assessment may be influenced at each of the three levels.

At the curricular level different methods of teaching and assessment are described; at the classroom level the theories behind learner and teacher-centred methods of teaching and assessment are described; and at the personal level, theories of learning styles, motivation, teaching styles, as well as perceptions of control are elaborated on. All these levels might shape the learners' experiences in biology learning, and these factors might influence the learners' decisions as to how they would prefer to be taught and assessed.

Thus this chapter has pointed out, step by step, how various aspects, findings and recommendations from the literature review have been used to guide and support the shape and design of the present investigation, taking earlier results and suggestions into account at particular points.

In Chapter 3 the research methodology of this investigation will be presented.
It is claimed that the current transformation in South African education is more a paradigm "leap" than a shift (Wilmot, 1999: 257). Van Harmelen and Kuiper (1996: 2) states that "a paradigm shift infers more than the mere articulation of a new theoretical position, but requires the adoption of that theory. All role players identified in the educational endeavour will not only be fully conversant with the theoretical perspectives, but will need to be convinced that the new theory will indeed address issues in education. Educators as practitioners would have to find the new theory accessible, i.e. they will have to understand it, then see its fruitfulness and plausibility so that they will feel there is sense in applying the theory and develop the tools and resources to actually do so".

According to Kahn and Volmink (1999:8-9) "...from the radical constructivists’ point of view individuals construct subjective knowledge by actively conjecturing and building theories about the nature of the world. They reject the idea that ideas match some true reality, but rather that ideas can fit within constraints imposed by the experiential world. There is an individualistic emphasis in radical constructivism that stems from Piagetian roots". According to the WCED (2000: 10), Piaget stated that learning is a natural process and internally driven. He identified two mental processes, assimilation and accommodation. The learner assimilates structures (interprets and attaches meaning to them) and accommodates (changes and develops them). These two processes leads to equilibration (Slavin, 1994: 55). Equilibration leads to learning.

Kahn and Volmink (1999: 9) stated that ..."social constructivism differs from radical constructivism in that it is believed that the experiential world includes the social world. An individual’s interpretation of the physical world is mediated by communication with others, linguistic knowledge, human values, rules and conventions. The dialogical view of knowledge forms the basis of knowing, learning and teaching in the social constructivist tradition".
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter the samples, methodology and instruments used in the study are presented and discussed. The research methods employed in the investigation are identified, and the selection of the data-gathering instruments and details of the different schools involved in the study are given. The hypotheses to be tested are specified. The formats of the proposed statistical analyses and the intended qualitative treatment of the data are also explained.

3.2 The samples of respondents

This research was conducted in eight different high schools during the period 1999 - 2001. The criterion for the selection of the schools was urban diversity (in respect to size, religion, handicap, socio-economic status, aims, philosophy etc.). All the schools were located in the greater metropolitan area of Cape Town, Western Cape. The classes at each of the schools in the study varied from grades 8 to 12. The sample numbers varied between 19 and 301 per school.

The eight high schools were:

a) School 1 - a conveniently available random sample of learners (n= 301 for each questionnaire) from a well-established progressive high school for girls in a middle class suburb, with a total school size of approximately 800 learners.

b) School 2 - a conveniently available random sample of learners (n=275 for the questionnaire “How would you prefer to be taught biology?” and n=269 for the questionnaire “How do you prefer to be assessed in biology?”) from a
co-educational school situated in a middle class suburb, with a total size of approximately 800 learners.

c) **School 3** - a conveniently available random sample of learners (n=60: for the questionnaire "How would you prefer to be taught biology?" and n=55: for the questionnaire "How do you prefer to be assessed in biology?") from a specialised high school for 300 cognitively handicapped learners, admitted on the basis of clinical diagnosis.

d) **School 4** - a conveniently available random sample of learners (n=59: for the questionnaire "How would you prefer to be taught biology?" and n=272 for the questionnaire "How do you prefer to be assessed in biology?") from a co-educational school situated in a lower middle class suburb, with a total size of approximately 900 learners.

e) **School 5** - a conveniently available random sample of learners (n=52: for the questionnaire "How would you prefer to be taught biology?" and n=197: for the questionnaire "How do you prefer to be assessed in biology?") at an exclusive gender-streamed Muslim high school, with a total size of approximately 750 learners.

f) **School 6** - a conveniently available random sample of learners (n=19: for the questionnaire "How would you prefer to be taught biology?" and n=20: for the questionnaire "How do you prefer to be assessed in biology?") at a recently established exclusive high school for boys still expanding in enrolment.

g) **School 7** - A wealthy co-educational high school (n= 95 for each questionnaire) situated in a middle class suburb, with a total size of approximately 800 learners.

h) **School 8** - A socio-economically deprived co-educational high school (n=50 for each questionnaire) located in a historically disadvantaged suburb, with a total size of approximately 1000 learners.
3.3 Research methodology: data collection and analysis

This study engaged two research paradigms, qualitative and quantitative. The quantitative approach used a survey methodology to gauge if there were significant differences between school learners’ preferences. A survey is recognised as a direct way to obtain information concerning an identified topic (Fink and Kosekoff, 1985). Butts (1983: 188) pointed out that the survey method is a rediscovered strategy for education.

The total data collected were the responses of 911 biology learners for the questionnaire "How would you prefer to be taught biology?" and 1259 biology learners for the questionnaire "How would you prefer to be assessed in biology?". More responses were obtained for the second survey due to the availability of longer time periods for the collection of data at certain schools. Both questionnaires contained a list of "yes/no" options. The learners’ most preferred and least favoured response data will be summarised for each questionnaire. The qualitative responses suggesting why the learners prefer particular methods of teaching and assessment, the most and least, will be re-arranged and sorted into emerging indicators, descriptive categories, trends and themes and presented at several levels of analysis.

Administratively, the completion of the two questionnaires required about 10-12 minutes per learner. The surveys were handed to classes of learners by their biology teachers during normal school hours at administratively convenient times, and were promptly collected upon completion.

The data were entered and stored using the computer software Microsoft Word and Microsoft Excel, and the quantitative data was subsequently imported to Statistica for statistical analysis. The data will be recorded and presented in the form of figures and tables.

At the first level of analysis the entire set of response data for surveys 1 and 2 will be re-classified or re-grouped to ascertain whether learners’ preferences taken as a whole are inclined more toward teacher-centred or learner-centred methods. Each response will be categorised and grouped by a panel of nine experienced teachers into one of three main divisions:
1. Where the predominant preference was for the teacher to take control of learning (teacher-centred learning).

2. Where the predominant preference was for the learner to take control of learning (learner-centred learning).

3. Where it was not certain whether the chosen methods are predominantly teacher controlled or learner-controlled, or where the control was agreed to be shared (unsure).

The overall resulting outcomes of the analysis will be tabulated.

In the final part of the statistical analysis of the data, school-by-school statistical comparisons will be made. Chi-square tests will be used to compare the frequencies of “yes” or “no” responses to each of the sixteen items on the questionnaire “How would you prefer to be taught biology?” and to the eighteen items on the questionnaire “How would you prefer to be assessed in biology?”.

One-by-one, the grouped responses to all items will be compared across all eight schools in order to ascertain whether there are significant differences in preferences between given pairs of schools.

Then samples of evidence from the qualitative data will be quoted in an attempt to suggest possible explanations for the observed statistical differences and the emerging themes. Extensive explanatory evidence will be cited from the learners’ open-ended responses recorded in the different schools. Possible identifiable influences such as class size, religious ethos and regional socio-economic status might emerge from the data.

3.4 Development of the instruments

A first draft for the questionnaire “How would you prefer to be taught biology?” comprised 16 items. A first draft of the questionnaire “How would you prefer to be assessed in biology?” comprised 13 items. The initial items were composed from the suggestions of three enthusiastic biology teachers at the progressive girls’ high school
who wrote down a list of common methods of assessment in biology. Each teacher was required to offer at least ten different methods as the first step, and their suggestions were then corroborated as important and established instructional approaches, strategies and techniques by a literature review.

Two pilot instruments were then constructed, not only from the biology teachers' lists, but also from additional library references (Race, 1997; WCED, 1998 pp 1-4). During trialling in the initial phase in September 1999, the instrument was workshopped on a grade 11 biology class at the progressive girls' high school (school 1) (Appendix 2). It was subsequently modified after the learners suggested more items, and the wording of these items was refined, modified and clarified. Additional development and validation of the wording occurred in October 1999 with the assistance of educational academics experienced in test item construction and formulation. The final version of the instrument, re-worded after six trials of improved modifications, was then used in the enlarged study of 2000-2001. The final versions comprised 16 items for the questionnaire "How would you prefer to be taught biology?" and 18 items for the questionnaire "How would you prefer to be assessed in biology?", and are presented in Appendix 3.

Respondents were invited to tick either "YES" or "NO" (or to leave a response blank). In the final section of the questionnaire, respondents were encouraged to focus on and choose their two most preferred and their two least preferred methods of teaching and assessment in biology.

After the learners had prioritised their choices they were invited to describe qualitatively, in their own words, why they had preferred certain methods of teaching and assessment in biology, and why they did not favour other methods.

To corroborate and justify the selection and inclusion in the survey instruments of statements on methods of teaching and assessment in biology, I will now cite research articles that are directly relevant to the sixteen methods of teaching biology and eighteen methods of assessment in biology, and to the keywords in the questionnaires. The essential point made by each reviewed article is briefly summarised in one sentence:-
Questionnaire no. 1: How do you prefer to be taught biology?

Methods of teaching incorporated into the survey:

Item 1: Experiments - Learning experience gained in a biology laboratory enables learners to acquire skills in handling apparatus during experimentation and other scientific investigation (Degenaar, 1985: 134).

Item 2: Demonstrations - Demonstrations are usually employed where classes are too big and there is a shortage of apparatus – they can help learners to think critically (Degenaar, 1985: 84-85).

Item 3: Biology projects - These are large tasks that are undertaken over a period of time, after some useful research (NDE, 1999: 1-12).

Item 4: Class discussions - Learners take risks in offering their ideas to the class – they should feel comfortable that there are no penalties for silly suggestions (Malcolm, 1998 (b):36).

Item 5: Computers - Computer-aided education has made the teaching and learning process much more exciting for both the teacher and the learner (Cwilewicz & Pudlowski, 1998: 223).

Item 6: Worksheets - A worksheet should be a complete packaged lesson, and the design of it should be of utmost importance to the biology teacher (Slabbert, 1990).

Item 7: Teacher-in-charge - In traditional education systems, teachers were intermediaries between the syllabus or textbook – their primary roles were to explain, demonstrate and direct (Malcolm, 1998 (a): 115).

Item 8: Biology outings - Excursions serve as an important supplementary teaching for biology learners (Degenaar, 1985: 239).
Item 9: *Biology videos* – Television can be used as a means of introducing learners to a topic on a concrete level, and it instills a sense of security and confidence in the learners to venture forth into the unknown, complex and abstract subject content (Degenaar, 1985: 67).

Item 10: *Biology games* – Games help the learners to contribute their ideas, imagination and experience to the class (Malcolm, 1998 (b): 36).

Item 11: *Creative Materials* – Creative materials help learners to create images – which are triggered readily into most minds; it is important to use imagery in the science class (Ebenezer, 1998: 5).

Item 12: *Investigations* – These teach the learners to reshape their ideas, and to plan steps for collecting and analysing data (Malcolm *et al.*, 1999: 25).

Item 13: *Teaching through problem-solving* – Problem-solving is a complex performance that involves the application of a combination of memory elements, particularly cognitive strategies (Ebenezer, 1998: 6).

Item 14: *Relating biology to everyday life situations* – The trends in changes in OBE have encouraged a movement from textbook-based knowledge to the use of applying knowledge to everyday life (WCED, 2002: 25).

Item 15: *Visual materials* – Visual materials can be used to clarify details in biology learning to gain a clearer understanding of the content work (Degenaar, 1985: 67).

Item 16: *Textbook summaries* – Biology texts should promote inquiry and thinking, and should reflect new methodologies (Leonard and Penick, 1993: 14).
Questionnaire no. 2: How do you prefer to be taught biology?

Methods of assessment incorporated into the survey:

Item 1: Examinations every six months – Traditional examinations cause learners to engage deliberately with subject matter (Race, 1997: 7).

Item 2: Class tests every two weeks – A traditional paper and pen test could be good for testing recall (Sunday Times, 2000: 1).

Item 3: A four-page project twice a year – This method can show learners how to use facts and structure these coherently into arguments (Sunday Times, 2000: 2).

Items 4 & 5: Completing worksheets – Worksheets are a very good way to evaluate a lesson, because any problems can be detected immediately with respect to formative as well as summative evaluation (Slabbert, 1990: 44).

Item 6: Biology practicals – Can demonstrate clearly how well learners understand certain specific concepts and how they translate these into practical implementation (Sunday Times, 2000: 3).

Item 7: Portfolio – A collection of a learner’s work – telling a story of the learner’s progress. The teacher and learner should decide how to assess it (WCED, 2002: 1-26).

Item 8: Problem-solving questions – Problem-solving involves the application of a combination of elements, to test the learner’s knowledge. A teacher must involve all the elements for a variety of concepts in science (Ebenezer, 1998: 6).

Item 9: Reviews – Learners are able to interact in-depth with information they review (Race, 1997: 15).

Items 10 & 11: Essays – Allow the student individuality and expression. They can reflect the depth of the learner’s learning, and their writing style (Race, 1997: 13).
Item 12: Revision tests – Aid in the recall of knowledge (Race, 1997: 11).

Item 13: Class involvement mark – Encourages learners to participate in classroom activities, and to build their self-confidence (Sunday Times, 2000: 4).

Item 14: Open-book examination – This examination is ‘relaxed’ allowing learners to answer questions with the aid of their chosen materials and at their own pace (Race, 1997: 10).

Item 15: Picture tests – The print media are a plentiful source of interesting, colourful pictures. These activities can stimulate learners in creative writing and in exercising visual literacy (Sunday Times, 2000: 3).

Item 16: Multiple choice tests (MCQs) – To test the learners’ understanding of a much greater cross-section of a syllabus – as opposed to long and detailed questions (Race, 1997: 11).

Item 17: Oral presentations – Allow learners to tell us what they know – assessing both their work completed and the ability to communicate what has been learnt (Sunday Times, 2000: 3).

Item 18: Oral examinations – Can be used to ensure that learners are familiar with things that other forms of assessment seem to indicate they have learnt well (Race, 1997: 23).

When questionnaire no. 1 (teaching methods) was given to a sample of n = 20 Grade 10 learners, and re-administered to the same sample three days later in August 2001, it yielded a reliability co-efficient of $r = 0.97$. Likewise, a reliability co-efficient of $r = 0.98$ was obtained with a sample of $n = 19$ for questionnaire no. 2 (assessment methods).

Thus, the devised scales were shown to be highly stable.
3.5 Hypotheses

The following hypotheses will be tested:

**H1** That, given a choice of 16 different methods of teaching in the biology classroom, all methods will tend to be **equally** preferred by the respondents in the samples drawn from the eight **diverse** schools:
- a) collectively; and
- b) compared school by school.

**H2** That the learners' preference for different forms of teaching will tend to follow similar trends, irrespective of the **nature** of the school (i.e. its ethos, philosophy, purpose, aims, status, size, composition, etc.).

**H3** That, given a choice of 18 different methods of assessment in the biology classroom, all methods will tend to be **equally** preferred by the respondents in the samples drawn from the eight **diverse** schools:
- a) collectively; and
- b) compared school by school.

**H4** That the learners' preferences for different forms of assessment will tend to follow similar trends, irrespective of the **nature** of the school (i.e. its ethos, philosophy, purpose, aims, status, size, composition, etc.).

3.6 Chapter Summary

In this chapter, the schools participating in this investigation have been described, and the development and refinement of the two instruments used in the study have been explained. The hypotheses to be tested, the intended data collection procedures, the proposed methods for the treatment of the data and selected analytical methods have been described. The results and findings of the research study now follow in Chapter 4.
CHAPTER 4

RESULTS

4.1 Introduction

In this chapter, the four hypotheses are tested and both the quantitative and qualitative results and findings are presented in detail. The preliminary findings have been reviewed and refereed, and published in Asary (1999) and Asary (2001).

The findings obtained during the period 1999 - 2001 for survey 1 (Teaching Methods) and survey 2 (Assessment Methods) are presented in two parts for each survey in turn. The first part sets out the overall pattern of empirical results for that particular survey. The second part summarises the learners' descriptive reasons for their choices. It presents a combined summary of the findings for the most and least important choices made by high school learners in all eight schools in this study for each survey in turn.

In section 4.3 the chapter proceeds to re-analyse the entire response data by re-classifying and re-grouping it according to its basic teacher-centredness or its basic learner-centredness.

In sections 4.4 to 4.6 the chapter makes statistical comparisons, school-by-school.

Qualitatively it is also suggested that differences in learners' preferences for some methods of teaching and assessment might reflect the diversities of the schools, since they are different in size, religion, socio-economic status, aims, philosophy etc. It is also suggested that learners' preferences for other methods of teaching and learning might be independent of school diversity; i.e. that certain choices will be common or universal, irrespective of the schools' particular backgrounds, traditions, contexts and parameters.
4.2 An overview of the empirical findings - overall trends

4.2.1 Responses to survey 1: How would you prefer to be taught biology? (N=911)

Quantitative results

The results summarising the response frequencies of the most and least favoured responses by the 911 high school learners are presented in Table 4.1 on page 63.

The two teaching methods with the highest degree of support among the learners in the purposive sample of eight schools were found to be:

- Biology Outings (item 8 : 478 responses)
- Experiments (item 1 : 191 responses)

Other methods of teaching that showed a high degree of support among the eight schools were:

- Computers (item 5 : 145 responses)
- Biology videos (item 9 : 121 responses)
- Biology games (item 10 : 112 responses)
- Class discussions (item 4 : 92 responses)
- Creative materials (item 11 : 82 responses)
- Biology projects (item 3 : 81 responses)

The two teaching methods least preferred by the learners were found to be:

- Your teacher takes charge (item 7 : 389 responses)
- Textbook summaries (item 16 : 386 responses)

Other methods of teaching not strongly favoured by the learners from the eight schools were:

- Investigations (item 12 : 186 responses)
- Demonstrations (item 2 : 145 responses)
Table 4.1: The frequency scores and best and least preferences of the 911 high school learners on Survey 1: How would you prefer to be taught biology?

<table>
<thead>
<tr>
<th>Method of teaching</th>
<th>Percentages</th>
<th>Response frequencies (N=911)</th>
<th>Number of best recommendations</th>
<th>Number of least recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Experiments</td>
<td>89%</td>
<td>9%</td>
<td>191</td>
<td>26</td>
</tr>
<tr>
<td>2. Demonstrations</td>
<td>35%</td>
<td>64%</td>
<td>21</td>
<td>145</td>
</tr>
<tr>
<td>3. Biology projects</td>
<td>67%</td>
<td>32%</td>
<td>81</td>
<td>82</td>
</tr>
<tr>
<td>4. Class discussions</td>
<td>83%</td>
<td>15%</td>
<td>92</td>
<td>39</td>
</tr>
<tr>
<td>5. Computers</td>
<td>70%</td>
<td>27%</td>
<td>145</td>
<td>47</td>
</tr>
<tr>
<td>6. Worksheets</td>
<td>64%</td>
<td>34%</td>
<td>55</td>
<td>54</td>
</tr>
<tr>
<td>7. Your teacher takes charge</td>
<td>22%</td>
<td>75%</td>
<td>16</td>
<td>389</td>
</tr>
<tr>
<td>8. Outings</td>
<td>92%</td>
<td>8%</td>
<td>476</td>
<td>14</td>
</tr>
<tr>
<td>9. Videos</td>
<td>83%</td>
<td>14%</td>
<td>121</td>
<td>51</td>
</tr>
<tr>
<td>10. Games</td>
<td>80%</td>
<td>17%</td>
<td>112</td>
<td>44</td>
</tr>
<tr>
<td>11. Creative materials</td>
<td>76%</td>
<td>21%</td>
<td>82</td>
<td>186</td>
</tr>
<tr>
<td>12. Investigations</td>
<td>36%</td>
<td>60%</td>
<td>21</td>
<td>74</td>
</tr>
<tr>
<td>13. Problem-solving</td>
<td>65%</td>
<td>31%</td>
<td>26</td>
<td>30</td>
</tr>
<tr>
<td>14. Everyday life situations</td>
<td>81%</td>
<td>16%</td>
<td>59</td>
<td>36</td>
</tr>
<tr>
<td>15. Visual materials</td>
<td>82%</td>
<td>15%</td>
<td>42</td>
<td>36</td>
</tr>
<tr>
<td>16. Textbook summaries</td>
<td>32%</td>
<td>66%</td>
<td>26</td>
<td>386</td>
</tr>
</tbody>
</table>

# Two choices were allowed, i.e. \(2 \times 911 = 1822\) is the maximum figure theoretically possible.

Qualitative findings: first level of analysis

The following are summarised comments commonly given by many of the 911 respondents for each of the above items. Photocopies of the learners' original comments are reproduced in Appendix 4.

