THE IMPLEMENTATION OF EDUCATIONAL MEDIA BY BIOLOGY TEACHERS IN THE THOHOYANDOU AREA

BY

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DECLARATION

I declare that IMPLEMENTATION OF EDUCATIONAL MEDIA BY BIOLOGY TEACHERS IN THE THOHOYANDOU AREA is my own work, that all the sources I have used or quoted have been indicated and acknowledged by means of complete references, and that this dissertation was not previously submitted by me or anyone else, to this University or to any other educational institution for a degree.

SIGNED:

DATE:
ACKNOWLEDGEMENTS

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- Above all, I thank Almighty God, who gave me life, strength, protection, sustenance and good health throughout this study.
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CHAPTER ONE

1. INTRODUCTION, MOTIVATION, RESEARCH PROBLEM, AIMS OF THE STUDY AND RESEARCH METHODOLOGY.

1.1 Introduction

Teaching and learning activity is characterised by effective communication. Teaching and learning as communication is successful when the learner has taken in new information with understanding. Effective teaching cannot take place unless effective communication takes place. On the other hand effective communication depends on media that are used in the teaching-learning activity (Heinich, et al, 1989: 13).

In the teaching and learning of biology, educational media are important. The study of biology is a practical venture that requires the use of media e.g. realia, models, pictures and chemicals. Biology needs to be learnt through active participation, experience, observation and investigation by both the learner and the educator. This is not possible without the use of media. In real life, the learner's senses are stimulated by media such as real objects, pictures, radio, television, books, etc. In the teaching of biology, the learner's senses must be equally stimulated. It is therefore necessary that the biology teacher be continuously reminded of the Chinese proverb which says, "I hear, and I forget; I see and I remember. I do, and I understand" (Dwyer, 1993: 194).

It is due to the above realisation of the need to use educational media in biology teaching, that this study focuses on the place, value and role of educational media in the teaching and learning of biology.

1.2 Motivation

The democratic Republic of South Africa is undergoing political, educational and economic changes. South Africa is divided into nine provinces. Each of the nine provinces has its own Department of Education, Arts, Culture and Sports. These departments share a co-curriculum, however each department runs its own examinations. On the basis of a
common curriculum it is possible to analyse and compare the results of the Grade 12 external examinations nationally.

When the Northern Province’s results of Grade 12 external examinations are compared with the results of other provinces, this province happen to have the lowest pass-rate.

The following are regarded as factors that contribute to this high failure rate:

a. **Underprovision of physical facilities and resources.**

The Northern province is constituted by the three former homelands of Venda, Lebowa and Gazankulu as well as a small portion of the former White South Africa. The homelands were discriminated against by the financial policies during the apartheid era. These policies led to high shortages of physical facilities such as classrooms, libraries and laboratories. (Duminy, 1992: 166) Conditions prevailing in this province have deteriorated to the extent where the Deputy President of the Republic of South Africa, Thabo Mbeki, declared the Northern Province an education disaster area in 1996 (MEC Keynote address in UNESCO, 1996: 2). In most schools in this province, teaching takes place outdoors or in shacks which are not conducive to instruction, alternatively pupils are taught in overcrowded classrooms. Resources, such as educational media are not available. The question that one has to ask is how biology is taught, and how effective are the instructional methods?

b. **Poorly trained and underqualified teachers.**

The MEC of Education, Arts, Culture and Sports, in his speech at the UNESCO Conference held in Moscow, declared that teachers in this province are poorly trained and underqualified (MEC Keynote address at UNESCO, 1996: 2). If teachers in this province in general are poorly trained and underqualified, what are the qualifications, both academic and professional, of biology teachers? To what extent are these teachers media trained both during pre-service and in-service training? How familiar are these teachers with the nature of biology, the aims and objectives of teaching the subject, as well as functions of media in teaching and learning in general?
c. Biology is a popular subject and therefore increases the total failure rate.

Biology is popular and had the highest enrolment rate between the years 1986 - 1990 in South Africa as a whole. However, during this period Blacks had the highest enrolment percentage of about 87 percent and the lowest pass rate of about 14 percent in comparison with other population groups (Samuels, 1995: 10 - 12). In the Northern Province biology is taken by students who follow a general subjects curriculum and those who follow a science subjects curriculum. The former group of students needs to pass biology to obtain matric exemption. A high failure rate in biology may contribute to the general high failure rate of the Grade 12 students in the Northern Province. Table 1.1 shows the symbol distribution of biology candidates during the period 1995 - 1997 of sampled schools in the Thohoyandou Inspection Area. Compiled by the researcher from raw data collected from the regional office at Thohoyandou.