In the next chapter (Chapter 5: Discussion) a more detailed analysis of the responses will explain how the learners' comments provide evidence to support the various principles and theoretical components advocated by Curriculum 2005.
The methods of teaching most preferred in biology:

a) **Biology outings (item 8)** were said to be favoured because :-

- These enable learners to work in groups and to share their views and opinions about a topic.
- They allow for hands-on experience, which makes the work interesting and visually stimulating.
- They can relate what one does in the classroom to everyday life - making the work more challenging and interactive.
- They are better than textbook work and the teacher talking in class.
- Learners are able to taste, smell, hear and see things that are being studied.
- They are fun and enable the learners to be more focused.

b) **Experiments (item 1)** were said to be favoured because :-

- They provide hands-on experience and there is no lecturing from the teacher.
- They allow learners to experience chemicals, microscopes etc. - experiences that one does not always encounter in everyday life.
- Learners have a clearer idea of what is happening in a topic - sometimes the textbook work can be confusing.
- They make learners think and extrapolate information.
- They involve less writing during lessons.

c) **Computers (item 5)** were said to be favoured because :-

- These allow for interaction with colourful diagrams.
- Learners are able to have access to a wealth of updated information via the internet.

d) **Biology videos and biology games (items 9 and 10)** were said to be favoured because :-

- These are interesting in that the learners can acquire knowledge as well as be taken away from the normal teaching routine.

The methods of teaching said to be least preferred in biology:

a) **Teacher-in-charge (item 11)** was not favoured because :-

- The teacher constantly speaking is boring and uninteresting.
- After some time the learner will lose concentration and tend to forget what the teacher has said by the end of the lesson.
• If the teacher gives homework at the end of the lesson, the learners won’t have help accessible to them.
• The learner needs to be occupied through some form of practical work.
• This type of teaching encourages parrot-fashioned learning.

b) Textbook summaries (item 16) were not favoured because :-

• It is difficult for learners to separate the important information; therefore they tend to write everything in the textbook into their notebook.
• Learners do not have the necessary skills to summarise information.
• Learners think that it is monotonous and tedious.
• There is no thought and insight when summarising textbook information.
• Learners think that it is the teacher’s way of keeping them ‘occupied’ for the lesson.

c) Investigations (item 12) were not favoured because :-

• They are too long and a ‘waste of time’ since there are other subjects on which to focus the learners’ attention.
• Sometimes the learners do not understand the question.
• The learners think that projects and investigations are marked with an emphasis on colourful presentation and not on content.

d) Demonstrations (item 2) were not favoured because :-

• Learners prefer to do the demonstrations themselves, since they will learn how to handle the apparatus.
• It will be fun and interesting if they do the work on their own, without the teacher telling what will happen in experiments.
• The teachers’ constant talking is tedious.

4.2.2 Responses to survey 2: How would you prefer to be assessed in biology?
(N=1259)

Quantitative findings

The results summarising the response frequencies of the most favoured and least favoured responses by 1259 high school learners are presented in Table 4.2 on page 67.

The two assessment methods with the highest degree of support among the learners in eight schools were found to be:
Revision tests (item 12 : 282 responses)
Open-book examination (item 14 : 269 responses)

Other methods of assessment which showed a high degree of support were:

Multiple choice tests (item 16 : 192 responses)
Biology projects (item 3 : 187 responses)
Class tests (item 2 : 182 responses)
Picture tests (item 15 : 151 responses)
Portfolios (item 7 : 144 responses)
Class involvement mark (item 13 : 118 responses)
Oral presentations (item 17 : 108 responses)
Examinations (item 1 : 101 responses)

The remaining methods of assessment in biology were favoured by fewer than 100 out of the 1259 learners.

The three methods of assessment least preferred in the eight schools were:

Two-page essays (item 11 : 438 responses)
Oral examinations (item 18 : 274 responses)
Oral presentations (item 17 : 245 responses)

Other methods of assessment which were least favoured by the learners were:

Worksheets (daily) (item 5 : 173 responses)
Examinations (item 1 : 122 responses)
Mini-essays (half-page) (item 10 : 101 responses)

The remaining methods of assessment were favoured by fewer than 100 learners.
Table 4.2: The frequency scores and best and least preferences of the 1259 high school learners on Survey 2: How would you prefer to be assessed in biology?

<table>
<thead>
<tr>
<th>Method of assessment</th>
<th>Percentages</th>
<th>Response frequencies (N=1259)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Yes</td>
<td>% No</td>
</tr>
<tr>
<td>1. Examination</td>
<td>57</td>
<td>41</td>
</tr>
<tr>
<td>2. Class tests</td>
<td>72</td>
<td>25</td>
</tr>
<tr>
<td>3. Projects</td>
<td>81</td>
<td>17</td>
</tr>
<tr>
<td>4. Worksheets (weekly)</td>
<td>74</td>
<td>23</td>
</tr>
<tr>
<td>5. Worksheets (daily)</td>
<td>25</td>
<td>70</td>
</tr>
<tr>
<td>6. Biology practical</td>
<td>51</td>
<td>45</td>
</tr>
<tr>
<td>7. Portfolios</td>
<td>61</td>
<td>37</td>
</tr>
<tr>
<td>8. Problem-solving questions</td>
<td>58</td>
<td>40</td>
</tr>
<tr>
<td>9. Reviews</td>
<td>38</td>
<td>59</td>
</tr>
<tr>
<td>10. Mini-essays (half page)</td>
<td>43</td>
<td>53</td>
</tr>
<tr>
<td>11. Essays (two page)</td>
<td>13</td>
<td>81</td>
</tr>
<tr>
<td>12. Revision tests</td>
<td>79</td>
<td>15</td>
</tr>
<tr>
<td>13. Class involvement mark</td>
<td>73</td>
<td>24</td>
</tr>
<tr>
<td>14. Open-book examination</td>
<td>79</td>
<td>16</td>
</tr>
<tr>
<td>15. Picture tests</td>
<td>71</td>
<td>22</td>
</tr>
<tr>
<td>16. Multiple choice tests</td>
<td>71</td>
<td>24</td>
</tr>
<tr>
<td>17. Oral presentations</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>18. Oral examinations</td>
<td>36</td>
<td>62</td>
</tr>
</tbody>
</table>

# Two choices were allowed, i.e. 2 x 1259 = 2518 is the maximum figure theoretically possible.

**Qualitative findings**

The following are summarised comments commonly given by many of the 1259 respondents for each of the above items. Photocopies of the learners’ original comments are reproduced in Appendix 5.

In the next chapter (Chapter 5: Discussion) a more detailed analysis will explain how the learners’ comments provide evidence to support the various principles and theoretical components of Curriculum 2005.
The methods of assessment said to be most preferred in biology:

a) Revision tests (item 12) were said to be favoured because:

- They help the learner in preparation for the June and December examinations.
- They clarify the work at the end of each section.
- They motivate the learner to keep up to date with the work.
- They build the learners' confidence.
- They give the learners input as to what work they are experiencing problems with.
- They give the learner a guide as to how the teacher will set questions in the examination, as well as what key points they will look out for when marking.

b) An open-book examination (item 14) was said to be favoured because:

- The learner will not have to memorise work when preparing for tests and examinations.
- The learner will have an opportunity to apply and understand knowledge.
- It will build the learners' confidence since the learners assume that they will improve their marks.

(Some learners, however, did not perceive open-book examinations as advantageous, and they made the following remarks:

- Some learners do not understand the concept of an open-book examination.
- The learners felt that it would not be mentally stimulating.
- Learners felt that it would "decrease their thinking potential".)

c) Multiple choice tests (item 16) were said to be favoured because:

- This method will make studying easier.
- The learners will not have to express themselves through long sentences.
- The learners will have to understand their work and will not have to resort to memorising work when studying.

(Some learners however, did not perceive multiple choice tests as advantageous, and they made the following remarks:

- Learners will resort to not studying their work and thus guessing answers).

d) Biology projects (item 3) were said to be favoured because:

- Research will give the learners more insight into the topic - the learners therefore found work mentally stimulating.
- The work is interesting and the learners will be able to work independently and at their own pace.
• The learners can consult not only the textbook, but a variety of other sources, e.g. internet, journals, newspapers.
• The learners will be able to work in groups, and this will build their teamwork and social skills.

(Some learners however, did not perceive biology projects as advantageous, and they made the following remarks:

• For some learners group work was perceived to be counter-productive since some learners typically have no focus and do very little to contribute to the group.
• Introverted learners do not have an opportunity to express their opinions).

e) Class tests (item 2) were said to be favoured because:

• They enabled the learners to prepare for the examination.

f) Picture tests (item 15) were said to be favoured because:

• They allow the learners to identify different parts, and this aids in understanding processes in biology.
• Learners find it easier to remember visuals and colour when studying.
• They are an effective way of remembering when studying.

g) Portfolios (item 7) and class involvement mark (item 13) were said to be favoured because:

• They help the learners to keep track and up to date with their work and progress.
• The learners can reflect on their performance over a long period of time.
• The learners will not have to regurgitate answers for tests and examinations.
• They give the learners self-motivation.

h) Oral presentations (item 17) were said to be favoured because:

• They will help the learners to research and interpret information.
• After researching the topic, the learners will be able to ‘design’ the best way to present the topic to the class.
• The learners will be able to be as creative as they wish.

i) Examinations (item 1) were also favoured because:

• Though there were no substantial comments in justification of examinations, the learners still viewed these as a very popular choice.
The methods of assessment said to be least preferred in biology:

a) Two-page essays (item 11) were said to be not favoured because:
   - Learners will not be able to express themselves in so many words without repeating themselves.
   - Even though the learners have good ideas, they feel that they will not be able to express them in an essay of that length.
   - Sometimes the instruction is not clear.
   - This is an old-fashioned method and should not be used in biology any longer.

b) Oral examinations (item 18) were said to be not favoured because:
   - The learners will feel nervous and self-conscious if the teacher asks them questions.
   - There will not be enough time to think when expected by the teacher to give an answer.

c) Oral presentations (item 17) were said to be not favoured because:
   - Some learners would be afraid to speak in front of the class, and this might affect the learners' performances.
   - The learners were afraid to answer questions which the teacher or other learners would ask.
   - Extroverts would perform better than introverts.
   - Sometimes presentations are not interesting, resulting in boredom and frustration.
   - Valuable class time might be wasted with uninteresting presentations.

d) Daily worksheets (item 5) were said to be not favoured because:
   - Lessons will become uninteresting since there is no variety and class discussion time.
   - This method will lead to too much homework in one week.

e) Examinations (item 1) were said to be not favoured because:
   - Learners might become anxious during this period and not perform to their full potential.
   - The workload and pressure are too much.
   - The examination setting is too formal, adding to the anxiety.

f) Half-page mini-essays (item 10) were said to be not favoured because:
   - Sometimes it is difficult for learners to express themselves in lengthy sentences.
4.3 The second level of analysis: Do learners’ preferences tend to be more teacher-centred or more learner-centred?

In order to ascertain whether all learners’ preferences taken as a whole were inclined more towards being basically teacher-centred or more towards being basically learner-centred (discovery learning), the methods in each questionnaire were categorised and grouped by a panel of nine experienced teachers, into three main divisions of re-classification:

1. Where the type of preference is for the teacher to tend to take predominant control of learning (teacher-centred learning).
2. Where the type of preference is for the learner to tend to take predominant control of learning (learner-centred learning).
3. Where it is not certain whether the methods are predominantly teacher-controlled or learner-controlled (unsure) or whether the control was agreed to be shared.

This procedure was applied firstly to Survey 1 (teaching methods), and then to Survey 2 (methods of assessment). For Survey 1 *(How do you prefer to be taught biology?)*, the following items were classified by consensus as more teacher-centred items than learner-centred: numbers 2, 6, 7, 15 and 16. The items classified as more learner-centred items than teacher-centred were: numbers 1, 3, 5, 8, 11, 12 and 13 and the items classified as shared or unsure were: numbers 4, 9, 10 and 14. The grouped results derived from the learners’ analysed responses are summarised in Table 4.3 on page 72.
Table 4.3: Grouped results summarising the percentages of most preferred and least preferred responses on survey instrument no. 1: *How would you prefer to be taught biology?* using the data supplied by 911 learners.

<table>
<thead>
<tr>
<th>Classroom instructional style</th>
<th>Learners' most preferred teaching style (n=1566 responses) #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-centred methods</td>
<td>10.2%</td>
</tr>
<tr>
<td>Learner-centred methods</td>
<td>65.2%</td>
</tr>
<tr>
<td>Method classified as shared or unsure</td>
<td>24.5%</td>
</tr>
</tbody>
</table>

# Each of the 911 learners selected two choices, allowing a maximum of n = 1822 possible choices.

For survey 2 (*How do you prefer to be assessed in biology?*), the following items were classified as teacher-centred assessment methods: numbers 1,2,4,5,11,12,15 and 16. The items classified as learner-centred assessment methods were: numbers 3,7,8,9,13,14 and 17; and the items listed as shared or unsure were: numbers 6,10 and 18. The patterns of findings are summarised in Table 4.4 on page 73.
Table 4.4: Grouped results summarising the percentages of most preferred and least preferred responses to survey instrument no. 2: How would you prefer to be assessed in biology? using the data supplied by the 1259 learners.

<table>
<thead>
<tr>
<th>Classroom assessment approach</th>
<th>Learners' most preferred assessment approach (n=2130 responses) #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-centred assessment</td>
<td>48.4%</td>
</tr>
<tr>
<td>Learner-centred assessment</td>
<td>44.1%</td>
</tr>
<tr>
<td>Assessment classified as shared or unsure</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

# Each of the 1259 learners selected two choices, allowing a maximum of n=2518 possible responses.

4.4 A school-by-school comparison of the learners’ preferences for teaching and assessment

In section 4.5 below, chi-square tests will be used to compare the frequencies of “yes” or “no” responses to each one of the sixteen items on the questionnaire “How do you prefer to be taught biology?” and to the eighteen items on the questionnaire “How do you prefer to be assessed in biology?” One-by-one all items' grouped responses will be compared across all eight schools in order to ascertain whether there are significant differences in preferences within any given pair of schools.
In section 4.6 that follows, samples of evidence from the qualitative data will be quoted in an attempt to account for these observed statistical differences. Extensive explanatory evidence will be cited from the learners' open-ended responses recorded in the different schools. Possible suspected influences such as class size, religious ethos or regional socio-economic status, might emerge from the data.

4.5 Testing the hypotheses

The findings for hypothesis 1 are presented in considerable detail from pages 74 to 87.

Hypothesis 1:
Given a choice of 16 different methods of teaching in the biology classroom, all methods will tend to be preferred equally by samples of 911 learners drawn from eight diverse schools:

a) collectively

b) school by school.

a) Collectively

The hypothesis that all 16 methods of teaching in biology will be preferred equally by all the 911 learners collectively is rejected.

Table 4.1 on page 63 shows, by inspection, that the sixteen methods of receiving biology instruction were certainly not equally preferred by the learners. The numbers of responses favouring each method were widely different. Thus, the learners do not favour the 16 methods of teaching biology equally.
b) **School by school**

Tables 4.5 and 4.6 present the frequency distributions of responses to survey 1 obtained from the eight schools. The hypothesis that *all 16 methods of teaching biology will be preferred equally by the samples of learners in all eight schools*, is rejected.

A systematic chi-square analysis of pairs of the frequency distributions in Tables 4.5 and 4.6 shows that, for the sixteen methods of being taught biology, at least some of the eight schools differed in their choices with regard to the following methods: *computers* (item 5); *worksheets* (item 6); *teacher-in-charge* (item 7); *outings* (item 8); *videos* (item 9); *problem-solving* (item 13); *everyday situations* (item 14) and *textbook summaries* (item 16). All the other methods of teaching recorded no significant differences in preferences between the schools, as recorded in Table 4.7 on pages 78 to 85.

The most prominent and distinctive trends in the differences occur for items 5 (*computers*); 7 (*teacher-in-charge*); and 16 (*textbook summaries*), as depicted in Figures 4.1, 4.2 and 4.3 on pages 86 to 87.

**Note:** For each grid on pages 78 to 85 there are 112 squares. Given a p-value of \( p \leq 0.05 \), up to 5 out of every 100 squares might be expected to be shaded purely on the basis of random chance alone. Thus, the findings recorded on pages 80 and 81 might possibly be spurious. However, the trends recorded on pages 78, 79 and 82-85 can be confidently interpreted as significant.
Table 4.5 The percentage responses for survey 1: How would you prefer to be taught in biology?

<table>
<thead>
<tr>
<th>No.</th>
<th>Teaching Method</th>
<th>SCHOOL 1 (n=301)</th>
<th>SCHOOL 2 (n=275)</th>
<th>SCHOOL 3 (n=60)</th>
<th>SCHOOL 4 (n=59)</th>
<th>SCHOOL 5 (n=52)</th>
<th>SCHOOL 6 (n=19)</th>
<th>SCHOOL 7 (n=95)</th>
<th>SCHOOL 8 (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Experiments</td>
<td>YES 83 NO 14</td>
<td>YES 95 NO 06</td>
<td>YES 88 NO 12</td>
<td>YES 98 NO 02</td>
<td>YES 88 NO 00</td>
<td>YES 100 NO 00</td>
<td>YES 83 NO 07</td>
<td>YES 86 NO 10</td>
</tr>
<tr>
<td>2</td>
<td>Demonstrations</td>
<td>YES 31 NO 65</td>
<td>YES 31 NO 71</td>
<td>YES 40 NO 60</td>
<td>YES 29 NO 71</td>
<td>YES 44 NO 50</td>
<td>YES 37 NO 58</td>
<td>YES 43 NO 51</td>
<td>YES 46 NO 50</td>
</tr>
<tr>
<td>3</td>
<td>Biology projects</td>
<td>YES 67 NO 29</td>
<td>YES 71 NO 31</td>
<td>YES 62 NO 38</td>
<td>YES 75 NO 24</td>
<td>YES 69 NO 27</td>
<td>YES 58 NO 42</td>
<td>YES 58 NO 31</td>
<td>YES 52 NO 50</td>
</tr>
<tr>
<td>4</td>
<td>Class discussions</td>
<td>YES 87 NO 10</td>
<td>YES 80 NO 19</td>
<td>YES 85 NO 13</td>
<td>YES 85 NO 12</td>
<td>YES 75 NO 19</td>
<td>YES 100 NO 00</td>
<td>YES 78 NO 16</td>
<td>YES 74 NO 20</td>
</tr>
<tr>
<td>5</td>
<td>Computers</td>
<td>YES 58 NO 39</td>
<td>YES 78 NO 21</td>
<td>YES 93 NO 05</td>
<td>YES 83 NO 15</td>
<td>YES 79 NO 04</td>
<td>YES 84 NO 16</td>
<td>YES 42 NO 46</td>
<td>YES 86 NO 10</td>
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<tr>
<td>6</td>
<td>Worksheets</td>
<td>YES 70 NO 25</td>
<td>YES 68 NO 34</td>
<td>YES 43 NO 57</td>
<td>YES 59 NO 41</td>
<td>YES 50 NO 42</td>
<td>YES 74 NO 32</td>
<td>YES 54 NO 37</td>
<td>YES 58 NO 38</td>
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<tr>
<td>7</td>
<td>Teacher-in-charge</td>
<td>YES 18 NO 78</td>
<td>YES 26 NO 76</td>
<td>YES 15 NO 83</td>
<td>YES 15 NO 85</td>
<td>YES 38 NO 52</td>
<td>YES 63 NO 37</td>
<td>YES 13 NO 78</td>
<td>YES 30 NO 64</td>
</tr>
<tr>
<td>8</td>
<td>Class outings</td>
<td>YES 94 NO 3</td>
<td>YES 91 NO 17</td>
<td>YES 97 NO 02</td>
<td>YES 97 NO 02</td>
<td>YES 85 NO 10</td>
<td>YES 95 NO 05</td>
<td>YES 84 NO 08</td>
<td>YES 90 NO 06</td>
</tr>
<tr>
<td>9</td>
<td>Biology videos</td>
<td>YES 82 NO 15</td>
<td>YES 88 NO 10</td>
<td>YES 90 NO 10</td>
<td>YES 90 NO 08</td>
<td>YES 73 NO 17</td>
<td>YES 84 NO 16</td>
<td>YES 72 NO 20</td>
<td>YES 68 NO 30</td>
</tr>
<tr>
<td>10</td>
<td>Biology games</td>
<td>YES 75 NO 21</td>
<td>YES 84 NO 16</td>
<td>YES 93 NO 05</td>
<td>YES 81 NO 17</td>
<td>YES 81 NO 06</td>
<td>YES 89 NO 11</td>
<td>YES 72 NO 21</td>
<td>YES 74 NO 22</td>
</tr>
<tr>
<td>11</td>
<td>Creative materials</td>
<td>YES 79 NO 18</td>
<td>YES 75 NO 23</td>
<td>YES 72 NO 25</td>
<td>YES 78 NO 20</td>
<td>YES 73 NO 13</td>
<td>YES 84 NO 16</td>
<td>YES 72 NO 17</td>
<td>YES 62 NO 34</td>
</tr>
<tr>
<td>12</td>
<td>Investigations</td>
<td>YES 32 NO 64</td>
<td>YES 35 NO 63</td>
<td>YES 38 NO 62</td>
<td>YES 34 NO 63</td>
<td>YES 48 NO 42</td>
<td>YES 68 NO 32</td>
<td>YES 37 NO 52</td>
<td>YES 44 NO 54</td>
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<td>13</td>
<td>Problem-solving</td>
<td>YES 57 NO 39</td>
<td>YES 70 NO 26</td>
<td>YES 83 NO 15</td>
<td>YES 63 NO 34</td>
<td>YES 77 NO 17</td>
<td>YES 79 NO 21</td>
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<td>YES 64 NO 30</td>
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<td>14</td>
<td>Relating to everyday life</td>
<td>YES 85 NO 10</td>
<td>YES 76 NO 21</td>
<td>YES 80 NO 20</td>
<td>YES 92 NO 07</td>
<td>YES 79 NO 15</td>
<td>YES 89 NO 16</td>
<td>YES 68 NO 27</td>
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<td>Visual materials</td>
<td>YES 82 NO 16</td>
<td>YES 87 NO 13</td>
<td>YES 82 NO 17</td>
<td>YES 76 NO 20</td>
<td>YES 77 NO 15</td>
<td>YES 84 NO 11</td>
<td>YES 71 NO 20</td>
<td>YES 90 NO 06</td>
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<td>16</td>
<td>Textbook summaries</td>
<td>YES 38 NO 60</td>
<td>YES 27 NO 73</td>
<td>YES 27 NO 75</td>
<td>YES 20 NO 78</td>
<td>YES 42 NO 46</td>
<td>YES 47 NO 53</td>
<td>YES 23 NO 69</td>
<td>YES 50 NO 42</td>
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</table>
Table 4.6  The percentage responses for survey 2: *How would you prefer to be assessed in biology?*

<table>
<thead>
<tr>
<th>No.</th>
<th>Teaching Method</th>
<th>SCHOOL 1 n=301</th>
<th>SCHOOL 2 n=269</th>
<th>SCHOOL 3 n=55</th>
<th>SCHOOL 4 n=272</th>
<th>SCHOOL 5 n=197</th>
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<tr>
<td>1</td>
<td>Examinations</td>
<td>YES 50 NO 44</td>
<td>YES 62 NO 42</td>
<td>YES 67 NO 35</td>
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<td>YES 75 NO 25</td>
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<td>YES 64 NO 34</td>
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<td>2</td>
<td>Class tests</td>
<td>YES 69 NO 27</td>
<td>YES 77 NO 17</td>
<td>YES 53 NO 45</td>
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<td>YES 71 NO 27</td>
<td>YES 71 NO 27</td>
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</tr>
<tr>
<td>3</td>
<td>Biology projects</td>
<td>YES 88 NO 10</td>
<td>YES 77 NO 21</td>
<td>YES 80 NO 20</td>
<td>YES 85 NO 15</td>
<td>YES 71 NO 27</td>
<td>YES 80 NO 20</td>
<td>YES 82 NO 13</td>
<td>YES 76 NO 20</td>
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<td>4</td>
<td>Worksheets (weekly)</td>
<td>YES 67 NO 28</td>
<td>YES 80 NO 16</td>
<td>YES 80 NO 20</td>
<td>YES 78 NO 19</td>
<td>YES 68 NO 36</td>
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<td>YES 82 NO 14</td>
</tr>
<tr>
<td>5</td>
<td>Worksheets (daily)</td>
<td>YES 19 NO 76</td>
<td>YES 24 NO 77</td>
<td>YES 31 NO 67</td>
<td>YES 33 NO 66</td>
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Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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[Notes: cont./...]

University of Cape Town
Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items.
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School 2 vs. School 5
School 2 vs. School 6
School 2 vs. School 7
School 2 vs. School 8

cont./...
Table 4.7 (cont.)

Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items.
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Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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Table 4.7: Comparison between the pairs of schools of their preferred methods of being taught biology for 16 items.
(The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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School 7 showed a significantly lower preference (44%) for computers compared to some of the other schools (dotted line) as a teaching method in biology, followed by school 1 (58%).

Note:

Actual frequencies, not percentages, are used in the chi-square test calculations.
School 6 showed a significantly higher preference (63%) for teacher-in-charge compared to some of the other schools (dotted line) as a teaching method in biology, followed by school 5 (38%).

School 8 showed a significantly higher preference (50%) for textbook summaries compared to some of the other schools (dotted line), as a teaching method in biology, followed by school 6 (47%).
Hypothesis 2:

That the learners’ preferences for different forms of teaching will be independent of the nature of the school i.e. its ethos, philosophy, purpose, aims, size, composition etc.

The hypothesis that learners preferences for different forms of teaching will be independent of the nature of the school is partly supported. The chi-square results presented in Table 4.7 show that, across all eight schools, the learners’ preference patterns were similar for teaching methods 1-4, 10-12 and 15. However, for exceptional teaching methods 5-9, 13, 14 and 16, the reasons expressed by the learners can be linked to their described influences of the contexts of the schools they attend. These qualitative accounts and explanations by the learners are presented in detail below in section 4.6.

The findings for hypothesis 2 are presented in considerable detail from pages 78 to 87.

Hypothesis 3:

Given a choice of 18 different methods of assessment in the biology classroom, all methods tend to be equally preferred by samples of 1249 learners drawn from eight diverse schools: a) collectively b) school by school

a) Collectively

The hypothesis that all 18 methods of assessment biology will be equally preferred by all the 911 learners collectively is rejected.

Table 4.2 on page 67 shows, by inspection, that the eighteen methods of being assessed in biology are certainly not equally preferred by the learners. The numbers of responses favouring each method are widely different. Thus, the learners do not favour the 18 different methods of teaching assessment equally.
b) **School by school**

The hypothesis that *all 18 methods of assessment in biology will be preferred equally by the learners in all eight schools* is rejected.

A systematic chi-square analysis of the pairs of frequency distributions in Table 4.5 and 4.6 on pages 76 to 77 shows that, for the eighteen methods of being assessed in biology, at least some of the eight schools differed in their choices with regard to the following methods: *examinations* (item 1); *biology practicals* (item 6); *problem-solving questions* (item 8); *class involvement mark* (item 13); *multiple choice tests* (item 16); *oral presentations* (item 17) and *oral examinations* (item 18). All the other methods of assessment recorded no significant differences in preference between the schools, as recorded in Table 4.8 on pages 90 to 93.

Some of the most prominent trends in the patterns of responses are depicted in Figures 4.4 to 4.9 on pages 94 to 98.
Table 4.8 (cont.): Comparison between the pairs of schools of their preferred methods of being assessed in biology for 18 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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Table 4.8: Comparison between the pairs of schools of their preferred methods of being assessed in biology for 18 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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Class tests          Problem-solving   Reviews          Class involvement mark   Multiple choice tests   Oral presentations   Oral examination
Table 4.8 (cont.)

Table 4.8: Comparison between the pairs of schools of their preferred methods of being assessed in biology for 18 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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Examinations

Oral examination

cont/...
Table 4.8

Table 4.8: Comparison between the pairs of schools of their preferred methods of being assessed in biology for 18 items. (The chi-square value is presented as the top value in each grid and the p-value is presented as the bottom value in each grid).

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School 6 showed a significantly higher preference (75%) for examinations compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 3 (67%).
School 6 showed a significantly higher preference (70%) for biology practicals compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 3 (65%).

School 4 showed a significantly higher preference (76%) for problem-solving questions compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 6 (75%).
School 6 showed a significantly higher preference (95%) for *multiple choice tests* compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 4 (84%).

School 6 showed a significantly higher preference (65%) for *oral presentations* compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 3 (56%).
School 6 showed a significantly higher preference (70%) for oral examinations compared to some of the other schools (dotted line), as an assessment method in biology, followed by school 3 (62%).

Hypothesis 4:

That the learners' preferences for different forms of assessment will be independent of the nature of the school (i.e. its ethos, philosophy, purpose, aims, size, composition etc.)

The hypothesis that learners preferences for different forms of assessment will be independent of the nature of the school is partly supported. However, some methods preferred by the learners were linked to their described influences of the particular context of the school they attend. The qualitative accounts and explanations of the learners are now examined below in section 4.6.
4.6 Qualitative evidence - school-by-school narratives for the prominently significant items.

The 911 responses to the survey 1: How would you prefer to be taught biology? supplied more than 1000 written explanations and comments on the methods of teaching biology. For the 1249 response to survey 2: How would you prefer to be assessed in biology? approximately 1500 written comments were supplied. Sampled photocopies of the detailed comments made by the respondents at the different schools are attached in Appendix 4 and Appendix 5 as illustrative examples of the learners’ explanations.

The considerable amount of qualitative detail is now summarised and presented for each distinctive item identified in section 4.5. Most schools showed similar responses to a particular item, as the summarised positive and negative responses are presented. All the responses are quoted verbatim.

4.6.1 Reasons for either preferring or not favouring methods of teaching

a) Computers (item 5)

Positive responses

"Internet gives you all the answers" (All schools 1-8).
"Using computers is much easier" (All schools 1-8).
"Computers and internet has more to offer" (All schools 1-8).
"Software packages gives you a better understanding of biology" (School 2).
"You get updated information quicker and easier" (School 3).
"You will be taught how to use computers which will one day help us when we are looking for a job" (Schools 1, 3, 5, 6 and 8).
"All the work on computers is performed by us, and I think that it is definitely a vast improvement over older teaching methods" (School 7).
Negative responses

“Doing computers is boring. The computer is doing the work for us, we have to do something” (School 1).

“Not everyone has a computer and the internet” (School 2).

“I am so bad at computers I know that I will struggle” (School 3).

“Computers take too long and when information is found it is usually too much, unnecessary or the wrong topic. Computers are only nice when they offer unknown information” (Schools 1-8).

b) Teacher in charge (item 7)

Positive response

“The teacher helps one when one struggles without delay” (School 5).

Negative responses

“I don’t believe that the teaching being in charge you will learn anything” (School 1).

“A teacher must not talk through a lesson because it is difficult to work like that” (Schools 2 and 3).

“If we do not have fun, we do not like the class. We don’t like a lot of homework because it is hard and we won’t play after school” (School 4).

“When the teacher does everything you lose interest and tune out. And when you are given lots of homework you slowly over time will begin to dislike the subject” (School 5).

“We get too much homework” (All schools 1-8).

“When you go home you forgot what the teacher said” (All schools 1-8).

c) Textbook summaries (item 16)

Positive responses

“If you work out of the textbook, then you will get more of a picture of what the teacher is trying to say” (School 1).

“When you summarise you break it down and put it in a way you understand” (School 5).
"You read and put the work in your own words and understand better" (School 8).

Negative responses
"Children aren't interested in it, it is boring" (All schools 1-8).
"It is hard and we don't like it" (All schools 1-8).
"Textbook summaries are outdated" (School 1).
"Textbooks go into unnecessary detail. Your teacher uses simple biological terms and the teacher only uses biological terms. And I don't really like reading" (School 2).

4.6.2 Reasons for either preferring or not favouring methods of assessment

a) Examinations (item 1)

Positive responses
"I learnt a lot as I study for exams" (Schools 1,2,3,5).
"I have grown accustomed to such an assessment method, and would be displeased if it was changed" (School 4).
"I prefer it because it will make us refresh our memories on work we have done previously" (School 6).
"It would help you understand your work better" (Schools 7,8).

Negative responses
"I hate examinations and I think that they are stressful" (All schools 1-8).
"Writing an examination is horrible, we should rather have continuous assessment" (School 5).
"Examinations are unfair and are not a true reflection of how well or badly you work as there is a time limit and they are written in pressurised, uncomfortable conditions for long periods of time without a break and you lose concentration" (School 8).
b) Biology practicals (item 6)

Positive responses
“Helps you understand the section you are dealing with” (Schools 1,5).
“It is better than examinations” (All schools 1-8).

Negative responses
“Biology practicals will cause students too much stress” (Schools 5,6).
“Don’t always help understand the work” (All schools 1-8).

c) Problem-solving (item 8)

Positive responses
“Doing problem-solving makes you think and working in groups means that you can help one another (share knowledge)” (Schools 6,7,8).
“Doing problem-solving in groups gives you the opportunity to help each other out (share knowledge)” (Schools 1,2,3,4).

Negative responses
“I hate problem-solving. it’s terrible” (Schools 2,3,4,5).
“I don’t enjoy problem-solving” (Schools 1,6,7).
“Stresses out my brain” (School 7).
“Doing problem-solving frustrates me because I like to know what’s going on all the time” (School 8).

d) Multiple Choice (item 16)

Positive responses
“Everyone has an equal chance of passing which makes the subject more enjoyable” (Schools 3 and 4).
“Multiple choice questions would boost your marks” (Schools 1 and 2).
“It is good revision and helps give one practice” (Schools 5 and 7).
“This will open up your vision in biology, you don’t have to spell words and express yourself in too many words” (School 6).
“It is fast and a “no fuss” method of ascertaining how much the learner knows” (School 8).

Negative response
“Multiple choice tests can sometimes be answered by chance” (All schools 1-8).

e) Oral presentations (item 17)

Positive responses
“I love orals, it is fun” (Schools 1 and 8).
“This is interesting and the entire class learns from your findings. The fact that each person stands up and says something makes a change” (School 2).
“I love orals and doing research” (School 3).
“It is nice to hear different information from the class” (School 4, 5 and 6).
“I enjoy orals as it allows one to be more creative, which is one of my strong points. Orals are also good educational projects from which one learns in an exciting way” (School 7 and 8).

Negative responses
“We don’t like talking in front of people” (All schools 1-8).
“People get nervous and mess up” (School 3).
“Oral is boring and frustrating, students get low marks for not putting enough effort in it” (School 4 and 5).
“Some people just can’t express themselves by speaking the work out loud. It’s not fun, you are expressing yourself in a state of panic” (School 7).
f) Oral Examination (item 18)

Positive response
"It allows and determines whether a student really knows the work in his/her book when a person is able to orally present his/her work it will show how confident and how much he/she understands the work" (School 8).

Negative responses
"I don't like being asked questions while being put on the spot and then you still get it wrong. This is boring." (School 2).
"I don't perform well under pressure" (All schools 1-8).
"You feel pressurised by your teacher and become nervous if you think that he/she is looking at you horribly. People who know how to manipulate a situation would get good marks and shy people would be disadvantaged" (School 7).
"When it is an oral test you might not understand the question, you would be too scared to say "please repeat" and get nervous" (School 8).

4.6.3 Analysis of categories / themes emerging through the qualitative comments: results and findings

An in-depth qualitative analysis of the learners' written justifications for either avoiding or choosing certain methods of teaching and methods of assessment, have resulted in the emergence of recurrent issues, trends, factors, influences, suggestions, explanations, descriptors, categories and themes. These are derived from the comments that were common amongst the majority of learners in all eight schools. These emergent categories or themes will be elaborated upon in Chapter 5.
a) Learners’ perceptions of methods of teaching

The following are the wider categories or themes that resulted from the qualitative responses on the questionnaire: *How would you prefer to be taught biology?*

- Most learners preferred methods of teaching that were learner-centred.
- Most learners associated learner-centred methods with social interaction, physical interaction with the environment, groupwork, autonomy, freedom to explore and ask questions, moving out of the set classroom environment and personal interaction with the teacher (see, for example, Appendix 4 and Appendix 5).
- Generally, most learners expressed feelings of motivation when exposed to methods that they associated with learner-centred methods of teaching.
- Most learners did not prefer methods of teaching that were teacher-centred.
- Learners associated teacher-centred methods with being controlled by the teacher and a restrictive classroom environment.
- Generally, most learners felt less motivated when exposed to teacher-centred methods of teaching.

b) Learners’ perceptions of methods of assessment

The following are wider categories or themes that resulted from the qualitative responses on the questionnaire: *How would you prefer to be assessed in biology?*

- Most learners appeared to be more circumspect or careful when considering their choice of assessment methods, and they preferred mainly teacher-centred methods of assessment.
- Most learners preferred methods of assessment that “guided” them to the correct answers.
- Most learners indicated that they preferred methods that would help them prepare for the June and December examinations.
• Most learners preferred methods that were ‘easy’ so that they could get good marks and avoid methods that would require synthesis of knowledge.
• Most learners took a surface approach to learning.

4.7 Chapter summary

This chapter has presented the main results and findings have been presented. The findings obtained for survey 1 (Teaching Methods) and survey 2 (Assessment Methods) set out the overall pattern of empirical results and also a summary of the qualitative findings. The chapter proceeded to re-analyse the entire response data by regrouping it according to whether the learners preferred basically teacher-centred or basically learner-centred methods of teaching and assessment.

Then the chapter analysed statistically whether patterns of similarities and differences in choices of teaching or assessment methods were linked to the diversity of the schools.

Finally, the chapter consolidated the qualitative findings by re-analysing and presenting them into categories or themes, which will be explained and discussed in greater detail in the following chapter.
CHAPTER 5
DISCUSSION OF RESULTS

5.1 Introduction

This chapter discusses the empirical results reported in Chapter 4. First, an attempt is made to account for any differences or similarities in the results obtained among the variables that were investigated. Then suggested explanations are given for the outcomes of the hypotheses.

The qualitative findings are also discussed, explained and explored in terms of the several identified themes, issues, categories, indicators and trends that emerged.

The chapter is divided into the following sections:

Section 5.2 explains how the learners' stated preferences and perceptions are congruent with (or, alternatively, do not match) the gazetted government 2002 science curriculum policy statements or principles of didactics and assessment for high school level biology.

In section 5.3 the overall empirical results for survey 1 (teaching methods) are discussed, and attempts are made to account for the observed differences or similarities in the manifestation of the variables. The findings are also discussed in terms of other similar findings in the published literature.

In section 5.4 the overall empirical results for survey 2 (assessment methods) are discussed, and attempts are made to account for the discovered differences or similarities among the variables.

Section 5.5 discusses the outcomes of the hypotheses comparing the responses from the different schools; and suggestions are made to account for the discovered differences or similarities between the schools.
5.6 gives a summary of the chapter.

5.2 Are learners’ perceptions of teaching and assessment congruent with policy documents?

5.2.1 The learners tended to prefer learner-centred methods of teaching

The learners’ overall impression of how they should be taught biology is congruent with current statements in the WCED (2002: 1-26), Curriculum 2005 documents, as well as supporting the advocacy of learner-centred learning theories described in Chapter 2.

Learners’ stronger preferences for learner-centred methods of teaching suggest that they favoured methods that allowed them to be in control of their learning. According to the evidence gathered in this Cape Town study, the learners associated learner-centred methods with the following characteristics: social interaction with peers, physical interaction with instruments, group work, autonomy from the teacher, freedom to explore and ask questions, moving out of the set classroom environment and personal interaction with the teacher. Thus the learners perceived their input as relevant and were motivated to learn. They also perceived the teacher as being interested in them as individuals.

These findings support the theories of Bruner (1966), Ausubel (1968) and Vygotsky (1978). Other research evidence that supports the learners’ perceptions is that of Kinzie (1989: 13). He claimed that, when instruction incorporates learner-controlled features, learners will be more autonomous, ask more questions, and participate in more conceptually based information exchanges than learners in traditional classrooms. Learners who perceive that they are in control of their learning tend to be more motivated.

In their remarks and comments, learners also associated learner-centred methods with group-work and co-operative learning. A survey involving an analysis of 122 studies (Johnson, Johnson and Smith, 1981) showed that co-operative learning approaches show more positive results on student achievement than other methods. Fraser (1994: 506) also found that co-operative learning was more successful than competitive or individualistic learning. Nevertheless, there are many studies in this field that showed mixed results.
Thus Fraser (1994) reiterates that results in this area are not conclusive and generalisable. This could be because the factors that affect an individual are multi-layered and involve both extrinsic factors (e.g. the curriculum, society, education etc.) and intrinsic factors (e.g. the personality of the individual). Thus, in analysing the qualitative results, one has to keep in mind the many factors that affect an individual's perceptions and choices.

The majority of learners in this Cape Town study did not prefer methods of teaching where the teacher was in constant control, talking and explaining throughout the lesson, giving instruction, always asking questions and generally having a tight reign in the classroom. They associated teacher-centred instruction with a restrictive learning environment that made them feel demotivated.

In Cape Town the degree of teacher involvement in the lesson appeared to influence learners' decisions as to how they perceived the subject. Lessons in which the teacher was predominantly in control, allowing for little interaction or input by the learner, were perceived to be teacher-centred. Many learners preferred neither this type of teaching nor methods that were associated with the teacher being in control throughout the lesson. This type of learning frequently restricts deep involvement by the learners, and it can lead to little motivation in the subject (Gibbs and Habeshaw, 1989: 17). This South African result is supported by similar findings reported by McRobbie and Tobin (1990); McRobbie and Tobin (1997) and Hanrahan (1998) in Australia.

5.2.2 Learners preferred mainly teacher-centred methods of assessment

The results are inconsistent with the proposal by the Department of Education that learners must undergo a "paradigm shift" (Moll, 2002:7) from traditional to learner-centred approaches in assessment. Also, a variety of assessment methods must be used to accomplish proposed outcomes (WCED, 2002: 4), but the Cape Town learners still preferred traditional methods of being assessed in biology. These learners felt that it would help them prepare for the examination.

Learners perceived that teacher-centred methods would give them more guidance during assessment exercises and lead to the "right answers". They also perceived assessment as
a means of preparing them for the June and December examinations, and methods like revision tests would speed up the preparation.

One recent study devoted entirely to low attaining students, and to students with learning disabilities, showed that frequent assessment feedback helps both groups enhance their learning (Fuchs et al. 1997: 540). Furthermore, Black and Wiliam (1998:4) stated that we would be able to motivate learners in the classroom, by frequently exposing them to a variety of assessment methods.

Black and Wiliam (1998: 8) also stated, “...a number of pupils...are content to ‘get by’...”. Where the classroom culture focuses on ‘gold stars’, grades or place-in-the-class ranking, then pupils look for the ways to obtain the best marks rather than the needs for their learning which these marks ought to reflect. This results in rote learning (Slavin, 1994: 213) and a surface approach to learning (Gibbs and Habeshaw, 1989). It seems that many learners in this Cape Town study seemed to adopt this attitude. Some of their qualitative comments will be described below to support this interpretation.