<table>
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<td>A</td>
<td>12</td>
<td>0.38</td>
</tr>
<tr>
<td>B</td>
<td>27</td>
<td>0.84</td>
</tr>
<tr>
<td>C</td>
<td>120</td>
<td>3.75</td>
</tr>
<tr>
<td>D</td>
<td>217</td>
<td>6.80</td>
</tr>
<tr>
<td>E</td>
<td>953</td>
<td>29.81</td>
</tr>
<tr>
<td>F</td>
<td>1012</td>
<td>31.65</td>
</tr>
<tr>
<td>G</td>
<td>90</td>
<td>2.82</td>
</tr>
<tr>
<td>GG</td>
<td>426</td>
<td>13.32</td>
</tr>
<tr>
<td>H</td>
<td>340</td>
<td>10.63</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3197</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1.1: Symbol distribution of biology candidates 1995 - 1997 of sampled schools.

The total enrolment for Grade 12 of the sampled schools in this area in 1995 – 1997 was 3378. Table 1.1 indicates that biology candidates during the same period were 3197, which constitute 94.6 percent of total enrolment.

The majority of students, (31.65 percent) obtained an F symbol. This symbol is regarded as a pass, however it is a poor symbol which does not satisfy conditions of admission at institutions where a pass in biology is required.
Samuels (1995: 13) has noted that teaching styles in African schools are mainly expository. The tendency of teaching biology mainly through the expository methods is opposed to the DET Syllabus stipulation that biology should be taught through the experimental, discovery, observation and inquiry methods (DET Biology Std 10 Syllabus 1989). Teaching and learning in biology should be through practical investigation.

Educators argue that media have various functions that enhance learning. Consequently, it stands to reason that if media are not integrated in the teaching and learning of biology, this can result in ineffective learning and poor achievements by the learners. This study focuses on the place and value of educational media in the teaching and learning of biology at the Thohoyandou Inspection Area of Region 3 in the Republic of South Africa.

1.3. Research problem

In view of the foregoing discussion, the problem here would be to investigate the place, value and role that educational media play in the teaching and learning of biology in the study area. The main research problem under investigation is:

What role does media play in the teaching and learning of biology? The following questions give an overview of the research problem:

- Does the use of media in the teaching of biology motivate and improve the interest of the learner?

- Does the use of media in the teaching of biology make learning more effective?

- Does the availability and non-availability of media have any bearing on the teaching of biology?

- Do biology teachers receive in-service training in the skills of media utilisation and methods of teaching biology?
Can biology be effectively and successfully taught without the use of any other media except textbooks, chalkboards and the teacher's choice?

An attempt is made in this study to answer these questions. Having formulated the research problem, it is therefore necessary to state the aim of this study.

1.4 Aims of the study

The aims of this investigation are summarised as follows:

- To determine the role played by media in the attainment of traditional subject outcomes of teaching biology.

- To define the nature of biology and outcomes of teaching biology.

- To determined the suitability of biology teachers to teach the subject in relation to both their professional and academic qualifications.

- To assess the level of media training of biology teachers during pre-service and in-service training.

- To determine the relationship between media and certain teaching strategies, namely: Process approach, concept mapping and outcomes based education.

- To make recommendations for the provision and incorporation of media in the teaching and learning of biology in particular, as well as in general instruction.
1.5. Research Methodology

To arrive at a more representative view on factors that lead to the high failure rate as experienced in the Northern Province, three sets of data are relied upon for this study. These are:

1.5.1. Biology teachers’ questionnaire.

The objectives with these questionnaires are:

- To determine the extent of biology teachers’ qualifications, both academic and professional, as well as the level of media training they have received.

- To assess the biology teachers’ knowledge of the nature of biology, aims and objectives of teaching the subject. The aims and objectives of teaching biology were replaced by specific outcomes of science as outlined in the discussion document, Curriculum 2005 (Department of Education, 1997: 134). These specific outcomes were rephrased to make the terminology more suitable for biology.

The specific outcomes of teaching biology are included because they play an important role in the task of teaching the subject. Educational media play a significant role in instruction, therefore it is considered important to assess the attitude and knowledge of biology teachers about the place and functions of educational media in the teaching of biology. The Northern Province experiences high shortages of physical facilities such as classrooms, laboratories and resources. Consequently one of the objectives of the questionnaire to biology teachers is to establish the average enrolments of biology students per class and the availability of laboratories in this inspection area.
1.5.2. Questionnaire to the principals.

Questionnaires were circulated to principals of schools in this inspection area. The objectives of circulating these questionnaires are to establish the principals' attitude towards the integration of media in general instruction and media provision at schools in this inspection area. Principals are influential in the planning of the schools' budgets. They are regarded as having first hand information about the schools' financial capacity.

1.5.3. Questionnaire to the media science lecturers

Four questionnaires were circulated to media lecturers at colleges of education found in Region 3 and one questionnaire was circulated to the media lecturer at the University of Venda. Media lecturers are engaged with the media training of teachers on a day to day basis. Media lecturers are considered to be knowledgeable about matters that concerns media training of teacher at pre-service level.