The problem is exacerbated by the fact that the learners seemed to have favoured methods that they perceived as “easy”, e.g. revision tests, multiple choice tests and open-book examinations, because they needed little preparation. They seemed to have avoided methods of assessment that they perceived to be “difficult”, e.g. essays, daily worksheets and orals. These methods mainly required extensive research and synthesis of knowledge. From the qualitative responses of the learners, it seemed that many of them were reluctant to try new methods, out of fear of failure. These learners felt demotivated and insecure when encountering difficult tasks. Black and Wiliam (1998: 9) stated that pupils who encounter difficulties and poor results are led to believe that they lack ability, and this belief leads them to attribute their difficulties to a defect in themselves. They will “retire hurt” and avoid interest in learning, focussing on other ways to boost their self-esteem Black and Wiliam (1998: 10).

High achievers, on the other hand, can do well in a very mark-orientated culture, but the overall result is that the frequency and extent of underachievement is enhanced.
5.3 Survey 1: discussion of the quantitative and qualitative findings

5.3.1 Discussion of the quantitative findings: methods of teaching

Learner-centred teaching tends to be preferred by the learners

In Chapter 4, Table 4.1 presented the learners’ most and least preferred methods of teaching in biology; after which these methods were re-grouped into teacher-centred and learner-centred methods of teaching in biology in Table 4.3. Using the same classification method as in section 4.3 (Table 4.3), it is further discovered that the methods chosen by the 911 learners as their most favoured methods of being taught biology tend to be learner-centred methods of being taught biology. This new theme is shown in Table 5.1 below.
Table 5.1: The rankings and locus of control of the methods in Table 4.1 showing only the most preferred methods of being taught biology for survey 1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Method</th>
<th>Teacher-centred (T) / Learner-centred (L) / Unsure/ neutral (UN)</th>
<th>No. of respondents' votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Biology outings</td>
<td>L</td>
<td>478</td>
</tr>
<tr>
<td>1</td>
<td>Experiments</td>
<td>L</td>
<td>191</td>
</tr>
<tr>
<td>5</td>
<td>Computers</td>
<td>L</td>
<td>145</td>
</tr>
<tr>
<td>9</td>
<td>Biology videos</td>
<td>UN</td>
<td>121</td>
</tr>
<tr>
<td>10</td>
<td>Biology games</td>
<td>UN</td>
<td>112</td>
</tr>
<tr>
<td>4</td>
<td>Class discussions</td>
<td>L</td>
<td>92</td>
</tr>
<tr>
<td>11</td>
<td>Creative materials</td>
<td>L</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td>Biology projects</td>
<td>L</td>
<td>81</td>
</tr>
<tr>
<td>14</td>
<td>Everyday life situations</td>
<td>UN</td>
<td>59</td>
</tr>
<tr>
<td>6</td>
<td>Worksheets (weekly)</td>
<td>T</td>
<td>55</td>
</tr>
<tr>
<td>15</td>
<td>Visual materials</td>
<td>T</td>
<td>42</td>
</tr>
<tr>
<td>13</td>
<td>Problem solving</td>
<td>L</td>
<td>26</td>
</tr>
<tr>
<td>16</td>
<td>Textbook summaries</td>
<td>T</td>
<td>26</td>
</tr>
<tr>
<td>12</td>
<td>Investigations</td>
<td>L</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Demonstrations</td>
<td>T</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>Teacher in charge</td>
<td>T</td>
<td>16</td>
</tr>
</tbody>
</table>

This trend is supported by the findings recorded in Table 4.3, which showed that 65.2% of the learners preferred to be taught using learner-centred methods in biology, while only 10.2% of the learners preferred teacher-centred methods of being taught biology. The remainder (24.3%) were undecided or neutral as to which method they preferred for being taught.

Table 5.1 (and Table 4.1) show that the methods of teaching most preferred by the learners were also classified as learner-centred, i.e. biology outings (478 responses), experiments (191 responses) and computers (145 responses). This finding provides evidence to support the learner-centred preference theories of educational psychologists Kinzie (1989) and Tobin et al. (1990) as discussed in the next section. By contrast, the three methods of teaching that were least preferred (Table 4.1) were classified as teacher-centred, i.e. teacher-in-charge (389 negative responses), textbook summaries.
(386 negative responses) and investigations (186 negative responses). This finding offers evidence in support of the educational theories of Brady (1985) and Slavin (1994) as discussed in the next section. Therefore, the 911 responses did not favour all 16 methods of being taught biology equally.

To ascertain whether there were significant differences in the preferences of certain teaching methods at different schools, chi-square analyses were performed using pairs of frequencies in Table 4.5. The most prominent differences and distinctive trends were presented in Table 4.7 and Figures 4.1, 4.2 and 4.3.

Figure 4.1 on page 86 showed that, regarding the methods of teaching that the learners preferred the most, schools 1 and 7 showed a significantly lower relative preference for computers. These results are interesting since both these schools have well-established computer departments as well as advanced technological equipment, so their use might be perceived as merely routine.

Figures 4.2 and 4.3 on page 87 showed that, of the methods of teaching that the learners preferred the least, school 6 showed a significantly higher preference for teacher-in-charge (Figure 4.2) compared to the other schools, while school 8 (Figure 4.3) showed a significantly higher preference for textbook summaries compared to the other schools. These results will be discussed in detail in the following section.

5.3.2 Discussion of the qualitative findings: methods of teaching

A qualitative analysis of the categories or themes emerging from the comments of the learners for survey 1: How would you prefer to be taught biology? is summarised in section 4.6.3. Chapter 4 suggests that the learners prefer and feel motivated by learner-centred methods of teaching.

In the section 5.3.3, I will focus on which instructional methods were perceived to be most and least effective for facilitating desired outcomes. I will refer to the theories of learning described in Chapter 2 to explain some of the data.
5.3.3 Most and least preferred methods of teaching and assessment

The frequencies with which the different activities were cited as the three most liked and the three least liked were summarised in Tables 4.1 and 4.2 in Chapter 4.

When interpreting these results statistically, it should be noted that a choice of two in 16 responses (for survey 1) and two in 18 responses (for survey 2) can occur merely from chances of just over 12.5% and 11.1% respectively, for those methods being chosen randomly. For this reason, only these activities scoring appreciably above those percentages are of interest. Also, a very low percentage of learners listing a particular activity as one of their two favoured activities does not necessarily imply that learners dislike the particular activity. Equally, it may mean that they are neutral toward such an activity, including the possibility that they did not fully understand the supplied description of the activity in the questionnaire. The very low frequencies among the favoured activities in teaching and assessment are not discussed here.

Furthermore, if a majority of learners did not prefer a particular method of teaching or assessment, this does not mean that these methods of teaching should be discarded. It may imply either that the teacher could try to change the way this method is presented to the class to increase its popularity; or that it is being overused, and should be incorporated perhaps only occasionally into lessons (where it can be used in the appropriate context).

It is also expected that all learners would not prefer the same methods of being taught. This is because different learners may have different learning styles (e.g. Kolb, 1984; and Thompson, 1997) and multiple intelligences (Gardner, 1983), as discussed in Chapter 2 and below.

In Chapter 4 (section 4.2) learners were asked to explain why they liked certain activities most, and why they disliked other activities. The three activities that they preferred the most and least (survey 1) are now discussed below.
• **Biology outings as the most preferred method of learning biology**

Learners perceived *biology outings* to be a learner-centred method (Table 5.1), and they also tended to prefer it to the other methods of being taught biology.

Table 4.1 showed that 478 of the respondents chose *biology outings* as one of their two preferred methods of being taught biology, while 14 learners did not choose this method. Their reasons for choosing *biology outings* as their favourite method were mainly for the social interaction, group work, enjoyment and movement away from teacher-centred teaching that it allowed.

Almost all the favourable responses mentioned that *biology outings* encourage learners to pool their ideas and learn from one another. They also realised the social benefits of learning in a group, as in the comment, "We can share all our ideas and opinions about the topic being studied". In a study in Israel, Kempa and Orion (1996:35) reported that pupils gave a high degree of support to studying in groups when doing fieldwork. However, when the learners were asked how much they learnt in a group during their fieldwork activity, they judged the extent of their learning to be very low. Clearly, pupils enjoy working in the field and in groups. They did, however, have reservations as to whether learning has taken place. The learners associated true learning with a structured classroom environment. The unstructured learning environment on *biology outings*, did not convince them that they could enjoy themselves and learn.

Such reasons have been given by teachers of environmental education in the countries of Belize and Cameroon for avoiding working in the field (Niblock, 1997 cited in Lock, 1998a :636). In the present study, learners in Cape Town approve fieldwork, and they see it as an effective teaching method, but further research should be done to see whether teachers perceive *biology outings* in the same light as the learners. Effectiveness may depend on how they are structured for teaching instructional content, in addition to attitudes and values.

Learners also believed that interaction was a very important component of biological studies. They preferred lessons that were "hands-on", "visually stimulating" and
"memorable", like Kolb's accommodators and divergers. Further comments like "We are able to feel, touch and interact with living plants and animals" and "Biology is the study of life, therefore we must experience real things" support the above statement. Killerman (1996: 334) also found that fieldwork had a positive effect on learners’ attitude toward the environment. The study concluded that fieldwork enhanced pupils knowledge and awareness of ecology.

Other international studies however, showed that fieldwork might not always be an effective method to teach biology - for example, in Cameroon (Niblock, 1997 cited in Lock, 1998a: 637), and in England and Wales (Adkins & Lock, 1994: 50). A questionnaire-based study of 200 school biology departments in England and Wales found that less biology fieldwork was being taught to 15 and 16 year olds than in previous years (Killerman, 1996: 335). Two reasons cited were, timetable pressures and the lack of confidence displayed by the older learners.

A large percentage of the comments in Cape Town suggest that learners would like to learn about topics that would be relevant - i.e. that relate to everyday life situations. They feel that biology outings provide this opportunity and enable them to "see the bigger picture" of what they learn in the classroom. They would also be able to do investigations, worksheets, oral presentations etc., on topics that are relevant and interesting to them.

Many learners remarked that "too much teacher talk" and "always learning from textbooks" was boring and uninteresting, and through biology outings they could avoid such boredom in the classroom. Lock (1998a: 635) stated that learners who know that they are going to work outside the classroom are intrinsically motivated. Furthermore, group work is "fun" and they perceive biology outings as "biology in action".

In this Cape Town study, 14 of the learners did not prefer biology outings as a teaching method. This is expected since different learners usually have different learning styles (Kolb, 1984 and Thompson, 1997). Some learners indicated that they felt uncertainty about the usefulness of the outcomes of biology outings, exemplified by the statements, "I like biology outings least because you cannot know if you know the correct thing or not" and "......Some people do not take biology outings seriously and do not work - they simply play around......". These learners also resented the lack of guidance during their
These learners probably required more guidance and support during fieldtrips. They required an assisted learning approach to biology outings (Ausbuehl, 1968).

Many of these learners used social arguments as their reasons for not liking biology outings. For example, "Many of the class members do nothing and take information from those who work during the outing" and "I do not like biology outings because I don't like working in a group". Though they did acknowledge that the exercises they did in the field were meaningful and worthwhile (e.g. worksheets, practical work, investigations etc.), these learners seemed to have problems with learners who did not contribute during teamwork.

- **Experiments as a preferred method of learning biology**

Learners tended to perceived experiments to be a learner-centred method of being taught biology (Table 5.1). They also selected this to be one of their favourite methods of being taught biology.

Table 4.1 showed that 191 of the respondents chose experiments as one of the two preferred methods of being taught biology, while only 26 learners did not choose this method. Their reasons for choosing experiments as their favourite method were similar to those for biology outings, i.e. they preferred the interaction and the enjoyment that the method allowed, like Kolb's convergers and accommodators.

Almost all favourable responses mentioned that experiments enabled learners to work with microscopes, chemicals, models and even live organisms. This allowed for "hands-on" experience and therefore perceived learning. Both interactive and constructivist learning in science are supported by many authors internationally (e.g. Driver and Oldham, 1986; Leach and Scott, 2000) and locally (e.g. Malcolm et al., 1999; WCED, 1999; WCED, 2000). This type of interactive learning is intrinsically motivating to many learners and helps learners to understand and remember work (Pintrich and De Groot, 1990: 33).
Most learners also pointed out that they preferred this method because it enabled them to move away from the teacher-centred "teacher talking throughout the lesson", as well as "doing experiments from the textbook". Many of the other responses were similar to those expressed in biology outings.

- **Computers as a preferred method of being taught biology**

Most learners perceived **computers** to be a learner-centred method (Table 5.1) and also chose this method as one of their favourite methods of being taught biology. Table 4.1 showed that 145 of the respondents chose **computers** as a preferred method of being taught biology, while 47 learners did not choose this method. Their reasons for choosing computers as their favourite method were varied.

They preferred this method since it allowed direct **interaction** with the information the computer gave them. This is clear from their responses such as: "We are able to interact with colourful pictures and examples" and "There is a wealth of information on the internet". This type of interaction allowed them to steer away from the **teacher-centred** lessons to which some of the learners had been exposed. Some learners commented that, "All the work on the computer is performed by us and not the teacher" and "I think that it is definitely a vast improvement than older teaching methods". This result is supported by studies of Roblyer (1999: 157) and Edwards and Fritz (1997: 17), who found that learners enjoyed the control of the pace of their learning and were thus self-motivated.

The learners also appreciated the fact that, when they researched the information, they would be exposed to updated information that was easy to find. They commented that "You get updated information quicker and easier" and "Software packages gave me a better understanding of biology". Many learners also felt that not only would they be exposed to a wealth of the latest information, but knowing basic computer skills has a **positive impact on their future**. One learner commented that, "You will be taught how to use a computer which will one day help us when we are looking for a job".

Those learners who did not prefer this method of being taught biology generally responded that they did not like **computers** because they were **not user-friendly**.
Therefore they became anxious. This finding is supported by the studies of McMahon et al. (1999:302) and Carr (2000: 32), who found that learners became anxious when they were not experienced with using the computer, and thus perceived the computer as difficult to use. It was also found that more experienced learners, i.e. those who have computers at home, experienced less computer anxiety. Ropps' (1999) review of the literature concluded that most research into computer anxiety showed similar results.

The difficulty experienced by some respondents in accessing the relevant information was frustrating. Comments occurred like, "Computers take too long and, when information is found, it is usually too much, unnecessary or the wrong topic". Other learners perceived computer work to be boring since it allowed little interaction. Some examples of their comments were, "Doing computers is boring" and "The computer is doing the work for us, we have to do nothing". Harrell (1999: 268) also found that many learners complained that the periodic slowness of the internet and server problems made learning frustrating.

An added difficulty with computers as a method of teaching was that many learners felt that interaction with the computer screen was limiting. They preferred human contact. Previous research has shown that some learners who work on-line report feelings of isolation and loneliness. They miss the social contact and face-to-face interaction. These types of learners might lack self-motivation and may eventually dislike the work (Harrell, 1999: 270).

These responses were prevalent among the learners in schools 1 and 7. These schools have excellent computer facilities and well-established computer departments. However they showed low preferences for computers as a teaching subject. Using separate personal interviews with learners and the teacher in school 1, I tried to determine the reasons for their low interest in the computer-based lessons. It was found that the learners perceived the teacher to be authoritarian in his teaching and to be de-motivated in most lessons. They indicated that they were not able to extend themselves in lessons and perceived the lessons as "boring". They expressed feelings of isolation (e.g. c/f Harrell, 1999), frustration with technical problems (c/f Harrell, 1999; Ropps, 1999) and computer anxiety (c/f McMahon et al., 1999 and Carr, 2000).
Some learners, because they were advanced in their computer skills due to having access to computers at home (c/f Ropps, 1999), felt frustrated that they could not progress with their computer skills since the teacher taught at a slow pace.

School 7 would not allow the researcher to conduct personal or recorded interviews with the learners.

- **Other methods of teaching favoured by learners**

Many learners perceived biology videos and biology games as favoured methods of being taught biology. They said that they preferred these methods because they allowed them to put some fun into the lessons. It seemed that the learners perceived that these methods should not be taken too seriously. They were simply there to fill in time during lessons. Their general comments were that, "The method is interesting, since it takes us away from the normal teaching routine".

However, learners can take these methods seriously if they are managed properly. For example, Sherwood (1991: 310) claimed that games could be an effective tool in the OBE classroom if implemented properly. They are effective in developing problem-solving, social interaction, research and creativity. Alessi and Trollip (1991:55) claimed that games can be intrinsically motivating, while Jones (1997: 2) claimed that a game can be short but can offer long-term rewards.

- **Teacher-in-charge was not usually a preferred method of being taught biology**

The responses of many learners indicated that they gained a better understanding by ‘doing’, rather than ‘listening’ to the teacher throughout the lesson. If a teacher used this method exclusively, some learners perceived the lessons as tedious (e.g. using comments like, “A teacher must not talk through a lesson since it makes the lesson boring and uninteresting”). This perception might also filter into their perception of the subject as a whole, e.g. “If the teacher talks through the lesson, we lose interest and begin to dislike the subject".
Dlamini et al. (1996: 223) stated that a possible reason for the low interest in science as a subject – especially in African countries - is the student perception of these subjects. Lockheed and Kormer (1989: 101), cited in Dlamini et al. (1996: 224), stated that students' perceptions of their school subjects played an important role in their subject choice in African countries as well as in the industrialised world. In the latter, gender differences in subject choices have been convincingly established. In this study, further research has to be done to determine whether there are gender differences when using the instructional method of teacher in charge. This study did not focus on gender differences.

However, the present study does indicate that, when teaching biology at the classroom level, using this method exclusively is detrimental to the motivation of many of the learners. This result is consistent with the findings of McRobbie and Tobin (1997) and Hanrahan (1998). There are some learners who did prefer this method, and it should be said that this method could be used in the classroom, if it is used in the proper context.

A school-by-school comparison of the 16 methods of being taught biology revealed that school 6 showed a significantly higher preference for teacher in charge as a method of being taught biology (Figure 4.2 on page 87). This was an interesting result, since the learners in this school perceived the teacher to be an accepted authority figure and enjoyed the guidance that the teacher was able to offer them. The learners were from a private boys high school, and this small sample that was studied was mainly from grade 8. The ethos of the school was that one respects the teacher. A personal interview with the learners indicated that the boys enjoyed his lessons. The learners found him to be innovative and interesting, since he was always willing to listen to them and try “new” methods. The teacher had a good rapport with the learners and enjoyed lessons with this class because it was small and manageable. He enjoyed teaching biology and has been teaching it for the past five years.

Though some learners did perceive teachers who constantly read out of textbooks during teaching to be “boring”, they respected the role of the teacher in the classroom and conceded that it was the teacher who transferred the knowledge to them.
Textbook summaries was not usually a preferred method of being taught biology

Many learners explained that textbook summaries did not help them gain a better understanding of biological concepts.

The learners seemed to perceive this method as difficult, since inherently they tended to concentrate on perfecting their writing skills and not on understanding the concept. Comments like, "Learners lack the necessary skills to summarise information" support this statement. Thus, the learning process was tenuous and little real concept formation appeared to be taking place when summarising from a textbook.

This seems to be a real problem in disadvantaged schools. Naidoo (2000: 99) states that learners from disadvantaged schools in South Africa have under-developed reading skills and therefore struggle with comprehension exercises. This problem is exacerbated by the fact that the natural science curriculum is overloaded with complex terms. In the biology classroom, there is little time to interact with texts. Learners who summarise textbook content usually end up with work that consists of the uncritical reproduction of text, and many of these learners are not able to organise or synthesise information (Dole et al., 1991: 260).

Furthermore, many learners commented that this method presented very little learning because there was no interaction with the work that was being summarised. The implication of the majority of the learners' comments was that they would rather prefer "doing" than sitting and "writing out information that was already in the textbook". They also felt that experimentation would bring across the point more clearly.

Some learners clearly indicated that they did not prefer this method because they were not interested in reading more from the textbook – even to contribute to their existing knowledge. There were possibly two reasons why learners did not want to read around the topic. Firstly it could be because they were lazy; or because they had become so demotivated in the subject that they had no interest in making the effort to gain knowledge from sources other than the teacher.
A school-by-school comparison of the selections of the 16 methods of being taught biology showed that school 8 showed a significantly higher preference for textbook summaries as a method of being taught biology (Figure 4.3 page 87). This was an interesting result, since the learners at this school came from a low socio-economic background and lacked the motivation to learn. Some learners clearly stated that they did not enjoy reading and that, in their view, this method of teaching was outdated. A personal interview with the teacher at the school indicated that the learners hated this method because they were exposed to it so frequently, not only in biology, but in other subjects as well. They also lacked science laboratories and equipment to do practical work. The work ethic in the class was low, and learners appeared to have a discipline problem. The teacher stated that, “Teaching is difficult, and getting the learners to read and summarise information is near impossible”.

An added problem was that the classes were large (between 60 to 70 learners). There were also gang-related discipline problems, and general demotivation amongst the learners due to social factors. Even if the learners wanted to read and summarise work, it would not have been possible because of the constant disruption and lack of discipline.

Other methods not preferred by learners

Many learners in this Cape Town study did not prefer investigative activities and this result is consistent with that of Dlamini et al. (1996). This study, conducted in Swaziland, found that when given a choice of teaching methods, learners preferred interactive methods like experiments, groupwork and interactive approaches. They did not perceive investigations as interactive.

In this study, many learners perceived investigations as meaningless and commented that they were “a waste of time”. They focussed on their uncertainty about the correctness of their experimental planning. As a learning method investigations did not give them the confidence to work independently. For example, comments included, “We do not understand the question” and “We do not know if we are doing the right thing”. Also, they were not interested in methods that required planning experiments, thinking and independent work and they perceived investigations as this type of instruction.
However, the few learners who did prefer this method commented that it encouraged independent thinking, and that it prevented the teacher from "taking over the class".

Another method not preferred by many of the learners was demonstrations. They claimed that it did not give them opportunities to become actively involved in learning. They were also not able to handle the apparatus, which activity they would prefer rather than watching the teacher perform the experiments. They favoured being actively involved in the experiment, to allow them to learn more. Comments like, "It would be fun to see if experiments work without the teacher telling us" also support this interpretation.

5.4 Survey 2: discussion of the quantitative and qualitative findings

5.4.1 Discussion of quantitative findings: methods of assessment

Teacher-centred assessment is preferred by the learners

In Chapter 4, Table 4.2 presented the most and least preferred methods of assessment in biology, while in Table 4.4 these methods were classified into teacher-centred and learner-centred methods of teaching biology. If one uses the same classification method as in section 4.3 (Table 4.4), it is found that the method that the learners had chosen to be their most favoured method of being assessed in biology was item 12. This is shown in Table 5.2 below.
Table 5.2: The rankings and locus of control of the methods in Table 4.2 showing only the most preferred methods of being assessed in biology for survey 2.

<table>
<thead>
<tr>
<th>Item</th>
<th>Method</th>
<th>Teacher-centred (T) / Learner-centred (L) / Unsure/neutral (UN)</th>
<th>No. of respondents' votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Revision tests</td>
<td>T</td>
<td>282</td>
</tr>
<tr>
<td>14</td>
<td>Open-book examinations</td>
<td>L</td>
<td>269</td>
</tr>
<tr>
<td>16</td>
<td>Multiple choice tests</td>
<td>T</td>
<td>192</td>
</tr>
<tr>
<td>3</td>
<td>Biology projects</td>
<td>L</td>
<td>187</td>
</tr>
<tr>
<td>2</td>
<td>Class tests</td>
<td>T</td>
<td>182</td>
</tr>
<tr>
<td>15</td>
<td>Picture tests</td>
<td>T</td>
<td>151</td>
</tr>
<tr>
<td>7</td>
<td>Portfolios</td>
<td>L</td>
<td>144</td>
</tr>
<tr>
<td>13</td>
<td>Class involvement mark</td>
<td>L</td>
<td>118</td>
</tr>
<tr>
<td>17</td>
<td>Oral presentations</td>
<td>L</td>
<td>108</td>
</tr>
<tr>
<td>1</td>
<td>Examinations</td>
<td>T</td>
<td>101</td>
</tr>
<tr>
<td>8</td>
<td>Problem-solving questions</td>
<td>L</td>
<td>78</td>
</tr>
<tr>
<td>4</td>
<td>Worksheets (weekly)</td>
<td>T</td>
<td>68</td>
</tr>
<tr>
<td>6</td>
<td>Biology practicals</td>
<td>U</td>
<td>68</td>
</tr>
<tr>
<td>10</td>
<td>Mini-essays</td>
<td>U</td>
<td>52</td>
</tr>
<tr>
<td>18</td>
<td>Oral examinations</td>
<td>U</td>
<td>37</td>
</tr>
<tr>
<td>9</td>
<td>Reviews</td>
<td>L</td>
<td>36</td>
</tr>
<tr>
<td>5</td>
<td>Worksheets (daily)</td>
<td>T</td>
<td>32</td>
</tr>
<tr>
<td>11</td>
<td>Essays (two-page)</td>
<td>T</td>
<td>25</td>
</tr>
</tbody>
</table>

This result is supported by Table 4.4, which showed that 48.3% of the learners preferred to be assessed using teacher-centred methods in biology, while 44.1% of the learners’ least preferred methods of being assessed biology were learner-centred. The rest (7.3%) were undecided or neutral as to which assessment method they preferred in biology.

Tables 4.2 and 5.2 show that the three methods of assessment most preferred by the learners were classified as a mixture of teacher-centred and learner-centred responses, i.e. revision tests (282 responses), open book examinations (269 responses) and multiple choice tests (192 responses). However, the three methods of assessment least preferred by the learners were two-page essays (438 negative responses), oral examinations (274 negative responses) and oral presentations (245 negative responses).
The learners seemed to be more careful in choosing how they preferred to be assessed in biology; hence the mixture of learner- and teacher-centred responses. This suggests that the learners were more cautious in their consideration of how they would prefer to be assessed in biology. They might perceive assessment as more important than how they are taught in biology. Perhaps this could be due to the fact that their progress marks are made public to teachers, parents and friends, but not their learning methods. In this Cape Town study the teachers at the eight schools studied were reluctant to hand over copies of the learners’ results. Thus, this analysis was not included in the study.

The findings also suggest that, when being taught the learners would opt for methods that might allow them to be independent in their learning. However, they might also prefer teacher-led guidance and constant monitoring of their progress when being assessed in biology. Methods that involved testing their knowledge seemed to be favoured by them (e.g. open-book examinations, multiple choice tests, class tests, picture tests).

5.4.2 Discussion of the qualitative findings: methods of assessment

A qualitative analysis of the categories or themes emerging from the comments of the learners for survey 2: “How would you prefer to be assessed in biology?” is summarised in section 4.6.3 in Chapter 4 on page 104.

Below are detailed qualitative reasons why learners preferred or did not prefer methods of assessment.

• **Revision tests as the most preferred method of being assessed in biology**

In Table 5.2, revision tests were perceived as being very important in learning. Revision involves the learners repeating and re-examining a unit of teaching, and it is directed toward achieving a stronger understanding of concepts, eliminating misconceptions, and acquiring greater clarity (Brady, 1985: 32). This type of assessment follows the theoretical foundations for the behavioural learning theory of drill and practice (Brady, 1985: 33).
The learners said they preferred this method because the revision of work they had covered earlier would help them “remember” and “understand” the work. With the teacher’s constant guidance, it clarified the work for them and it helped them “prepare” for the examination. This built their confidence and motivated them. Learners in all eight schools felt this way. These results suggest that many learners in this study still have the mindset that they need to be assessed in a way that would help them get “good marks” and they did not experience the “paradigm shift” proposed by the policy documents (WCED, 2000; Moll, 2002:7).

Comments like: “It would help us prepare for the June and December examinations” and “It would give us confidence in a section of work” were common among learners in all eight schools studied – even though they all came from different socio-economic backgrounds.

Constant input and guidance from the teacher were also a form of motivation for the learners. Comments like, “Revision tests motivate the learner to keep up to date with the work” and “...It acts as a guide as to how the teacher will ask questions during the examination”, showed that the learners valued teacher input in their learning. This result is consistent with a review of studies performed by Black and Wiliam (1998) and Fuchs et al. (1997), who found that frequent assessment feedback enhances the learning of low attaining learners and those with learning disabilities.

The learners also perceived assessment by examinations as a motivator to study, even though they did not consider this item to be very popular when they were given a range of choice of methods of assessment (Table 4.2). However, with the progression of OBE in the school system, examinations will be discarded which might result in learners having little or no motivation for long-term achievement goals.

Black and Wiliam (1998:13) stated that some pupils would resist attempts to change accustomed routines, for any such change is threatening. Also, emphasis on the challenge to think for oneself (and not just work harder) can be disturbing to many. Learners cannot be expected to believe in the value of changes for their learning before they have experienced the benefits of change. What is needed is a classroom culture of questioning and deep thinking in which pupils will learn from shared discussions with
teachers and from one another. The teacher will play an important role in initiating this type of change (Black and Wiliam, 1998: 13).

An important feature of a motivated learner is involvement, commitment and enthusiasm (Hanrahan, 1998). Unmotivated learners do not necessarily understand their work, they simply tend to memorise it. Learners want to prepare for the examination through revision tests by wanting to know only what is relevant for the examination. It seems that many learners do not seek a broader application of the knowledge.

- **Learners also preferred assessment through open-book examinations and multiple choice tests**

In the present study, the learners' perceptions of open-book examinations and multiple choice questions (Table 5.2) were similar. They perceived these methods as means of improving their marks, without too much learning pressure on them. Using open-book examinations, the learners commented that they would “not have to memorise work in preparation for the final examination”. This would make them less nervous. Multiple choice tests, on the other hand, would allow them to avoid “writing long sentences”, which many of the learners (in all eight schools) did not prefer.

However, the perceptions of learners in Cape Town of these two methods, and the findings reported in the earlier literature are completely opposite. For example, many of the learners in the present study perceive open-book examinations to be easy, since they have the theory in front of them. However (Mohanan, 2002) claims that this is not a soft option; rather it will test the ability of the learners to process and use information and to deliver well-structured and well-presented arguments and solutions. Also, marking will be more rigorous (Mohanan, 2002). What might be considered a good answer in a traditional examination might be judged as mediocre in an open-book examination. Thus, in this Cape Town study, teachers could make and set out clear guidelines as to what they expect when they use this method as an assessment tool.

Multiple choice tests, on the other hand, are not necessarily as objective as some teachers think they are, since humans set the tests. The learners said they did not want to express
themselves in "long sentences", but most researchers agree that multiple choice items are poor tools for measuring the ability to synthesise and evaluate higher order information or apply knowledge to complex problems (Fairtest, 2002).

Some learners did not perceive open-book examinations and multiple choice tests as beneficial. They commented that these methods were not "mentally stimulating" and could lead to "guessing". Some learners do indulge in "multiple guessing" (Fairtest, 2002). Thus it is harder to recall open-ended questions, because it is more difficult to recall answers than recognise them. Furthermore, McRobbie and Tobin (1997: 78) claimed that learners may have selected out these methods as a "short cut" to help them improve their marks. Therefore, their perception of the school system is to find the easiest route that would be beneficial to them.

To change the learners' outlook on learning, the teacher will have to take risks in the belief that time will yield rewards in the future, whilst 'delivery' and 'coverage' are pointless and even harmful (Black and Wiliam, 1998: 13). The teacher must change the nature and beliefs about learning. If the teacher believes that knowledge is to be transmitted and learnt, that understanding will develop later, and that clarity of exposition accompanied by rewards for patient reception are essentials of good teaching, then learners will think in this way (Tobin et al., 1990: 99). However, if teachers accept the wealth of evidence that the transmission model does not work, then the commitment must be to teaching through interaction to develop each learner's ability to incorporate new facts and ideas (Black and Wiliam, 1998: 13).

- **Learners usually did not prefer two-page essays**

The assessment method which many learners in all eight schools strongly opposed was evaluation by means of two-page essays (Table 5.2). They perceived this form of assessment as being teacher-centred - and this could partly be a reason why they did not prefer this method. Some learners commented that they "did not understand" the question, while others "did not like to express themselves in long sentences".
Alternatively, learners may have been strongly opposed to this method because of the high level of cognitive development that is required to synthesise information in essay writing (Van Huysteen, 1979: 47; Degenaar, 1985: 271). This skill takes a lot of practice as well as a deeper understanding of the knowledge - which many of the learners did not manifest. Also, it could be that the formulation of the essay question was not distinct. Some learners commented that "we did not understand what the teacher was looking for in answering the question". Degenaar (1985: 273) states that the formulation of the essay question must be in simple, unambiguous and understandable language so that the candidate knows what is expected and how to answer the question. The WCED (2002:11) advocates that these skills must be assessed, and a well-designed essay question is a good way to accomplish almost all the cognitive and thinking skills proposed by Bloom (1956).

Bloom (1956) suggested that there are six levels of cognitive attainment, ranging from simple recall or recognition of facts to more complex mental levels. Depending on the question set, I think that essay writing usually requires a combination of these cognitive skills - i.e. planning, organisation and preparation, construction of sentences and synthesis of facts. Teachers should set essay questions that would be suitable for the general developmental levels of the learners (Piaget, 1970), and also give them model essay questions and answers to help learners improve this skill.

- **Learners usually do not prefer assessing themselves through oral presentations and oral examinations**

Many learners were insecure about expressing themselves orally. Their main concern was that, if they did not have good communication skills, they would not be able to express themselves to the class, and their general comment was that they would "lose marks". Comments like, "...People get nervous and mess up" were common amongst the learners in all eight schools studies.

When learners express themselves orally, the dialogue with the teacher provides the opportunity for the teacher to respond to and re-orientate the pupils' thinking (Black and
Black and Wiliam (1998: 11) however, do caution that there are clearly recorded examples of discussions where teachers, quite unconsciously, responded in ways that would inhibit the future learning of the pupil. They found that teachers normally look for particular answers when they ask questions. Some teachers lack the flexibility or confidence to deal with the unexpected. Hence they try to direct the learners toward the answers, thus often sealing off thoughtful and unorthodox attempts to work out their answers. Over time, some learners will lose their confidence and probably fear speaking in public so that they will not say the wrong thing.

A school-by-school statistical comparison of the frequencies of responses towards these little favoured methods disclosed that school 6 showed a significantly higher preference for oral presentations and oral examinations. This might have been because of the small classes in which the learners already felt comfortable speaking frequently in front of the teacher.

- Other methods of assessment that learners did not prefer

Most learners did not favour methods that were repeated on a very frequent basis (e.g. daily worksheets), or where they were not directly test-related (e.g. biology practicals, mini-essays, reviews and problem-solving questions).

Almost all of the methods of teaching and assessment investigated in this study were methods to which the learners in all eight schools had been exposed. Learners in school 1 already had been practising the two modern Curriculum 2005 methods of assessment portfolios and class involvement mark. The rest of the learners apparently chose these methods of assessment purely on the definitions of these methods supplied in the questionnaire on assessment. Yet, surprisingly, these selected methods scored highly in the response rankings in Table 5.2 - even higher than examinations to which many of the learners had been exposed throughout their school careers.

Therefore, it seems that the learners may have been thoughtful and particularly careful about their choices of methods on how they would prefer to be assessed in biology.
5.5 Discussion of hypotheses

Although the eight schools studied were diverse in their cultural and socio-economic backgrounds, gender, ethos, ability of the learners, etc., yet it was found that the majority of learners at the different schools were similar in their common perceptions of how they preferred to be taught and assessed in biology.

Very few appreciable differences between schools were recorded in how the learners preferred the various methods of teaching. There were more differences on how they preferred to be assessed in biology at the different schools. The differences could be due to learners' particular experiences of being taught these methods at the different schools. Differences in teachers' teaching styles, learners' learning style preferences and learners' types of intelligences could be some of the factors that might have contributed toward the learners' perceived differences in the schools.

Four hypotheses were chosen and tested. Hypotheses one and three were tested to determine whether learners preferred all methods of teaching and assessment equally, collectively or school-by-school.

Hypotheses two and four tested whether the preferences of methods of teaching and assessment were due to the differences in the schools themselves. The results of the hypotheses are explained and discussed below.

5.5.1 Survey 1

**Hypothesis 1**: Given a choice of 16 different methods of teaching in the biology classroom, all methods will tend to be preferred equally by samples of 911 learners drawn from eight diverse schools: a) collectively

b) compared school by school

The lengths of exposure of the eight schools to computers varied, but was most advanced for schools 1 and 7. Thus, one can conclude from the present study in Cape Town that
teachers should be aware that learners not exposed to computers as a teaching method might have to overcome hurdles like computer frustration e.g. Harrell (1999) and computer anxiety McMahon et al. (1999), before they are able to progress with their computer skills. This has implications for the implementation of computers as a method of teaching in biology.

School 6 showed a significantly higher preference for teacher in charge as a teaching method. Personal interviews with the learners indicated that they valued the opinions of the teacher and felt that they needed the teacher’s constant guidance in their teaching. However, this school was very small (n=50) with very small classes (n=15) and the learners that were surveyed were grade 8 and 9 learners. Thus, their lower age might be the reason why they were so dependent on the teacher’s constant guidance and input. Further research might be done in this area, and it could be explored whether learner’s dependence on teacher’s guidance is age-specific. This result, however, is not conclusive due to the small sample size in this school.

School 8 showed a significantly higher preference for textbook summaries as a method of teaching. A personal interview with the teacher at the school suggested that the learners preferred this method because they came from a disadvantaged socio-economic background and had very little laboratory equipment; thus their teachers tended to spend more time using the textbook in their teaching. They were exposed to few other methods of teaching.

Hypothesis 2: That learners’ preferences for different forms of teaching will be independent of the nature of the school i.e. its ethos, philosophy, purpose, aims, size, composition etc.

For survey 1, hypothesis 2 was partly supported. Most learners from different schools preferred similar teaching methods, which could be due to their similar experiences of these throughout their common learning experiences. However, some learners preferred different teaching methods. This could be due to different reasons; for example, contextual reasons (different teaching environments) (e.g. Hanrahan, 1998; McRobbie, 1997) and personal reasons (different preferences and learning styles, e.g. Kolb, 1984). Each of the two reasons will be explained in more detail below.
Contextual reasons

Contextually, the teaching and learning environment probably influences the learners perception of a method. For example, the learners exposed to computers as a method of teaching in schools 1 and 7 were able to make clear judgements as to how they perceive the method. They were able to express clearly both their negative and positive feelings toward the method. However, the perceptions of the learners at the other schools, who had limited exposure to the method, were more positive.

Their successful experience with this method made them perceive computers as a mere tool in their learning; whereas the other schools, who did not have that much exposure, perceived the method to be very highly valued and recommended. They did not realise that there can be many technical and logistical problems associated with this method (Bolinger, 2000).

In South Africa, when many ex-Model C schools acquired computers a study showed that teachers lacked the necessary skills to use them. Woodrow (1991: 168) acknowledged that if, “technology as a learning and teaching tool is to be maximised, teachers’ attitudes toward computers must be monitored continually. Thus, schools 2, 3, 4, 5, 6 and 8, in this study, many have more positive perceptions about the potential value of computers due to their lack of exposure to them.

Another example of a contextual reason that affected learner perceptions was the high regard learners at school 6 had for the method teacher in charge. These learners had a good relationship with their teacher. This, combined with their small class size, created a good environment for this method to be used.

School 8, on the other hand, is a disadvantaged school, plagued with discipline problems in the classroom and gangsterism. Class sizes can vary from 50 to 80 learners. They preferred interactive methods of being taught, and they did not prefer methods that involved the teacher controlling the class. The teacher mainly used methods like textbook summaries. Comments from the teacher suggested that he had used this method as a means of controlling the class due to the discipline problems. He added that interactive
methods did not work due to lack of resources and limited classroom space. The classroom environment was always tense.

School 5, a predominantly Muslim school, had an ethos of respect and discipline. They respected teachers because they were authority figures well-qualified to give them knowledge. They did not mind teacher-controlled lessons, though they occasionally preferred other methods of teaching for variety. The class size was fairly large \( n = 35 \), but the teacher always managed to control the class during lessons.

Thus, the above examples illustrate that context was a factor that appeared to affect the learner's choice of methods of teaching.

**Personal reasons**

A learner's preferences can be influenced by a number of external and internal factors (see Chapter 2). The external factors may influence how learners perceive their experiences in the classroom.

The fact that learners have different learning style preferences is clearly shown in the results. For example, though the majority of learners selected biology outings as their preferred method of teaching, a small number of learners did not. In section 5.3 the comments of the learners suggested this small number of learners did not enjoy teamwork exercises, and preferred more guidance from the teacher. These learners might be described as conscientious learners according to Kolb's (1984) definitions described in Chapter 2.

Learners' previous exposures to different teaching methods in the classroom may also have influenced their preference. For example, though problem-solving was not favoured amongst all the schools, school 4 had a higher preference for this method. This might be due to their known exposure to OBE-related methods and the fact that their teachers were skilled and trained to perform these methods properly in the classroom. This has led the learners to have a positive perception for this method. On the other hand, though OBE has also been implemented in schools 1 and 7, learners generally did not prefer this method. Comments from the teachers suggested that, although OBE principles are
encouraged at their school, they have not been adequately trained to implement the methods. Thus, both the learners and teachers are not happy with the fact they are forced to apply these methods without training.

5.5.2 Survey 2

**Hypothesis 3:** Given a choice of 18 different methods of assessment in the biology classroom, all methods will tend to be preferred equally by samples of 1259 learners drawn from eight diverse schools: a) collectively

b) compared school by school

Hypothesis 3 was rejected. Learners did not prefer all methods of assessment equally, tending to choose methods that are mainly teacher-centred (e.g. revision tests, multiple choice questions and class tests) and learner-centred (e.g. open-book examinations and biology projects).

Their qualitative explanations suggest that they seemed to value methods of assessment in which the teacher was always involved in monitoring their progress and building their confidence, thus motivating them. This finding is supported by Black and Wiliam (1998).

School 6 was a small private school with a fairly high socio-economic background, and learners seemed to display confidence in their small classes. They valued highly the guidance of the teacher, but they preferred a variety of methods when being taught. They had a good relationship with their teachers and enjoyed interactions with the teachers and their peers when being taught and assessed. This school sample showed a higher preference for examinations (Fig. 4.4); biology practicals (Fig. 4.5); multiple choice questions (Figure 4.7); oral examinations (Fig. 4.9) and oral presentations (Fig. 4.8). All the other schools showed similar trends in their likes and dislikes for methods of assessment. The findings for school 6 cannot be conclusive due to their small sample size (n=20) and the fact that most of the learners were in grade 8. They came from different feeder schools and were probably exposed to methods in their primary schools that, taken together, can account for the differences.
The learners in school 4 showed a significantly higher preference for problem-solving as a method of assessment (Fig. 4.6). This might be due to the learners' constant past exposure to OBE methods. The staff at this school is advanced in their use of OBE as a philosophy of teaching. Teachers encourage interactive methods when teaching and assessing.

**Hypothesis 4:** That learners' preferences for different forms of assessment will be independent of the nature of the school i.e. its ethos, philosophy, purpose, aims, size, composition etc.