Closed-ended questions in all questionnaires are used, however a key: strongly agree, agree, disagree and strongly disagree, is used to allow different extremes of expression. It is considered that those who responded that they strongly agree or strongly disagree are explicit in their decisions.

1.6. Definition of terms.

1.6.1. Educational outcomes

They are also known as essential or critical outcomes. They express in a broad sense the intended results of education. They are not restricted to any specific learning context. (Conradie, 1997: 9).
1.6.2. **Educational specific outcomes**

These are narrowly defined context-linked aspects of the education process. They describe what learners should be able to demonstrate in specific contexts of learning (Conradie, 1997:9/10).

1.6.3. **Educational media**

Educational media means any person or objects that are used deliberately to put across or communicate learning content in the didactic situation (Freysen, 1993: 3). Any form of objects whether real or models, pictures, diagrams, transparency, video, computer, apparatus etc., which are used in the instruction of biology or learning thereof is regarded as educational media.

1.6.4. **Multi-media systems.**

Multi-media systems refer to a multi-sensory way of learning, that is, where more that one medium is used in a lesson.

1.6.5. **Region 3 of the Northern Province.**

This refers to the geographical area incorporating the former Republic of Venda, part of the former Gazankulu homelands, part of Lebowa homeland and a section of the former Transvaal Provincial Administration.

1.6.6. **Inspection Area.**

The term inspection area means the Thohoyandou Inspection area.
1.6.7. DET

The term DET means the Department of Education and Training.

1.6.8. MEC

The term MEC refers to the Member of Executive Council at provincial level.

1.6.9. CAI

The term CAI refers to computer assisted instruction.

1.6.10. OBE

The term OBE means Outcomes Based Education.

1.6.11. Media

The term media refers to educational media.

1.7. The programme of the study

Chapter one: It forms an introduction of this study. The motivation, research problem, the aims of the study, research methodology and definition of terms are outlined in this chapter.

Chapter two: Biology teaching and media. The focus of this chapter centres on:

a. how outcomes direct the process of teaching.

b. the nature of biology as a science.
c. outcomes and how they are derived from the nature of biology.
d. how outcomes of teaching biology in South Africa compare with those envisaged abroad.
e. how the process approach and concept-maps contribute in the effective teaching of biology.
f. discussion on the way forward, the outcomes-based education as a new approach for a new curriculum.

Chapter three: Literature survey on the place and value of media in teaching of biology. This chapter outlines how didactic principles are realised by integrating media. Media have attributes that direct the biology teachers to select a certain type of media to attain particular outcomes. These attributes determine the functions of media. Hence media enhances acquisition of outcomes of teaching.

Chapter four: Research design, methodology and data analysis. This chapter gives an outline on:

- Selection of the population,
- Pilot work,
- Problems encountered and
- analysis of questionnaires.

Chapter five: Biology teaching and media integration as a way of acquiring educational outcomes. The focal point of this chapter can be summarised as follows:

- Teacher education and media training.
- Media and outcomes acquisition in the teaching of biology.
- The use of media and approaches of teaching biology.
- Guidelines on media usage in biology teaching, the Northern Province context.

Chapter six: Summaries, conclusions and recommendations.
CHAPTER II

2. MEDIA CENTRED BIOLOGY TEACHING

2.1. Introduction

Education in South Africa is in a period of significant change, in order to normalise and transform teaching and learning. One of the goals of education is to provide quality life-long learning to all its citizens (Samuels, 1995: 28).

According to the National Curriculum Framework (NQF) document which is based on the principles of the White Paper on Education and Training (1995), there is a paradigm shift from the traditional aims and objectives approach to outcomes-based education. This paradigm shift is a prerequisite for the achievement of the following vision for South Africa: “A prosperous, truly united, democratic and internationally competitive country with literate, creative and critical citizens leading productive, self-fulfilled lives in a country free of violence, discrimination and prejudice” (Department of Education, 1997B: Preface).

According to the discussion document “Curriculum 2005”, (Department of Education, 1997B: 133) the rationale for the learning of Natural Sciences must be based on the development of appropriate skills, knowledge and attitudes and an understanding of the principles and processes of the Natural Sciences, namely to:

- enable learners to make sense of their natural world;

- contribute to the development of responsible, sensitive and scientifically literate citizens who can critically debate scientific issues and participate in informed way in democratic decision-making processes;

- are essential for conserving, managing, developing and utilising natural resources to ensure the survival of local and global environments; and

- contribute to the creation and shaping of work opportunities.
In view of its potential to improve the quality of life, learning in Natural Sciences must be accessible to all South Africans.

It is acknowledged that implementing the new curriculum, may not be an easy task. There is an urgent need for the provision of facilities and resources, especially in rural areas, on a need-to-have, able-to-use basis linked with in-service education (Department of Education, 1997B: 132).