Hypothesis 4 was partly supported. Most learners from different schools preferred similar assessment methods, which could be due to their similar experiences of these particular assessment methods in biology throughout their learning experiences. However, some learners preferred other assessment methods, and this could be for different reasons - for example, contextual reasons (different teaching environments, e.g. Hanrahan, 1998; McRobbie, 1997) and personal reasons (different preferences and learning styles, e.g. Kolb, 1984).

Each of these two reasons will be elucidated in more detail below.

**Contextual reasons**

Learners in School 6 preferred a wide variety of assessment methods due to their constant exposure to these methods. The learners were confident in these methods and enjoyed them. For example, generally, many learners did not prefer to express themselves orally; but at school 6, this was not the case.

This could be due to a number of reasons; for example, the small class sizes. The teacher and learners felt comfortable exploring different lessons and discussing whether or not the lessons were working in the classroom. The learners were also very enthusiastic to listen to the teacher and, being of the same sex, discuss various issues pertaining to them. Thus, the good relationships in the class could be a factor that contributed toward the enjoyment of this method of oral work.
However, by contrast with school 6, the majority of the learners in school 8 did not prefer this oral method, due to bigger classes, less discipline and the fact that these learners were older and did not want to make fools of themselves in front of the class.

School 1, on the other hand, did not mind oral presentations since they felt comfortable with the teacher and their friends. This all-girl classroom environment gave the girls confidence.

Thus, the above examples show that different contexts create different environments that might influence learners in accepting or rejecting certain methods of assessment.

**Personal reasons**

Many learners' choices of favourite assessment methods were influenced by the marks that they received for a particular method. If they had received good marks in the past, they would prefer the method; if not, they would reject the method.

In all eight schools, the majority of learners preferred revision tests, but a small percentage did not. In section 5.4, the comments were that they preferred methods that were innovative and could make them think. These learners were motivated to learn, but were confronted with repetitive tests, which the majority of learners preferred.

**5.6 Chapter Summary**

A major finding in this study is that many learners in Cape Town, with different socio-economic statuses and previously advantaged and disadvantaged backgrounds, want to be fully involved in their learning. This would give them a perception of control and thus motivated them intrinsically. These learners indicated that they preferred methods of teaching perceived to be learner-centred. This type of teaching and learning is supported by current educational learning theories as well as by the Western Cape Education Department policy documents (WCED, 2000; WCED, 2002).

Schools 6 and 8 showed a significantly higher preference for teacher-in-charge and textbook summaries respectively. The majority of learners perceived this method to be
teacher-centred. This result indicated that, even though teacher-centred methods of teaching was generally not preferred by the overall majority of learners in this Cape Town study, the option of this method of teaching should not be discarded. If implemented occasionally and correctly, learners may well appreciate it as a valuable method of teaching in biology. However, if implemented exclusively in the classroom, learners will not always tend to appreciate this method of teaching.

*Computers,* as a method of teaching, can be implemented successfully if teachers are aware that the previous experiences of learners in the computer classroom vary. Some learners enjoy this method due to being able to practice their computer skills both at school and at home. However, other learners - lacking advanced computer skills and access to computers - may experience computer anxiety, computer frustration and become de-motivated in lessons. The qualitative responses of some of the learners at schools 1 and 7 showed signs of computer anxiety and computer frustration. An implication for the OBE classroom is that the implementation of "new" and *frequently used teaching methods could be difficult initially for both teacher and learner, but might improve with more experience of these methods. This might only happen if the teacher intervenes before learners lose motivation.*

The learners' perceptions of assessment were appreciably different from how they preferred to be taught, in that they preferred constant guidance (e.g. *revision tests*) from the teacher and preferred methods that were mainly *teacher-centred.* These methods were preferred because they would *"help them prepare for the examinations"; yet as a method of assessment, examinations* did not feature highly on the ranking list in Figure 5.2. It seems that these samples of learners in Cape Town are mark-orientated. They find value in assessment methods that might help improve their marks (e.g. *multiple choice tests and open-book examinations*).

Learners did not usually prefer methods of teaching that required a compact and logical synthesis of knowledge (e.g. *two-page essays*), nor verbal communication of knowledge (e.g. *oral presentations and oral examinations*). This could link to the finding that some of the learners did not prefer *textbook summaries* as a teaching method. This suggests that they did not prefer reading, and thus neither synthesising nor communicating their knowledge. This discussion is not conclusive and further research is required in this area.
CHAPTER 6
CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions, possible implications and recommendations of the research. The investigation was designed to answer the three focus questions in chapter 1. Consequently this chapter will be organized around answering the three focus questions.

Much of the study occurred in suburban schools with basic resources such as e.g. biology laboratories, computers and financial resources for excursion opportunities. The conclusions and recommendations are therefore relevant to urban schools with similar backgrounds and resources.

6.2 Question 1: To what extent are teacher-centred methods of teaching and assessment perceived to be appropriate to biology as a school subject?

6.2.1 Conclusions

Survey 1: How would you prefer to be taught biology?

The policy documents (WCED, 2000; WCED, 2002) recommend that emphases on teacher-centred methods of teaching in biology are inappropriate, and suggest that learner-centred methods are more appropriate in the modern biology classroom. The findings of this study are congruent with the policy documents, since the majority of learners prefer learner-centred methods when being taught biology.

Teacher-centred methods of teaching should, however, still be part of biology teaching at present. The findings in this Cape Town study suggests that a small percentage of learners still prefer teacher-centred methods of teaching. These learners perceive
educator guidance and a structured classroom environment as an essential part of their learning.

On the other hand, the majority of learners prefer learner-centred methods of teaching in biology where they would participate actively in the learning process. These learners associate learner-centred methods with a less structured environment that encourage social interaction that is central to their learning.

Survey 2: How would you prefer to be assessed in biology?

The policy documents (WCED, 2002) place emphasis on the use of a variety of assessment methods. In addition to formal examinations and tests, the policy documents encourage the use of projects, assignments, experiments and worksheets as a form of assessment.

The main finding in this Cape Town study is that some learners preferred teacher-centred methods of assessment, whereas others preferred learner-centred methods. Those learners who favoured the teacher-centred methods indicated that it assured them that they were making progress, thus ensuring that they would get “good marks”. The other learners, although they preferred the learner-centred methods of assessment, raised concerns about how this might affect their marks.

6.2.2 Implications

Survey 1: How would you prefer to be taught biology?

This implies that the teaching method documents should state clearly that learner-centred teaching can imply that the educator should not be excluded from the learning process, rather that there are two forms of learner-centredness, a guided and an unguided form. This view is supported by Ausubel’s (1968) theory of assisted learning and Vygotsky’s (1978) theory of scaffolding. Thus, learners and educators need to be cautioned that although the Western Cape Education Department (WCED) advocates that learner-centred methods are to be used in the biology classroom, they should be aware that the educator could play a bigger role in the learner-centred classroom.
Survey 2: How would you prefer to be assessed in biology?

The fact that many of the learners in this study preferred teacher-centred assessment implies that they may have needed constant educator guidance during assessment. Through the use of constructive feedback, educators can use assessment as a learning process, rather than using it as a means of judging a learner's ability. Formative assessment should therefore play a more prominent role in the learning process.

6.2.3 Recommendations

Recommendations for learners

In order to facilitate learning, learners might be directed more frequently towards activities that could develop autonomy in their learning. This would help to develop the necessary confidence that is required for self-sufficiency and intrinsic motivation during assessment.

Recommendations for educators

Educators should be encouraged to create a learning environment that is supportive and accommodates a variety of different learning styles. In order to ensure that educators employ appropriate teaching and assessment methods recommended by the WCED (2002) policy document, they should familiarise themselves with current literature on teaching and assessment in biology. In addition, educators should be encouraged to utilise the available workshops on educator and learner development.

Recommendations for curriculum development

Although there are teaching resources that meet the requirements of the new curriculum theories, there might need to be additional resources that guide both learners and educators to more clearly define their roles in active learning.
Recommendations for educator training

For the success of the new biology curriculum theory, additional emphasis might be placed on teacher-centred and learner-centred theories and their practical implications for the learning process in biology lessons.

6.3 Question 2: In what ways do diverse samples of learners perceive how biology should be taught and assessed?

6.3.1 Conclusions

The findings of this study in Cape Town indicate that, regardless of their social background, ethos, access to resources etc., learners generally preferred learner-centred methods of teaching, but teacher-centred methods of assessment.

Although learners showed interest in learner-centred methods of teaching there were varying degrees of interest in certain methods. For example schools that had limited access to computers favoured these facilities. Learners from those schools that had access to this resource were aware of the logistics of utilising computers, therefore they showed less interest in this method.

6.3.2 Implications

The study indicates that the availability of a variety of methods of teaching and assessment in the biology classroom has effects on learner motivation. This implies that biology teachers should be conscious of how learners at their school perceive their methods of teaching and assessment in biology. The levels of awareness among teachers and learners about their perceptions of methods might affect the levels of motivation in the classroom.

6.3.3 Recommendations

Educators are encouraged to attempt a needs analysis in their classrooms to determine how learners perceive the learning environment. They might also determine what
methods of teaching and assessment the majority of the learners prefer. Educators should be aware that the learners’ perceptions might vary according to their personal backgrounds, curricular expectations and classroom experiences.

6.4 Question 3: Can the learners’ perceptions be reconciled to current curricular pronouncements and expectations in biology as a school subject?

6.4.1 Conclusions

In terms of teaching methods, the perceptions and views of the majority of learners involved in this study, were compatible with the present curricular expectations. As far as assessment methods are concerned, the findings partly supported the present curricular expectations.

6.4.2 Implications

In order to encourage the implementation of the Revised National Curriculum Statement (2002), we have to be aware that some learners need support and time to allow for the shift from traditional methods to learner-centred methods of teaching and assessment.

6.4.3 Recommendations

The curriculum designers should be encouraged to take into consideration the learners’ social backgrounds and differences in terms of access to resources in order to make informed curricular pronouncements.
6.5 Further research

This section makes suggested recommendations for further research in the field:

**Recommendation 1.** The research sample could include more learners from disadvantaged and under-resourced areas.

**Recommendation 2.** Learners' personal classroom histories could be studied to determine whether their past exposure to methods of teaching and assessment could influence their present choices of methods of teaching and assessment in biology.

**Recommendation 3.** A possible research area would be to determine how biology teachers perceive methods of teaching and assessment. This data could be used to compare against the learners' perception.

**Recommendation 4.** Another possible area of research would be to compare learners' biology achievement marks with their choices of methods of teaching and assessment.

**Recommendation 5.** The effect of school resources on learners' choices could be another possible area of research. A comparative study could be made of how learners in well-resourced and under-resourced schools prefer to be taught and assessed in biology. These results would help determine whether resources, or the lack thereof, play a role in learners' choices of methods of teaching and assessment.

6.6 Final conclusion

This research has investigated some of the issues around methods of teaching and assessment in biology. The research had its own identified weaknesses as well as its strong aspects. The present investigation has identified some of the most important issues that are related to how learners in the classroom feel about the present biology
curriculum policies being implemented in their classrooms. However, further research is needed into the issues that have emerged.
Reference list


APPENDIX

1

Photocopies of articles in conference proceedings
List of Publications


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<td>The attraction for Science: Why Grade 12 Girls in Five High Schools have chosen Science at School</td>
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<td>Teachers Views on Mathematics, Mathematics Teaching and their Existing Practices</td>
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<td>How High School Biology Learners Prefer to be Assessed and Taught in Biology: A Comparison of the Ratings of Three Classes</td>
<td>50</td>
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<td>An Investigation into the Nature of Verbal Interactions During the Practical Training of Medical Technology Students</td>
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<td>The Impact of a Pentium Technology Option on Biology Students’ Choice of A Multimedia Instructional Methodology: A Preliminary Study</td>
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<td>Exploring Methodological and Ethical Considerations in Reporting on Collaborative Assessment Practices in Physical Science in Four Secondary Schools</td>
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<td>Challenges for Promoting Quality and Equity in Mathematics, Science and Technology Education in Africa in the Next Millenium</td>
<td>85</td>
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How High School Biology Learners Prefer To be Assessed and Taught in Biology: A Comparison of the Ratings of Three Classes.

M. Asery
School of Education, University of Cape Town, Rondebosch

ABSTRACT
This study was conducted with three classes of biology learners in 1999 at a well established girls high school. It was found that the learners preferred biology outings as a teaching method, but did not prefer teacher dominance and textbook summaries as a means of teaching biology. In addition to this, the learners preferred multiple choice tests and revision tests as a means of assessment in biology, while the least preferred method of assessment in biology was completing worksheets in class every day and writing two-page essays.

BACKGROUND AND PURPOSE
The background to this investigation is the most important current unresolved issue in relation to the adoption of Curriculum 2005, namely: how should learners be assessed, and what are the implications of this for the teaching methods adopted in actual biology lessons?

It is an extension of the work of Jones (1997) who argued that, in order to embrace the benefits of Outcomes Based Education, one has to develop suitable outcomes based assessment strategies to reflect the pedagogy taught using OBE.

Thus, the first purpose of this study was to determine how three samples of learners prefer to be assessed and taught in biology; and the second purpose was to use this information ultimately to suggest and construct appropriate assessment strategies and pedagogies. This research aimed to contribute toward the resolution of at least some of the current problems in the context of biology lessons in one large, well-established girls high school.

METHODOLOGY
Research Method
The research method used in this study is survey sampling. A survey is recognised as a direct way to obtain information concerning an identified topic (Fink and Kosecoff, 1985; Bybee and May, 1986). Butts (1985:188) has pointed out that the survey method is a rediscovered strategy for education.

Sample and procedure
The questionnaire research method was used to gather “yes/no” and “best choice/least favoured” data from a sample of 112 grade eight, nine and ten biology learners at Rustenburg Girls’ High School in October 1999. Permission was sought from the Head of the Biology department to distribute the questionnaires to the biology learners. It was briefly explained to the biology teachers what the questionnaire was about and how it should be completed. The Biology department has used these responses as a means of gathering information about how the learners preferred to be taught and assessed, and staff now intend to adjust their future methods of teaching and assessment to what the learners themselves preferred.

Hypotheses
Three hypotheses were formulated to test whether significant differences would occur between the responses of the three classes (grades 8, 9 and 10) in their preferences for 16 methods of teaching/learning biology.

Three additional hypotheses were formulated to test whether significant differences would occur between the responses of the three classes (grades 8, 9 and 10) in their preferences for 13 methods of assessment in biology.

DEVELOPMENT OF THE INSTRUMENTS
The first survey comprised 16 items and the second survey comprised 13 items. The initial items were formed from the suggestions of three biology teachers at Rustenburg Girls’ High School who wrote down a list of common, important methods of teaching biology and a list of methods of assessing biology. Each teacher was requested to give at least ten different methods on each list.

Two pilot instruments were constructed from the biology teachers’ lists and from additional library references (Race, 1997; WCED, 1998 pp.1-4) for trialling in the initial phase. The instruments were pretested on a grade 11 biology class at Rustenburg Girls’ High School, and were subsequently modified after the learners suggested more items, and the wording of these items were refined, modified and clarified. Additional validation of the wording occurred with the assistance of educational academics experienced in test item construction and formulation.

Respondents were required to tick either “YES” or “NO”. In the final section of the questionnaire, respondents were encouraged to choose their two most preferred and the two least preferred methods of teaching, as well as their two most preferred and their two least preferred methods of assessing biology. This enabled the learners to prioritise their choices in order of importance.

RESULTS
Tables 1-8 present the overall results.

Findings
(1) H1 was rejected. Table 1 records that the grade 8 and grade 9 class had significantly different preferences for demonstrations, biology projects, computers and teacher in charge. Whereas the grade 8 class had a more widespread preference for projects and computers, the grade 9 class favoured more demonstrations and teacher leadership.

(2) H2 was rejected. Table 2 records one significantly different teaching method preference between the grade 9 class and the grade 10 class, namely: the grade 9 class had a much greater preference for biology videos as a teaching method.
It was an interactive learning experience for them which they said they thoroughly enjoyed. However, if they were sent to the rocky shore with no goals to reach by the end of the day it would simply have been “dressing up in the latest fashions and missing a day of school lessons”.

The learners’ viewpoint that biology is an interactive subject was supported by the evidence that they rejected teacher dominance and textbook summaries. They expressed their view that the teacher should not talk during the whole lesson since they have a limited concentration span, and they said they would prefer to give their own opinions on topics in class. Teachers should present lessons in such a way that they are able to express their ideas. They said: and it helps to make the lessons more interesting.

The learners also claimed that they needed guidance from their teachers when composing textbook summaries. In their experience, textbook summaries were a means of the teachers “getting rid of them”. They pointed out that they were not confident that their summaries were of the desired quality because they all had different notes in their books. They stated that they felt very strongly that these summaries, in order to mean anything to them, should be checked by the teachers. The teachers, on the other hand, said that it was time-consuming checking every textbook summary which they (the learners) had written in class. It thus seems that neither the learner nor the teacher in the sample studied had benefited fully from the use of textbook summaries as a teaching / learning method.

In terms of being assessed in biology, learners interviewed claimed that multiple choice tests and revision tests were a good means of testing how well they understood their work, and would help them prepare for the examination. The teachers claimed that, even though it increased their workload in terms of marking, they could use these two methods as a means of testing how well the learners understood the way they taught the topic. In this manner they would be able to revise work with which they struggled - to help them prepare for the examination. Thus both the learners and the teachers interviewed preferred methods of assessment which emphasise the old examination-driven curriculum as a means of preparation for the examination.

The learners said that they did not prefer the method of daily worksheets in class because the workload was too much. They claimed that writing two-page essays was too long, especially for both the grade 8 and 9 learners.

CONCLUSION

Since conducting and reporting and presenting this study with three classes in October, the investigation has surveyed a total of ten additional biology classes (grades 8 to 11) at Rustenburg Girls High School. Preliminary results show that from the enlarged sample of approximately 350 learners, the learners most preferred to be taught through biology outings (157 votes) and then through class discussions (57 votes). The teaching methods most rejected by the biggest majority of learners were teacher dominance (134 votes) and textbook summaries (114 votes).

The learners most preferred to be assessed through revision tests (97 votes) and portfolios (62 votes). The assessment methods most rejected by the biggest majority were two-page essays (122 votes) and oral examinations (92 votes).

At the time of going to press, data has been obtained from two other schools - one co-educational, and one private - and the comparative findings will be reported in a subsequent publication.
ACKNOWLEDGEMENTS

A very special thank you to Dirkie Botha, the head of the Biology department at Rustenburg Girls’ High, for her help with the instrument and to Professors M.B. Ogunniyi and K. Rochford who both gave very insightful comments, which helped to shape the final form of the investigation.

REFERENCES


Table 1: A comparison of preferences of RGHS grade 8 and grade 9 classes for 16 different methods of teaching biology.

<table>
<thead>
<tr>
<th>No.</th>
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<th>p = 0.05</th>
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<td>0.005</td>
<td>0.15</td>
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<tr>
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<td>10</td>
<td>9</td>
<td>0.005</td>
<td>0.15</td>
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<tr>
<td>4</td>
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<td>9</td>
<td>0.005</td>
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<td>0.005</td>
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<td>0.005</td>
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<td>Experiences</td>
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* p = 0.05 Significant differences between grades 8 & 9 learners' response patterns on the following scores: 2, 3, 4 and 7.

Table 2: A comparison of preferences of the RGHS grade 9 and grade 10 classes for 16 different methods of teaching biology.

<table>
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<tr>
<th>No.</th>
<th>Method</th>
<th>Grade 9</th>
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<th>p</th>
<th>p = 0.05</th>
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<td>4</td>
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<td>Experiences</td>
<td>10</td>
<td>9</td>
<td>0.005</td>
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* p = 0.05 Significant differences between grades 9 & 10 learners' response patterns on the following scores: 2, 3, 4 and 7.
### Table 3: A comparison of the preferences of the ROHS grade 9 and grade 10 classes for 10 different methods of teaching biology.

<table>
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<td>Project</td>
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<td>17</td>
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<tr>
<td>Test (Other subject)</td>
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### Table 4: A comparison of the preferences of the ROHS grade 9 and grade 10 classes for 13 different assessment methods in biology.

<table>
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<tr>
<th>Method</th>
<th>ROHS Grade 9</th>
<th>ROHS Grade 10</th>
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<td>Lecture</td>
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<td>Science Project</td>
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### Table 5: A comparison of the preferences of the ROHS grade 9 and grade 10 classes for 12 different assessment methods in biology.

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### Table 6: A comparison of the preferences of the ROHS grade 9 and grade 10 classes for 12 different assessment methods in biology.

<table>
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<tr>
<th>Method</th>
<th>ROHS Grade 9</th>
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<tbody>
<tr>
<td>Lecture</td>
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</table>

*P < 0.05 Significant differences between grades 9 & 10 teachers' response patterns on the following item: 9.
Table 7: A comparison of the most preferred and the least preferred methods of learning biology selected by three classes of learners.

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<td>Coverage</td>
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<td>Videos</td>
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<td>Visual materials</td>
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<td>Homework summary</td>
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</table>

Table 8: A comparison of the most preferred and the least preferred methods of assessment selected by three classes of biology learners.

<table>
<thead>
<tr>
<th>Methods</th>
<th>U1</th>
<th>U2</th>
<th>U3</th>
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<tr>
<td>Examinations</td>
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<td>4</td>
<td>3</td>
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<td>2</td>
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<td>Mathematical tests</td>
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<td>2</td>
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<td>Biology project</td>
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<td>2</td>
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<tr>
<td>Multiple choice</td>
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<tr>
<td>Essays - short</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
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<td>Essays - two-page</td>
<td>1</td>
<td>1</td>
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<td>Handout tests</td>
<td>1</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Class involvement</td>
<td>1</td>
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CONFERENCE
INTEGRATING CONTENT AND LANGUAGE: PROVIDING ACCESS TO KNOWLEDGE THROUGH LANGUAGE

2 to 4 July 2001

PROGRAMME AND ABSTRACTS

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Bellville
Western Cape
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<tr>
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<td>Abraham J</td>
<td>44</td>
<td>Language as a barrier preventing the science learning of Grade 12 learners</td>
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<td>Abrahams E &amp; Inal A</td>
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<td>Abrahams E</td>
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<td>Abrahams M</td>
<td>6</td>
<td>A comparison of the mathematics scores of grade 8 learners when tested in two different assessment formats - traditional (textbook) format and sentence format</td>
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<td>Asary M</td>
<td>14</td>
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<td>Baynham M</td>
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<td>Texts and practices: researching academic literacies in Higher Education</td>
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<td>Bosman V &amp; Williams S &amp; Parker R</td>
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</table>
An investigation into the preferences of high school biology learners for different forms of assessment

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ABSTRACT

The investigation reports on the findings of a study conducted during 2000-2001 in eight schools involving approximately 1249 high school biology learners in grades 8-12. The aim of the investigation was to determine the relative importance to the learners of 18 different possible choices of methods of assessment. It also involved a comparison between schools of learners' preferences. The data was gathered using a survey comprising two sections (one section gathering quantitative data and the other qualitative data) on each learner's preferences. This paper explains the results in terms of the most frequently and least frequently favoured methods of assessment.

INTRODUCTION

In science lessons students can learn many skills – investigative, analytical, handling apparatus, and so on. However, they are assessed through formal examinations and therefore they cannot always be tested on the full range of skills they have learnt. Public examinations fail to cover a full range of goals to which science teaching is directed (Calloids, 1997: 124). Written tests place boundaries on what can be assessed. Multiple choice examinations do not allow for comprehensive communication skills, while practical work skills are not incorporated into formal examination programmes.

Continuous assessment (WCED, 1998) should be more reliable and valid than traditional examinations. Since learners can be assessed continuously, it may provide a more comprehensive profile of the learners' science abilities and achievement. This is because a broader range of skills or outcomes are assessed – and this can be done more than once. A number of countries have replaced examinations either partly (e.g. Papua New Guinea) or completely (e.g. Morocco) (Calloids, 1997: 125). Continuous assessment is effective only if the teachers are well-trained, are good bookkeepers and have professional ethics.
Sometimes teachers are insufficiently prepared for assessment tasks because they have received no training. Recently they considered the wording and expression of official documents on assessment ‘not too clear’ (Asmal, 2000). I suggest that in such cases informed student teachers who are in their final year of study at universities and teachers training colleges might act as ‘substitute’ assessors and teachers. They can be despatched to help ‘older’ teachers become updated on the latest curriculum assessment terminology. Furthermore, the teachers in full-time employment will have huge workloads with so many more assessment tasks and time constraints in teaching.

In South Africa, continuous assessment has become an integral part of the new system of curriculum – Curriculum 2005 (Asmal, 2000). Reeves (1999) reported on a study of grade seven learners in ten Western Cape schools. The study tried to discover whether teachers would really achieve the natural science outcomes that the policy document on Curriculum 2005 listed. The results showed that most teachers in urban townships were unlikely to be able to provide a context in which learners would achieve the outcomes. The context was described in terms of the time taken to teach, the available physical resources and the learners’ abilities. Also, teachers lacked the knowledge and teaching skills to relate examples to everyday life. They also misunderstood the concept of "continuous assessment". Teachers in Model C schools, on the other hand, were able to cope better with continuous assessment, probably because they had better resources.

If learner-centred education is to be implemented at school level, teachers will have to take responsibility for the design (or adaptation) of locally applied curricula. Since this is a new concept for some teachers, such teachers will probably need some guidance. I have found that the questionnaire presented in this study can be used to help teachers gain an understanding of what the learners themselves prefer in their assessment methods. The future benefits might be threefold:

1) educators might be better informed to design relevant lessons that will interest the local learners;
2) teaching and assessment might become more integrated; and
3) more of the government-prescribed outcomes might be achieved.

THE RESEARCH PROBLEM

With the change in the South African curriculum, moving from a content-based system to an outcome-based education (OBE) model, emphasis has fallen on the acquisition of skills by the learner. In order to accommodate this change, a paradigm shift from teacher-centred to learner-centred methods of assessment has to take place in many school classrooms. Coupled with this, some teachers have to change their perception of methods of teaching and assessment as isolated, and realise that these have to be integrated in order to make OBE successful. Jones (1997) emphasised this by stating that, in order to embrace the benefits of OBE, some teachers will have to develop suitable outcome-based
assessment strategies to reflect the pedagogy taught using OBE. Other teachers, however, have always used some forms of OBE instruction and testing in their lessons for variety and interest. Thus, learner-centred classes in South African schools are nothing new to them.

Many high school learners have been exposed to a variety of methods of teaching and assessment in biology throughout their school careers. They might prefer some methods to enhance their learning, while they might not prefer others. There are also many other ‘new’ methods of teaching and assessment which the Western Cape Education Department document (WCED) (1998) has included. The recommended variety of OBE methods of teaching and assessment might be more beneficial to both learners and educators if teachers could determine how the learners themselves prefer to be taught and assessed in biology. After determining this, some educators might structure their lessons around how their own learners, given free choice, actually prefer to learn. Thus, teachers might acknowledge that different schools have different ethos, cultures, learner experiences etc., ultimately making the introduction of OBE curricula options easier in different contexts, as well as making lessons more enjoyable to both learners and educators in their particular schools.

In a pilot study conducted during 1999 at a well-established progressive girls’ high school, about 350 learners in grades 8-11 were given two surveys, each presenting a variety of accepted methods of teaching and assessment in biology. The feasibility study used a 16 item instrument for “preferred methods of teaching” and a 18 item instrument for “preferred methods of assessment. This paper reports the pilot study findings obtained using only the methods of assessment questionnaire in biology.

The feasibility study results showed that learners most preferred to be assessed through revision tests and portfolios at this one school. The assessment methods most unpopular with the biggest majority were two-page essays and oral examinations.

Hence, the purpose of this enlarged study conducted during the period 2000-2001 was to determine whether biology learners from eight different schools with different socio-economic backgrounds, ethos, cultures and learner experiences would show similar or significantly different trends in their preferences and aversions, and whether they would present similar or different patterns of reasons for their choices. In this way educators, when attempting to implement the policies set out in WCED documents, might structure lessons around what their learners actually prefer.
METHODOLOGY

(a) Research Methodology

The research method used in this study is survey sampling. A survey is recognised as a direct way to obtain information concerning an identified topic (Fink and Kosecoff, 1985; Bybee and May, 1986). Butts (1983: 188) has pointed out that the survey method is a rediscovered strategy for education.

(b) Samples

This research was conducted in eight different high schools between 1999 - 2001. The criterion for the selection of the schools was diversity (in respect to size, religion, socio-economic status, aims, philosophy etc.). All the schools were located in the greater metropolitan area of Cape Town, Western Cape. The learner grades at each of the schools in the study varied from grades 8 - 12. The sample numbers at each school varied between 19 - 301 per school.

The eight high schools were:
1. School 1 (N = 55) - a specialised high school for cognitively handicapped learners, admitted on the basis of clinical diagnosis.
2. School 2 (N=301) - a well-established progressive girls high school in a middle class suburb.
3. School 3 (N=182) - an exclusive Muslim high school.
4. School 4 (N=19) - a recently established exclusive boys high school still expanding in enrolment.
5. School 5 (N=95) - A wealthy co-educational high school situated in a middle class suburb.
6. School 6 (N=269) - A co-educational school situated in a middle class suburb.
7. School 7 (N=272) - A co-educational school situated in a lower middle class suburb.
8. School 8 (N=50) - A socio-economically deprived co-educational high school located in a historically disadvantaged suburb.

(c) Data to be gathered

The data collected were the responses of 1259 biology learners to a questionnaire with a list of "yes/no" options. The learners' most preferred and least favoured response data were summarised. The qualitative responses suggesting why the learners prefer particular methods of assessment the most and least were classified, collected and summarised.
(d) Statistical analysis

Chi-square tests have been used to compare the frequencies of “yes” or “no” responses to each one of the 18 items by the learners either school by school, or collectively. The open-ended response data has been analysed qualitatively using categories and descriptive indicators.

(e) Hypotheses

H1 That, given a choice of 18 different methods of assessment in the biology classroom, all methods will tend to be equally preferred by samples of 1259 learners drawn from eight diverse schools: a) collectively; and b) school by school.

H2 That the learners' preferences for different forms of assessment will be independent of the nature of the school i.e. its ethos, philosophy, purpose, aims, size, composition etc.

(f) Development of the instruments

The first draft questionnaire comprised 13 items. The initial items were composed from the suggestions of three enthusiastic biology teachers at the progressive girls' high school who wrote down a list of common methods of assessment in biology. Each teacher was required to offer at least ten different methods as the first step, and their suggestions were then corroborated by a literature review.

Two pilot instruments were then constructed, not only from the biology teachers' lists, but also from additional library references (Race, 1997; WCED, 1998 pp 1-4). During trialling in the initial phase in September 1999, the instrument was workshopped on a grade 11 biology class at the progressive girls high school (school 2). It was subsequently modified after the learners suggested more items, and the wording of these items was refined, modified and clarified. Additional validation of the wording occurred in October 1999 with the assistance of educational academics experienced in test item construction and formulation. The final version of the instrument, re-worded after six trials of improved modifications was used in the enlarged study of 2000-2001.

Respondents were required to tick either “YES” or “NO” (or to leave a response blank). In the final section of the questionnaire, respondents were encouraged to choose their two most preferred and their two least preferred methods of assessment in biology. After the learners had prioritised their choices they were invited to describe qualitatively in their own words why they had preferred certain methods of assessment in biology and why they did not favour other methods.
RESULTS

Survey 1: How would you prefer to be assessed in biology? (N = 1259)

Quantitative findings

The results summarising the response frequencies of the most favoured and least favoured responses by 1259 high school learners are presented in Table 1. Since the 18 different methods of assessment were not equally preferred, hypothesis no. 1 is not supported by the data.

The two assessment methods with the highest degree of support among the learners in eight schools were found to be:

- Revision tests (item 12: 282 responses)
- Open-book examination (item 14: 269 responses)

Other methods of assessment which showed a high degree of support were:

- Multiple choice tests (item 16: 192 responses)
- Biology projects (item 3: 187 responses)
- Class tests (item 2: 182 responses)
- Picture tests (item 15: 151 responses)
- Portfolios (item 7: 144 responses)
- Class involvement mark (item 13: 118 responses)
- Oral presentations (item 17: 108 responses)
- Examinations (item 1: 101 responses)

The remaining methods of assessment in biology were favoured by fewer than 100 out of the 1259 learners.

The three methods of assessment least preferred in the eight schools were:

- Two-page essays (item 11: 438 responses)
- Oral examinations (item 18: 274 responses)
- Oral presentations (item 17: 245 responses)

Other methods of assessment which were least favoured by the learners were:

- Worksheets (daily) (item 5: 173 responses)
- Examinations (item 1: 122 responses)
- Mini-essays (half-page) (item 10: 101 responses)

The remaining methods of assessment were favoured by fewer than 100 learners.
Table 1: The frequency scores and preferences of the 1259 high school learners on Survey 1: How would you prefer to be assessed in biology?

<table>
<thead>
<tr>
<th>Method of assessment</th>
<th>Percentages</th>
<th>Response Frequencies (N=1259)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Yes</td>
<td>% No</td>
</tr>
<tr>
<td>1. Examination</td>
<td>57</td>
<td>41</td>
</tr>
<tr>
<td>2. Class tests</td>
<td>72</td>
<td>25</td>
</tr>
<tr>
<td>3. Projects</td>
<td>81</td>
<td>17</td>
</tr>
<tr>
<td>4. Worksheets (weekly)</td>
<td>74</td>
<td>23</td>
</tr>
<tr>
<td>5. Worksheets (daily)</td>
<td>25</td>
<td>70</td>
</tr>
<tr>
<td>6. Biology practical</td>
<td>51</td>
<td>45</td>
</tr>
<tr>
<td>7. Portfolios</td>
<td>61</td>
<td>37</td>
</tr>
<tr>
<td>8. Problem-solving questions</td>
<td>58</td>
<td>40</td>
</tr>
<tr>
<td>9. Reviews</td>
<td>38</td>
<td>59</td>
</tr>
<tr>
<td>10. Mini-essays (half page)</td>
<td>43</td>
<td>53</td>
</tr>
<tr>
<td>11. Essays (two page)</td>
<td>13</td>
<td>81</td>
</tr>
<tr>
<td>12. Revision tests</td>
<td>79</td>
<td>15</td>
</tr>
<tr>
<td>13. Class involvement mark</td>
<td>73</td>
<td>24</td>
</tr>
<tr>
<td>14. Open-book examination</td>
<td>79</td>
<td>16</td>
</tr>
<tr>
<td>15. Picture tests</td>
<td>71</td>
<td>22</td>
</tr>
<tr>
<td>16. Multiple choice tests</td>
<td>71</td>
<td>24</td>
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<tr>
<td>17. Oral presentations</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>18. Oral examinations</td>
<td>36</td>
<td>62</td>
</tr>
</tbody>
</table>

Qualitative findings

The following are summarised comments commonly given by many of the 1259 respondents for each of the above items.

The methods of assessment most preferred in biology:

a) Revision tests (item 12) were favoured because: -
   - They help the learner in preparation for the June and December examinations.
   - They clarify the work at the end of each section.
   - They motivate the learner to keep up to date with the work.
• They build the learners’ confidence.
• They give the learners input as to what work they are experiencing problems with.
• They give the learner a guide as to how the teacher will set questions in the examination, as well as what key points they will look out for when marking.

b) **An open-book examination (item 14) was favoured because :-**

- The learner will not have to memorise work when preparing for tests and examinations.
- The learner will have an opportunity to apply and understand knowledge.
- It will build the learners’ confidence since the learners assume that they will improve their marks.

(Some learners, however, did not perceive open-book examinations as advantageous, and they made the following remarks:

- Some learners do not understand the concept of an open-book examination.
- The learners felt that it would not be mentally stimulating.
- Learners felt that it would “decrease their thinking potential”.
)

c) **Multiple choice tests (item 16) were favoured because :-**

- This method will make studying easier.
- The learners will not have to express themselves through long sentences.
- The learners will have to understand their work and will not have to resort to memorising work when studying.

(Some learners however, did not perceive multiple choice tests as advantageous, and they made the following remarks:

- Learners will resort to not studying their work and thus guessing answers.
)

d) **Biology projects (item 3) were favoured because :-**

- Research will give the learners more insight into the topic - the learners therefore found work mentally stimulating.
- The work is interesting and the learners will be able to work independently and at their own pace.
- The learners can consult not only the textbook, but a variety of other sources, e.g. internet, journals, newspapers.
- The learners will be able to work in groups, and this will build their teamwork and social skills.

(Some learners however, did not perceive biology projects as advantageous, and they
made the following remarks:

- For some learners group work was perceived to be counter-productive since some learners typically have no focus and do very little to contribute to the group.
- Introverted learners do not have an opportunity to express their opinions.

**e)** Class tests (item 2) were favoured because:
- They enabled the learners to prepare for the examination.

**f)** Picture tests (item 15) were favoured because:
- They allow the learners to identify different parts, and this aids in understanding processes in biology.
- Learners find it easier to remember visuals and colour when studying.
- They are an effective way of remembering when studying.

**g)** Portfolios (item 7) and class involvement mark (item 13) were favoured because:
- They help the learners to keep track and up to date with their work and progress.
- The learners can reflect on their performance over a long period of time.
- The learners will not have to regurgitate answers for tests and examinations.
- They give the learners self-motivation.

**h)** Oral presentations (item 17) were favoured because:
- They will help the learners to research and interpret information.
- After researching the topic, the learners will be able to ‘design’ the best way to present the topic to the class.
- The learners will be able to be as creative as they wish.

**i)** Examinations (item 1) were favoured because:
- Though there were no substantial comments in justification of examinations, the learners still viewed these as a very popular choice.

**The least preferred methods of assessment in biology:**

**a)** Two-page essays (item 11) were not favoured because:
- Learners will not be able to express themselves in so many words without repeating themselves.
Even though the learners have good ideas, they feel that they will not be able to express them in an essay of that length.
 Sometimes the instruction is not clear.
 This is an old-fashioned method and should not be used in biology any longer.

b) **Oral examinations (item 18) were not favoured because:**

- The learners will feel nervous and self-conscious if the teacher asks them questions.
- There will not be enough time to think when expected by the teacher to give an answer.

c) **Oral presentations (item 17) were not favoured because:**

- Some learners would be afraid to speak in front of the class, and this might affect the learners’ performances.
- The learners were afraid to answer questions which the teacher or other learners would ask.
- Extroverts would perform better than introverts.
- Sometimes presentations are not interesting, resulting in boredom and frustration.
- Valuable class time might be wasted with uninteresting presentations.

d) **Daily worksheets (item 5) were not favoured because:**

- Lessons will become uninteresting since there is no variety and class discussion time.
- This method will lead to too much homework in one week.

e) **Examinations (item 1) were not favoured because:**

- Learners might become anxious during this period and not perform to their full potential.
- The workload and pressure are too much.
- The examination setting is too formal, adding to the anxiety.

f) **Half-page mini-essays (item 10) were not favoured because:**

- Sometimes it is difficult for learners to express themselves in lengthy sentences.

2. **Do learners’ preferences tend to be more teacher-centred or more learner-centred?**

In order to ascertain whether the learners’ preferences were inclined more towards being teacher-centred or more towards being learner-centred (discovery learning), the methods
in the questionnaire were categorised and re-grouped by a panel of nine experienced teachers, into three main divisions:

1. Where the type of preference is for the teacher to tend to take complete control of learning (teacher-centred learning).
2. Where the type of preference is for the learner to tend to take complete control of learning (learner-centred learning).
3. Where it is not certain whether the methods are teacher-controlled or learner-controlled (unsure) or whether the control was agreed to be shared.

This procedure was applied to survey 1. The findings are summarised in table 2 below.

Table 2: Grouped results summarising the percentages of most preferred and least preferred responses to survey instrument no. 2: How would you prefer to be assessed in biology? using the data supplied by the 1259 learners.

<table>
<thead>
<tr>
<th>Assessment style</th>
<th>Learners’ most preferred assessment style (N=2130)</th>
<th>Learners’ least preferred assessment style (N=2155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-centred</td>
<td>48.4%</td>
<td>47.5%</td>
</tr>
<tr>
<td>Learner-centred</td>
<td>44.1%</td>
<td>31.4%</td>
</tr>
<tr>
<td>Classified as Shared or Unsure</td>
<td>7.3 %</td>
<td>21 %</td>
</tr>
</tbody>
</table>

# Each of the N = 1259 learners selected two choices, allowing a maximum of n=2130 and n=2155 possible choices.
Hypothesis No. 2

The results presented in table 1 show that the two methods of assessment most strongly supported by the learners from the eight schools were revision tests and open-book examinations. An item-by-item chi-square test disclosed that there were no significant differences between any of the six schools in their patterns of YES/NO responses for these two assessment options. They agreed on the methods of assessment of which they approved of, irrespective of the nature of the school selected for the survey. Thus hypothesis no. 2 was supported for assessment items 12 and 14.

DISCUSSION

The learners' qualitative responses suggest that they supported revision tests because they were perceived to be an effective means of preparing for the examinations in June and November. Their mind-set was still very mark-orientated even though they come from different backgrounds. The learners also stated that they needed to feel confident when they entered an examination room – as well as motivated in preparing for the examination. Revision tests were clearly favoured solutions.

Similarly, open-book examinations were perceived to be 'confidence boosters' and they discouraged rote-learning. The learners who were not in favour of open-book examinations felt insecure because their perception was that if they did not rote-learn from their files, the examination would be meaningless and it would 'decrease their working potential'.

There was also support for multiple choice tests. Many learners said they found it difficult to express themselves in full sentences during an examination. For example, an item-by-item chi-square test comparison of the responses from all eight schools showed that School six differed significantly from the other seven schools on its perceived unimportance of item 16 multiple choice tests. They were apprehensive that multiple choice tests might lead to 'guessing' answers.

The three least favoured methods of assessment with the highest degree of disapproval were two-page essays, oral examinations and oral presentations. A large proportion of the learners perceived themselves as 'not ready' at any grade, or in any school, to express themselves verbally or through constructing sentences. In many biology assessment formats these methods are common, yet the many learners do not support them. One explanation might be that they are probably going through puberty and do not want to speak in front of the class.

It is interesting to note that the learners in school 6, whose learners tended to differ from the other schools in their support for multiple-choice tests, preferred oral presentations. They were completely comfortable when speaking to their peers in a group. In this case,
oral testing might have been encouraged by their particular teacher's style of instruction and classroom management.

On item 18, the preferences of the learners in school 2 differed significantly from those of the learners in the other five schools. Many learners were not afraid to be tested through oral examinations. They agreed that they felt comfortable with their teachers and enjoyed discussions. Therefore this method would be perceived as non-threatening, and a way of 'discussing' the answers with their teacher.