However, it is hoped that this vision can be successfully implemented through the commitment from all participants in the learning process (Department of Education, 1997A: 1).

In the light of the above paragraph, there exist possibilities that a biology teacher may contribute to the achievement of the vision of the new curriculum as outlined in the curriculum 2005 (1997A) document. The National Minister of Education states that “much of our efforts will be focused on providing the necessary support in the form of in-service teacher training, assessment, guidelines and student orientation” (Department of Education, 1997A: 1).

The focus of this chapter centres on:

(a) how traditional subject outcomes direct the process of teaching
(b) the nature of biology as a science
(c) traditional subject outcomes and how they are derived from the nature of biology
(d) how traditional subject outcomes of teaching biology in South Africa compares with those envisaged abroad
(e) how the process approach and concept-maps contribute in the effective teaching of biology
(f) discussion on the way forward, the outcomes based education as a new approach for a new curriculum
2.2. The significance of educational outcomes in teaching

Effective teaching involves having reasons for teaching what we teach, and why we teach it the way we do (Van Aswegen, et al, 1993:38).

The teacher who teaches without outcomes is like a ship without a mast or a traveller without a map. There is a need to formulate outcomes or to identify them and take them into consideration when one has to teach. This requirement is based on the reason that outcomes provide guidance and direction. Effective teaching requires clarification and understanding of outcomes. It is through the stipulated outcomes that the reasons for teaching are given.

The available curriculum 2005 documentation mentions two levels of outcomes, namely Critical Cross-field Outcomes (cf.2.2.1) and Specific Outcomes or Learning Area Outcomes, e.g. for Natural Sciences (cf. 2.6.3.). No further differentiation is made into different outcomes applicable to subject content (e.g. Biology) within broader learning areas (e.g. Natural Sciences). This creates problems in the teaching (even within an OBE-paradigm) of subject content which is exclusively biological in nature (Van Rooyen, 1998).

Over the years some authors have postulated and refined aims and objectives for biology teaching (cf. Falk, 1980; Sands, et al,1986; Samuels, 1995; Van Aswegen, et al, 1993). These sets of objectives are still valid for the teaching of biology content, even within a broader learning area of Natural Sciences. Van Rooyen (1998), therefore, suggests that these sets of subject objectives are being referred to as “traditional subject outcomes”.

2.2.1. Educational outcomes

Education is a purposeful and purposive venture. Educationists the world over agree that the general outcome of education is to educate the child so that he should eventually become someone with a balanced personality, showing inner stability and steadfastness (Du Plooy, Griesel, and Oberholzer, 1982: 135). It is appropriate to stress that educators who subscribe to different philosophies of life view adulthood from different perspectives. Du Plooy states that according to Van Zyl, the aim of education is geared “to the aim of
life or a way of living”, to Kriekenmans, it is “the spiritual emancipation”, to Perquin, it is “the becoming -an-adult of the child” (Du Plooy, et al, 1982:137/138; Engelbrecht, Yssel, Griessel & Verster, 1985: 23/24).

Van Aswegen, et al (1993: 38) views the critical outcome of education as the act of unlocking reality for the child. The outcome of education is also regarded as acquisition of various facets of life such as personal qualities and attitudes, human capabilities as well as skills, knowledge and understanding (Duminy, Steyn, Dreyer, Vos and Peters, 1992: 10).

From the above paragraphs, it is evident that specific outcomes are often general and diffuse about the intention of the course of teaching. They are difficult to implement (Van Aswegen, et al, 1993: 42; Sands, et al, 1985: 8; Samuels, 1995: 31).

There are reasons why traditional subject outcomes must be developed, implemented and assessed. Outcomes indicate to the ultimate destination. They describe why teachers are teaching and their intentions (Van Aswegen, et al, 1993: 38). Kibler, et al (Samuels, 1995: 30) regards the significance of outcomes as being closely related to the “concept of accountability”. According to him outcomes assure those who finance education that something worthy of their money is being accomplished.

Taking into consideration that various educators hold different concepts of educational outcomes; Hall, et al (1973: 18) suggests that the following criteria must be borne in mind when educational outcomes are formulated:

(a) The all-round development of the learner, for example, psychological development, physical development and emotional development.

(b) A consideration of the consumer requirements; for example, employers in industry or business and the student himself.

(c) The nature of the subject, in this case biology.
(d) Feasibility constraints imposed, for example by resources, by the competency of the teachers and the culture of the country.

It was stated in the introductory paragraph, that South Africa is faced with educational changes. These changes embrace a shift from content-based to outcomes-based approaches, from old values and attitudes formed in the old divided South African to new ones which will promote a unified prosperous democratic South Africa.

These changes also include the integration of education and training, fostering of human rights, multi-lingualism and multi-culturalism and a sensitivity to the values of reconciliation and nation building (Department of Education, 1997A: 1). The critical cross-field outcomes of education for the democratic South Africa are laid down in the document Curriculum 2005 (Department of Education, 1997A: 16) as follows:

Learners will:

1. Identify and solve problems and make decisions using critical and creative thinking.

2. Work effectively with others as a member of a team, group, organisation and community.

3. Organise and manage one self and one’s activities responsibly and effectively.

4. Collect, analyse, organise and critically evaluate information.

5. Communicate effectively using visual, symbolic, and/or language skills in various modes.

6. Use science and technology effectively and critically showing responsibility towards the environment and health of others.
7. Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

8. Show awareness of the importance of effective learning strategies, responsible citizenship, cultural sensitivity, education and career opportunities and entrepreneurial abilities.

It is envisaged that this type of education will offer a better quality of life for everybody in South Africa, irrespective of race, age, gender, colour, religion, ability or language (Department of Education, 1997A: 2).

“These broad teaching aims and learning aims, however, are not specific to assist directly in the creation of proper educational experiences”, (Samuels, 1995: 32). Consequently critical outcomes need to be structured in terms of “subject matter” such as history, biology, geography, etc.

“Aims served by the subject are known as subject matter aims or syllabus aims” (Samuels, 1995: 32; Van Aswegen, et al, 1993: 38).

Since critical outcomes are always general and diffuse for teaching purposes; they must therefore be translated into specific outcomes (Hall, 1973: 23).

2.2.2. Specific outcomes

Specific outcomes are outcomes which should be obtained much quicker, that is within a course of a single lesson. They describe what the learners will be able to do at the end of the lesson or educational programme. Put more precisely specific outcomes refer to the new capability which the learner should be able to demonstrate at the completion of the lesson or instruction. They describe what the learner ought to get out of the lesson (Falk, 1980: 48; Sands, et al, 1985: 8; Heinich, 1989: 37; Farmer, et al, 1980: 105; Van Aswegen, et al, 1993: 43).
2.2.2.1. Writing traditional subject outcomes

According to Van Aswegen, et al (1993: 43) traditional subject outcomes should be written so that they may serve three functions; namely: guide to learning, guide to instruction and guide to assessment.

In addition Mayer, (Van Aswegen, et al, 1993: 43); Falk, (1980: 50); Heinrich, et al (1989: 38 - 40) and Freysen, et al (1989: 34) describe a well-formulated traditional subject outcome as one that consists of the following characteristics:

- A description of behaviour, which indicates that the learner has achieved the outcome or the performance component.

- The important conditions under which the behaviour will be expected to occur or the condition component.

- The criteria of acceptance performance describing how the learner must perform to be considered acceptable - the criterion component.

(a) The performance component

The traditional subject outcomes must be formulated in such a manner that the expected terminal behaviour, in other words, the abilities which the pupils are expected to demonstrate at the end of the lesson, must be stated in observable behavioural terms.

The action verb, which represents the observable learning outcome, needs to be used to formulate the traditional subject outcome.

By using the action verb, the teacher avoids being vague. The vague terms which must be avoided include terms such as “to know”, “to understand”, etc.
The significance of using the action verbs lies in the fact that a fair assessment of whether learning has occurred or not, becomes possible. Action verbs such as explain, describe, label, mention, identify, to mention a few, are therefore more acceptable for the purpose (Heinich, et al, 1989: 38/39; Falk, 1980: 51; Farmer, et al, 1980: 105; Van Aswegen, et al, 1993: 43).

(b) Condition Component

This component states what the learner will be given or denied or what he/she should have done to achieve a given outcome. It indicates special limitation or restrictions which are placed on performance (Heinich, et al, 1989: 39; Falk, 1980: 51; Van Aswegen, et al, 1993: 45).

The condition component guides the teacher on how to assess the learning process. The teacher is led to provide a diagram, if the stated outcome requires of the learner to identify parts of the kidney by labelling a diagram of the kidney. For example: Using the specimens provided, tabulate the difference between a monocotyledonous flower and dicotyledonous flower.

(c) Criterion Component

The criterion states how well a pupil must do before his or her performance is considered acceptable. Heinich, et al, (1989: 40) describes criterion as a degree of accuracy or proficiency, the pupil is expected to achieve.

The acceptable performance is indicated by adding words which describe the criterion of success. The criterion part of an outcome may include one or more of the following four types of standards:

- A reference to standard operating procedure, for example in correct sequence;
- A reference to acceptable level of accuracy, for example how many errors are allowed;

- A reference to time constraints, for example, at the end of twenty minutes; and

- A reference of production rates.

2.2.2.2. Advantages and shortcomings of traditional subject outcomes.

(a) Advantages of traditional subject outcomes.

The merits of stating traditional subject outcomes are vast. A number of these merits are proposed by Van Aswegen, et al (1993: 53/54) as follows:

(i) Outcomes can be regarded as a guide to the planning for the teaching.

(ii) The teacher is guided to think and define clearly the essentials which pupils have to learn.