Conclusion

Current policies for Curriculum 2005/Curriculum 21 recommend that a wide variety of assessment methods be employed in modern South African schools. The data presented in this paper suggests that some assessment methods may be received by learners more enthusiastically than others. In this respect, teachers in schools may find the findings and instrument developed in this study to be a useful guide to the more effective implementation of current educational policies.

Acknowledgements

The financial assistance of the National Research Foundation and of the University Research Committee of the University of Cape Town towards the production of this paper are hereby acknowledged with thanks.

BIBLIOGRAPHY


Conference
EDUCATION STUDENTS' RESEARCH CONFERENCE

28 - 29 SEPTEMBER 2001

PROGRAMME,
ABSTRACTS,
PAPERS
AND
DISSERTATIONS

GRADUATE SCHOOL IN HUMANITIES
UNIVERSITY OF CAPE TOWN
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HIGH SCHOOL BIOLOGY LEARNERS’ PREFERENCES FOR DIFFERENT FORMS OF ASSESSMENT

MELANIE ASARY
University of Cape Town
asarym@rghs.wcape.school.ac.za

ABSTRACT

The investigation reports on the findings of a study conducted during 2000-2001 in eight schools involving approximately 1249 high school biology learners in grades 8-12. The aim of the investigation was to determine the relative importance to the learners of 18 different possible choices of methods of assessment. It also involved a comparison between schools of learners’ preferences. The data was gathered using a survey comprising two sections (one section gathering quantitative data and the other qualitative data) on each learner’s preferences. This paper explains the results in terms of the most frequently and least frequently favoured methods of assessment.
APPENDIX

2

Copies of the initially developed surveys.
HOW WOULD YOU PREFER TO BE TAUGHT BIOLOGY?

 Tick the relevant box with

<table>
<thead>
<tr>
<th>YES</th>
<th>I prefer this method</th>
<th>NO</th>
<th>I do not prefer this method</th>
</tr>
</thead>
</table>

1. **Experiments**
   (e.g. doing experiments in the laboratory, working with the microscope, observing, designing experiments, recording results, etc.)

2. **Demonstrations**
   (All experiments are done by your teacher while you listen and record results in your notebook.)

3. **Biology Projects**
   (Finding information in different books, newspapers, journals, magazines etc. and writing up important information in your project books.)

4. **Class Discussions**
   (Discussing issues related to a topic you studied in Biology.)

5. **Computers**
   (Learning Biology from computer packages and the Internet.)

6. **Worksheets**
   (Your teacher explains work for half of the lesson and you complete a worksheet on your own for the other half of the lesson.)

7. **Your teacher takes charge**
   (Your teacher explains work for the whole lesson and then gives you homework.)

8. **Outings**
   (Visits to the museum, nature reserves, zoo, botanical garden, power station, observatory, laboratories, soap powder factory, etc.)

9. **Videos**
   (Watching Biology TV videos.)

10. **Games**
    (Using different games e.g. crosswords, drama, dominoes, etc. to help you understand different words in Biology.)

11. **Creative materials**
    (Pupils creating posters, models, charts, etc. in Biology lessons.)

12. **Investigations**
    (Doing long-term projects. At the beginning of the project you pose questions and by the end of the project you try to find solutions to the questions posed.)

13. **Teaching through problem-solving**
    (You work in a group to solve problems given by your teacher. At the end of the lesson you find an answer to the problem.)

14. **Relating Biology to everyday life situations**
    (Your teacher includes information from magazines, television and personal experiences from the pupils in the Biology lessons.)

15. **Visuals Materials**
    (Your teacher uses teaching materials like transparencies, overheads, slides, posters, etc. to teach during a lesson.)

16. **Textbook Summaries**
    (You will use your textbook at the end of each lesson to make summaries of the sections your teacher has taught in class.)

From the above methods of teaching Biology, choose the two NUMBERS of the methods which YOU prefer:

THE BEST: Numbers (______) and (______)
THE LEAST: Numbers (______) and (______)
- Add any additional ideas or suggestions on how you would like to be taught Biology.
HOW WOULD YOU PREFER TO BE ASSESSED (TESTED) IN BIOLOGY?

Tick the relevant box with

YES  - I prefer this method
NO   - I do not prefer this method

<table>
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<tr>
<td>2. Writing <strong>class tests</strong> every two weeks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Doing a 4 - <strong>page project</strong> twice a year.</td>
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<tr>
<td>4. Completing <strong>worksheets</strong> once a week.</td>
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<tr>
<td>5. Completing a <strong>worksheet</strong> everyday in class and handing it in to your teacher to be marked.</td>
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<tr>
<td>6. Doing a <strong>Biology practical</strong> once a week and handing it in to your teacher to be marked.</td>
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<td>7. <strong>Multiple choice tests</strong> once a week.</td>
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<tr>
<td>8. Doing <strong>problem-solving questions</strong> in groups twice a week and handing in the answers to your teacher at the end of the period to be marked.</td>
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From the means of assessment (testing) in Biology above, choose the two **NUMBERS** of testing YOU prefer:

THE BEST: Numbers (____) and (____)

THE LEAST: Numbers (____) and (____)

Please Turn Over ......

University of Cape Town
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology

In ANY of the methods of assessment (testing) above, who would you prefer to mark your work:

FIRST READ THE FOLLOWING:

A. Only my teacher marks my work.

B. When we work in groups only a group-leader, chosen by all the other group members, gives us a group mark.

C. With group work or my own project work, I give myself a mark (HONESTLY), according to the amount of effort I put into the work.

D. My teacher, group-leader and I work together to give the group or myself a mark.

THEN, BY WRITING THE LETTER NEXT TO THE NUMBER, CHOOSE WHICH OF THE ABOVE MEANS OF MARKING YOU PREFER THE MOST (1) TO THE LEAST (4):

1. _______ 3. _______

2. _______ 4. _______
APPENDIX

3

Copies of the re-wording of some of the items in the surveys.
HOW WOULD YOU PREFER TO BE TAUGHT BIOLOGY?

Tick the relevant box with

YES - I prefer this method
NO - I do not prefer this method

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<td>12. Investigations (Doing long-term projects. At the beginning of the project you pose questions and by the end of the project you try to find solutions to the questions posed.)</td>
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<td>13. Teaching through problem-solving (You work in a group to solve problems given by your teacher. At the end of the lesson you find an answer to the problem.)</td>
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<td>14. Relating Biology to everyday life situations (Your teacher includes information from magazines, television and personal experiences from the pupils in the Biology lessons.)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>16. Textbook Summaries (You will use your textbook at the end of each lesson to make summaries of the sections your teacher has taught in class.)</td>
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From the above 16 methods of teaching Biology, choose the two NUMBERS of the methods which YOU prefer:

THE BEST: Numbers (___) and (___)

THE LEAST: Numbers (___) and (___)

Please Turn Over ............
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.
HOW WOULD YOU PREFER TO BE ASSESSED (TESTED) IN BIOLOGY?

Tick the relevant box with

YES - I prefer this method
NO - I do not prefer this method

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<td>2. Writing class tests every two weeks.</td>
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<tr>
<td>3. Doing a project (e.g. 4 pages) twice a year.</td>
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<tr>
<td>4. Completing worksheets once a week.</td>
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<tr>
<td>5. Completing a worksheet every day in class and handing it in to your teacher to be marked.</td>
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<tr>
<td>6. Doing a Biology practical once a week and handing it in to your teacher to be marked.</td>
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<tr>
<td>7. A portfolio is a file containing all your tests, projects, reports etc. and your own ideas and comments about your progress. Your teacher will view it as a tribute to your growth throughout the year. You will hand in this file at the end of the year to be assessed.</td>
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<tr>
<td>8. Doing problem-solving questions in groups twice a week and handing in the answers to your teacher at the end of the period to be marked.</td>
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<tr>
<td>9. Reviews - You will gather newspaper articles and write up reports every term. These reports will be handed in to your teacher to be marked.</td>
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<tr>
<td>10. Mini-essay writing tests once a week - writing half-page essays.</td>
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<tr>
<td>14. Writing an open-book examination every six months. You will be allowed to consult your notes to answer open-ended questions during an examination.</td>
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<tr>
<td>15. Picture tests where your teacher gives you Biology drawings to identify and label.</td>
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</tr>
<tr>
<td>16. Multiple choice tests once a week.</td>
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<tr>
<td>17. Oral presentations - you will do reading research on a topic in Biology and present your information to the class.</td>
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<tr>
<td>18. Once every six months you will be given an oral examination in which your teacher will interview you by asking questions on topics which you learnt in class.</td>
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</tbody>
</table>

From the 18 suggested means of assessment (testing) in Biology, choose the two NUMBERS of testing YOU prefer:

THE BEST : Numbers (___) and (___)
THE LEAST : Numbers (___) and (___)

Please Turn Over ........
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.
APPENDIX

4

Participants' hand written comments for the survey

How would you prefer to be taught biology?
• Add any additional ideas or suggestions on how you would like to be taught Biology.

**lots of discussion while answering questions**

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

- Going on outings is something different being taught out of the class is always more interesting and fun. You also get to see how others teach and their opinions.

I'm quite arty and like making things. It makes the lesson shorter as well because you get so absorbed in what you're doing.

✓

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

- When teaches, just go on and talk the whole lesson. It's boring and you take nothing anything in because it doesn't get your attention.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Class Discussions - You can discuss the topic together in the class, and you can listen to what other people's ideas and what they have to say. If you don't understand something, then you can just ask your teacher.

Experiments - It's good to do experiments, so you can find out how something works by actually doing it. And if you do an experiment on something, you're far more likely to remember it, than reading something out of a book.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

Text Book Summaries - Summarising isn't going to help much, because you just read something out of a book and write it in your own words. You'll probably have forgotten it the week after.

Your teacher takes charge - People won't always remember things when their teacher is talking about it in class.
Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

4. Class Discussions - Class discussions allow the students to engage verbally about what they are learning and it allows them to delve into their own related life experience and that of others, relating to the work.

8. Outings - Outings are a great hands on experience to get to see what we learn in class in reality, we are able to understand better exactly what we learnt which would definitely remain in our memories.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

7. Teacher takes charge - It only allows for parrot fashion learning and one way exchanges of information which proves to be very boring.

16. Textbook Summaries - It makes learning dull boring and uninteractive.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Outings are: interesting, visual stimulating, exciting, challenging, a new experience, being active while learning helps remember it also being taught in different surroundings.

Creative: I enjoy anything creative using imagination. Matters materials, its not being on by you creating it, you remember the model, poster etc more clearly as it is your own.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

Worksheets: it's unstimulating sharing when a teacher tells you info for half a lesson & expects you to remember whilst you fill in a worksheet. This is unproductive.

This is more severe as now the teacher expects you to grasp and remember the boring discussion until your at home and doing your homework.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

quizzes and skits/plays

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Outings are visually stimulating and make biology fun & exciting. Here we learn and remember a great deal more than in class because we are more involved.

Class discussions allows one to voice opinions and add what they know to the teachers discussion. It once again involves the pupils and is therefore a better method.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

Long term projects are time consuming and should be avoided as we have so little time as it is. We need to have the information in order to remember & study it, not drag the process out.

Textbook summaries: this is a boring method of teaching leaving the pupil unstimulated and feeling maybe a little confused as it lacks teachers explanations. √
• Add any additional ideas or suggestions on how you would like to be taught Biology.

In a non formal way discuss with me about the topic without pressuring the class.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

4) You learn so much in class discussions, because you interact and can bounce ideas off one another and because it's informal you don't feel intimidated asking questions.

6) Although in outings you can be unfocused, such a vast array of practical materials & visual aid, in an environment concentrated on learning, is very helpful and provides a welcome change.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

10) I hate games, you don't learn from them, all they do is apply pressure for more due dates and stress, when what your doing has little academic value, when discussions can be held, to clarify subjects, it is rather spent playing GTA like games.

5) There aren't enough computers, half the class move around one other half look up unrelated Yahoo sites. No work gets done and you are left feeling frustrated or on how in which you
Add any additional ideas or suggestions on how you would like to be taught Biology.

Being given the chance to work out something for ourselves before the teacher gives us the answer.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Class discussions allow you to express your opinions as well as listen to other pupils. This keeps your attention in class & makes it interesting.

Relating biology to everyday life helps you notice things around you everyday, that would normally not notice. It makes you want to find out more about other new things you find and make your own analysis, then bring it up in the next lesson & have the teacher explain.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

When only the teacher speaks, you lose interest sooner as the lesson becomes boring. Listening to new or different thoughts makes it exciting. You might not understand the homework, because you didn't have a chance to ask questions in class.

I find textbook summaries monotonous, it's boring & you just want to get it over with so you rush through it & don't learn anything.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

"Many more hands-on experiments and outings. Get out of the classroom."

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Through experiments we have not only hands on, but a first hand experience to discover and therefore find out for ourselves the answers. Through our investigation and solving, we will learnt better and remember. On outings we enjoy ourselves tremendously. We always learnt best when we're enjoying ourselves and it will stay with us. We get a physical attempt to experience real nature, not a picture or model.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

Not only is copying from a book boring, everyone HATES it and we don't learn efficiently. Long-term projects create stress and tension as we have to find time for these useless things which clash and irritate.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

**Quizzes and skits (you will remember it)**

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

**Outings:** It is imperative that students have different exposure to learning methods. An outing is visibly stimulating & memorable. They are fun.

**Class Discussions:** Voicing your opinion & hearing others voice theirs can be an extremely beneficial way of learning. This is when the whole subject is covered & you are inspired to really think about the subject.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

**Investigations:** They are difficult & require too much from a student. Time is also most of the problem with conducting investigations.

**Textbook Summaries:** Here work is not done for us to learn, but for us to be 'working'. Knowledge is parroted from book to paper without thought & insight. It is a tiring & draining process that students do not even benefit from.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

no. 5. I like it because it would be different, instead of using your textbook one would get on the computer and research information.

no. 6. Outings are always interesting because it is a chance to get out of school and see the real world and learn about what this wonderful earth of ours has to offer.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

no. 6. I'm sure many people would agree with me when I say that doing summaries is very boring and extremely time consuming, that is why I don't enjoy summaries.

no. 4. I would rather get work for class than be taught for a whole lesson and then forget a half the work and struggle on it at home.
Add any additional ideas or suggestions on how you would like to be taught Biology.

No, I am satisfied

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

1) Hands on experiences allows you to make your own mistakes and investigations allowing you to formulate solutions, develop your own responses and react according to your personality as mentioned in class we would remember it much better than if you saw a diagram in a text book.

2) Much like number 1 in many aspects with the added addition of being outside the confined walls of classrooms. We can see things in their natural environment as opposed to on a page in a book of models.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you you regard them as being of least importance.

7) Listening to a teacher talk for a full hour can easily become boring and monotonous and then to go home and do a task where you don't have any one to ask for help if necessary is not ideal.

8) The textbook, although packed with information is not as beneficial as the other more practical methods. I find that when I summarize I tend to just write words and they do not register.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

No, I am happy with the way I am being taught.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

4 - It is important to talk about the things you have learnt in class as it helps bring everything into context.

8 - Going on outings brings biology to life, you can see where the animals you learnt about live, plants grow and how we use them in society.

Biology is more than sitting in a class room, it should include times of one on one in nature.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

7 - When your teacher takes charge, you're not involved in the learning process and lose interest quickly. Therefore, you don't learn one thing.

16 - Once again it is generally just a boring method. It can be valuable if used every now and then, but not constantly.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Add any additional ideas or suggestions on how you would like to be taught Biology.

A quiet environment is essential to concentration!!

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

• Experiments are hands-on, this keeps your attention and helps you to remember.

• Relating Biology to your own life helps one to think of it more as a life-skill and something useful than just a subject to study for. It's nice to know that what you are learning can be used later on in life.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you you regard them as being of least importance.

Computers take too long and when information is found it is usually too much, unnecessary, or the wrong topic. Computers are only nice when they offer new, unknown info.

When a teacher just talks all lesson it's get very boring and concentration drifts away from her/his topic.
Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

I think anything that can be related to personal interest or experience immediately sparks more attention, effort, and active participation. I enjoy figuring things out, whether on my own or in a group, through hands-on methods. The places I have been, and the people I have met, are what has taught me the most, regardless of subject or location. Just by listening to what another person has to say, one can learn quite a bit.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

These two methods are geared more towards doing for the sake of doing, rather than for pleasure or interest. I lack motivation for working through a textbook on my own spare time. I like visual aids, but particularly real ones, as in real specimens.
APPENDIX

Participants’ hand written comments for the survey

How would you prefer to be assessed in biology?
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

I like these 2 methods because they reflect performance over a longer period of time. Also because they don't just test an ability to regurgitate answers.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

I personally don't like to be tested, and don't feel that it's the best way to judge one's intelligence. Writing only 1 big exam every 6 months is hard to prepare for, and will not reflect all prior knowledge. I also believe that multiple-choice tests do not always portray an accurate description of knowledge or skills required.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Rather many small marks all together than one end-of-year mark.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

• Biology prac-experience is remembered far longer and clearer than other forms of learning.

• Test at end of each section gives a student the chance to make sure that they understand all. Also forces them to keep up to date and not fall too far behind. By the time the exams start it is too late to realise that you never understood.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

Orals that are worth many marks are very nerve-breaking and this could badly affect your ability to remember what you have learnt. It is also easier to write a sentence in the correct wording than it is to say it. End of year exams are inaccurate and hold the same problem associated with nerves.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

No. 3. Projects are fun but, if we are given a project then it should be of something really interesting, which will hopefully help us to gain some added knowledge. We should be allowed to choose our own topic on the work which we are doing in class.

No. 10. This method would be a good way to recap on the weeks work, it would be a good idea to do this every Friday.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

No. 17 I for one don't enjoy scales which is why I least favour this method.

No. 6.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

**Portfolio**: Having a portfolio would inspire students to do better as they reflect on their past records. It is a form of motivation & goal-setting which could only benefit a student with high standards or low standards to improve.

**Research Project**: This gives us the opportunity to be independent in our learning process. The method is best for remembering & understanding work as the information is first found, edited & then regurgitated in front of the class.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

Reviews give you the chance to choose a part of biology which you find interesting and want to learn more about.

Involvement marks are important because it encourages students to become involved, therefore paying more attention in class and in the process learning more.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

Working in groups, you always spend $\frac{1}{2}$ the lesson talking and when it's time to hand it in one clever person fills in all the answers.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Just getting marks for everything we hand in - no test or exam.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

An open-book test creates no stress as we can research and look up instead of having to remember too much.

A project of 4 pages each twice a year is relaxing, easy and efficient.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

Nothing that requires heavy studying, as once the test is over, you don't retain the studied information anyway. Long term reviews accumulate and cause stress as they always get in the way of other things.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

Oral presentations allow one to get creative and make the section of work fun and interesting. Some of your own research can be added in order to bring about new and different ideas.

Revision tests are imperative in order to see how clear your understanding is of the various sections. It creates a clearer picture of your knowledge and highlights your problem areas.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

Examinations place the pupil in a very stressful environment. The majority of your final mark is determined by this whereas it should be continuous assessment in case of a blank spell or anxiety under the strict conditions & pressure exuded.

An oral examination doesn't give you enough time to think.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

Exams are a good way of learning, there is enough pressure to motivate you. A larger amount of work means a more varied pattern of questioning helps you recall assessment areas, strong points and find closure.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

Picture tests are terrible, they are unclear and impractical, they aim at confusing the student. The photocopying is dreadful.

It's just going over board too much work is not in the right areas.
• Please add any additional suggestions or ideas on how you would like to be assessed in Biology.

Look again at your choices of your two most preferred ways of being assessed in biology. Explain in more detail why you favour these two methods of being assessed.

7. Encourages pupils to do well in Biology because they know the teacher will review everything.

16. Having a test once a week will ensure that the pupil can grasp what he/she learned during the week. Having it being multiple makes it easier and the pupil will look through all possible answers before he/she makes a decision so if they get it wrong they can remember the other options they had and so gain the right answer. It's also not so stressful and pressuring so the pupil feels that they can cope.

Look again at your two least favoured methods of being assessed in biology. Explain in more detail why you do not prefer them.

1) An examination involves studying a large volume of work which is non-productive, stressful and an unfair way of gaining marks as the pupil may not cope under such stressful situations and their year mark relies on doing well twice a year.

12) If you are tested at the end of each section it's not continuous: the pupil will forget what they learned at the beginning of the section. To ensure that all is remembered continual tests should be done throughout that section so all is remembered.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

**Outings**

1. Going on outings will make you focus more on what we're going to look at and clears your mind of all the other things because different people tells you what it all about.

**Videos**

2. People focus more if they are doing something they enjoy and will pay more attention while jotting down info.

Look again at your choices of your two least favoured teaching methods in biology. Explain in more detail why you regard them as being of least importance.

**Projects**

3. Some people think that project are very good but some people think (like myself) that it is a waste of time nerve-recking if you can't find any info.

**Teacher Takes Charge**

4. Very boring and I can't focus and remember things if I don't find it interesting. Might fall asleep.
• Add any additional ideas or suggestions on how you would like to be taught Biology.

Look again at your choices of your two most preferred teaching methods in biology. Explain in more detail why you rate them as being especially important.

Class discussions
→ It's very effective I think because we get to ask questions, express our opinions, say what we would like to say. Everyone remembers and can take part.

Outings
→ Outings are enjoyable and easy to learn from, it's something you always remember and I think it's effective because we don't learn in the same environment all the time, we can experience an outing.

Textbook summaries
→ They are important but not the nicest way to learn. It's stuff that is important otherwise we will forget and won't have any way of knowing what to study, but I just don't like all the writing and stuff.

Videos
→ You lose interest quickly and you can get lost on the way, and you don't know what's going on and you lose marks. It's not bad, but you tend to talk...