(iii) Well-stated outcomes assist the teachers to be more precise and specific in teaching.

(iv) They provide specification regarding the choice of content, methods, material and techniques.

(v) They provide criteria for assessing whether teaching and learning are a success.

(vi) Pupils are made aware of what is to be learned and how they should learn it.
In this way learners are spared the frustrations and time consuming effort of trying to guess what the teacher expect of them.

They enable the pupil to organise his work and assess his own progress because he knows what is expected of him.

Outcomes which include the action verb emphasise active participation of pupils.

They summon the pupil’s consciousness and aim at achievement.

The values of stating traditional subject outcomes (Samuels, 1995: 33) are the following:

(i) Make teaching responsive and relevant to the needs of the pupil.
(ii) Allow teachers to clarify his/her goals.
(iii) Allow teachers to communicate with other teachers, parents, advisors etc.
(iv) Allow for the issue of accountability;
(v) Spare pupils the frustration and time consuming effort of trying to guess what the teacher expects of them.
(vi) Help the teacher to evaluate pupils’ achievement and their teaching programme.
(vii) Help pupils organise their own learning and assess their own progress.
(viii) Enable effective curriculum planning.
(ix) Help the teacher to select methods and materials for teaching.
(x) Facilitate active pupils’ participation in learning.

Traditional subject outcomes that were achieved in the previous lesson serve as a frame of reference in the following lesson. One cannot turn a blind-eye on the values of stating traditional subject outcomes in biology teaching. Without explicit outcomes pupils would not know what is expected of them. If outcomes are clearly stated learning and teaching become outcomes - oriented. It stands to reason that no wise biology teacher will neglect the responsibility of stating outcomes.
Without underestimating the significance of stating outcomes one has to acknowledge the limits of stating outcomes. The following are shortcomings of stating outcomes as stated by Van Aswegen, et al (1993: 54).

It may not be possible to describe all concepts and ideas in terms of observable behaviour. The specifically stated outcomes may limit both the teacher's freedom and creativity. Outcomes for low-level abilities, such as simple recall of knowledge may receive more attention, while the higher level abilities are neglected. Over-emphasis of measurable learning achievement leads to superficiality.

Having stated both the merits and demerits of traditional subject outcomes, it must me stated explicitly that merits in stating outcomes rank higher than the demerits. The shortcomings on one hand, were highlighted to serve as warnings for the pitfalls which the teacher has to overcome when stating outcomes. On the other hand the teacher need to bear in mind that outcomes are not intended to limit what the pupils learn. To the contrary, they are intended to provide a minimum level of expected achievement.

The setting of learning outcomes is important for media selection, because learning outcomes that have been set direct the entire instructional activity. The learning outcome itself may give a clear indication of the media attributes and, consequently, of the medium that must be selected.

A stated outcome in a biology lesson could, for example be that the pupil is expected to identify and name the parts of a flower. This outcome implies that both a real flower and a descriptive depiction, such as a sketch, are required to enable the pupil to achieve the outcome.

A lesson that has well set traditional subject outcomes or learning outcomes, may not accomplish what is set to achieve, if it does not include a particular teaching method or methods. When a teaching method is decided upon, due consideration of the type of the learning content must be born in mind.
2.3. The development of the traditional subject outcomes of biology teaching.

2.3.1. The Nature of biology as a Science.

Allen (1979: 7) suggests that there is a need to explore critically what biology is and how it is taught. It seems most appropriate to try to inquire into the nature of biology before one attempt to describe how the subject is taught.

According to Samuels (1995: 38) before one can attempt to describe the traditional subject outcomes of biology teaching, one needs to answer the following questions:

- What is biology?
- Is biology the science of life?
- Is biology the study of plant and animal life?
- What is science?
- Is science a body of organised knowledge?
- What special skills do scientists use in obtaining scientific information?
- Are these skills a part of science?
- Do scientists need to have special attitudes to be effective scientists?
- What are these attitudes?
- Are these attitudes a part of science?

There is a general consensus amongst educators on the following issues:

1. Biology is a science that studies living organisms physical environment (Van Aswegen, et al, 1993: 4; Roberts, Reiss & Monger, 1993: 1; Carin & Sund, 1980: 2; Trojcak, 1979: 1).

2. Biology as science comprises of three components:

   (i) Products or knowledge.
   (ii) Processes or methods and

From the above, the nature of biology can then be described as a body of objective knowledge (product) obtained through reliable processes (method) and the way of life of the scientists, as well as attitudes of the scientists. The structure of biology is better outlined by Carin (1980: 3) in Figure 2.1.

![Figure 2.1: The nature of biology, Carin and Sund (1980: 3).](image)

In answering the question “why teach biology?” Dekker, et al (1993: 33), says “the answer is simply to say that once we know the nature of biology, it should only be taught for what it is”. According to Dekker, et al (1993: 33); Van Aswegen, et al (1993: 39); Falk, (1980: 12); Carin, (1980: 3); Sands and Hull (1986: 8), biology must be taught from the premises of its nature.
The broad outcomes of teaching biology should therefore be acquisition of: knowledge, inquiry skills or process and attitudes and values which guide the scientists in his practice. These three outcomes are interdependent and interrelated. Knowledge is acquired as one engages in the processes of science.

The processes of scientific investigation cannot be learned in the absence of knowledge. These two, knowledge and processes are successfully acquired in the presence of some set of values (Falk, 1980: 13; Dekker, et al, 1993: 33; Sands, et al, 1985: 8).

2.3.2 Towards a rationale for teaching and learning biology

Sands, et al (1985: 8) offers the following three reasons for teaching science.

1. Science has intrinsic value as a body of knowledge and as way of finding out about the world.

2. Learning science help individuals to fulfil their own personal potential.

3. Learning science helps the individual to learn to live in a society and both to contribute to it and to benefit from it.

On the same vein as Sands, Dekker, et al (1993: 35) stipulate the following three reasons for teaching biology:

a) Practical reasons:
   (i) to develop an interest in biology;
   (ii) to develop an awareness of the social and personal importance of biology.

b) There is a content reason: to increase the knowledge of facts, concepts and principles.
c) There are process reasons:

(i) to develop intellectual skills, such as observing, recording, inferring, classifying, predicting, explaining, hypothesising and experimenting.

(ii) to develop manipulative skills for handling apparatus and equipment.

(iii) to protect a true image of the subject.

In an attempt to define the reasons for teaching biology Sund, et al (1967:13) declares that any general education must include science so that future citizens can understand their society. He stipulates the following as general reasons for teaching science (Sund, et al, 1967: 20): Manpower opportunities, literacy of the citizens and the use of leisure time.

Although differently formulated, reasons for teaching biology as a science has the same focal point, which can be summarised as: acquisition of knowledge and inquiry skills, which will eventually benefit both the individual and community as a whole. It is, for example, important for the pupil to know which career can he/she pursue if he/she majors in biology. The reasons stated in paragraphs, above instil awareness on the teacher, of matters such as, development of interest in biology and social significance of studying biology.

“A good teacher knows what he is going to teach, how he is going to teach it, and why he is teaching it. In other words, he has outcomes he hopes students will reach under his instruction (Sund, et al, 1967: 20).

These reasons are further developed into traditional subject outcomes of biology teaching.
2.3.3 The traditional subject outcomes as derived from the nature of biology

Outcomes of teaching biology are derived from the nature of biology (Falk, 1980: 12). Again outcomes tend to be rather general statements difficult to translate directly into what to do (Sands, et al, 1986: 1). For teaching purposes they must be translated into specific outcomes, preferably behavioural so that assessment is possible (Hall, et al, 1973: 23).

For the purpose of this study the broad outcomes of biology teaching from South African Curriculum and from abroad are briefly outlined, followed by traditional subject outcomes as derived from the three components of the nature of biology. Each of the three general outcomes has traditional subject outcomes formulated from its premises.

The Department of Education and Training or DET Biology Higher Grade Syllabus for Std 10 1989, states that pupils should develop the following important attributes:

- an understanding of fundamental biological principles based upon a study of living organisms.

- an awareness of biological relationships.

- an ability to make critical, accurate observation of biological material and to make meaningful records of such observations.

- an ability to analyse biological information, to formulate hypothesis and to suggest procedures to test them.

- an ability to communicate clearly when reporting and expressing ideas.

- a respect for all living things and an urgent awareness of man's responsibilities in the preservation of life, particularly in the South African context.

These traditional subject outcomes of biology syllabus for South Africa (DET: 1989) are simplified into a diagram by Ayerst (Samuels, 1995: 42), and the outcomes of teaching biology abroad by Falk (1980: 12); Sands, et al (1986: 9/8,10) are shown in figure (2.2) and tables (2.1 - 2.3).

**Figure 2.2: Traditional subject outcomes of biology course by Ayerst (Samuels, 1995: 42)**

- Respect for life
- Love of SA flora and fauna

**INQUIRY SKILL**
- Analyse and Evaluate Information

**ATTITUDES AND VALUES**
- Be aware of patterns and relationship
- Developing an inquiring mind and a scientific approach to problems through a study of life

**GOAL**
- Communicate Clearly
- Acquire knowledge and learning skills (extra)

**KNOWLEDGE AND INQUIRY SKILLS**
- Able to make critical observations
- Understanding fundamental principles
- Formulate hypotheses and suggest procedures
Table 2.1: Traditional subject outcome of biology teaching (Falk, 1980:12) and its relationship to the nature of Science.

<table>
<thead>
<tr>
<th>Category of aim of Science teaching</th>
<th>Component of nature of science</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Understanding basic unifying themes</td>
<td>Knowledge</td>
</tr>
<tr>
<td>2 Understanding the investigative nature of science.</td>
<td>Process or inquiry skills</td>
</tr>
<tr>
<td>3 Acquisition of values and attitudes</td>
<td>Attitude and values</td>
</tr>
</tbody>
</table>

Table 2.2: Traditional subject outcomes of teaching biology (Sands & Hull, 1986: 9/10)

| a) To develop knowledge and awareness of the natural environment. | Knowledge |
| b) To develop knowledge and awareness of the man-made environment. | Knowledge |
| c) To develop knowledge and awareness of application of science in the home. | Knowledge and processes |
| d) To develop, understanding and awareness of the importance of technology. | Knowledge and process |
| e) To develop interest in and knowledge of the local environment (natural, man-made including industry. | Knowledge and attitudes |
| f) To encourage and develop actual or potential leisure activities. | Attitudes and values |
| g) To develop good attitudes to science (e.g. realise potential for good as well as dangers for evil need for social responsibility of scientists). | Attitudes and values |
| h) To develop scientific attitudes (e.g. inquiring mind, critical attitude, honesty, caution in making claims, being methodical and careful. | Attitude and values |
| i) To develop practical skills | Processes |
| j) To help to develop mathematical skills. | Processes |
| k) To develop, problem solving skills | Processes |
| l) To help to develop pupil’s skill in language | Processes |

At a closer scrutiny, of all these lists are found to be in close agreement with one another, and they differ in the way that the outcomes are described. Again these outcomes imply the three components of the nature of science (Samuels, 1995: 42).

The outcomes are interdependent and interrelated. Knowledge is acquired as one engages in the processes of science. And the processes of scientific investigation cannot be learned in the absence of knowledge. These two, knowledge and processes are successfully

2.3.3.1 The acquisition of biological knowledge

This outcome as far as biology teaching is concerned, aims at the increase of knowledge of facts, concepts and principles that is, the substantive structure of the subject. Biological knowledge is effectively learned when dealing with facts, concepts and generalisations related to unifying themes.

A biology curriculum which is structured according to unifying themes, helps the pupils to learn, transfer and retain major facts, concepts and generalisations more effectively. Therefore in the first place, unifying themes tend to explain the content and structure of modern biology, and in the second place, indicate what knowledge, attitudes and skills relevant to biology, would contribute the most to pupils personal lives (Van Aswegen, et al, 1993: 39).

Seven unifying themes in biology as proposed by Schwab (1963) as cited by Van Aswegen, et al, (1993: 39/40) are listed here, in an order and arrangement that suggest their interconnections. These seven unifying themes are listed together with their different sub-disciplines in the biological science as follows:

(i) Change of living things through time: evolution.
(ii) Diversity of type and unity of pattern in living things: taxonomy.
(iii) The genetic continuity of life: genetics.
(iv) The complementary of organisms and environment: ecology.
(v) The biological causes of animal behaviour: ethology.
(v) The complementary of structure and function: anatomy and physiology.
(vii) Self-regulation to preserve life in the face of change: homeostasis.

According to Novak (1981: 13), if students could understand each of these themes at some reasonable level, they would have achieved an understanding of biology rarely evident in
students who have completed a high school biology course. He further acknowledges that media such as charts and concept maps can be implemented to enhance understanding of living structure and functions.

(a) Isaac's traditional subject outcomes (Samuels, 1995: 47) for the acquisition of knowledge

Learners should demonstrate:

1. Ability to recall information (terms, symbols, drawings, diagrams, structures, functions, classification, properties, life cycles, processes, names of apparatus, chemicals, specimens, laboratory procedures and precautions etc.).

2. Ability to show the relationship between form and function, between organisms and their environment, amongst organisms and between processes.

3. Ability to demonstrate knowledge and understanding of the personal, social, economic and technological applications of biology.

4. Ability to explain the major themes of biology such as evolution, the continuity of life, homeostasis and energy flow.

2.3.3.2 The development of inquiry skills

Broadly defined, scientific inquiry is a search for truth and knowledge. It must be stated that the scientific method of inquiry may not be precisely defined (Falk, 1980: 16). However the scientific inquiry may be described from the premise of how the scientist works. Science educators agree that a scientist should demonstrate problem-solving skills such as observation, inferring, sensing and defining problems, making hypothesis,
outlining scientific procedures to test hypothesis, carrying out an investigation, controlling
and manipulating variables, formulating models, making valid conclusions, recognising
and using number relations, classifying, measuring, communicating and making
Victor, 1985: 15/16).

The scientific inquiry indicates that scientists search for relevant data that will answer
questions asked about the natural phenomena.

One of the values of scientific inquiry is that it cannot be learned apart from the subject
matter (the knowledge structure). A scientific investigation is performed in order to obtain
information about some objects, process or event in nature.

The nature of the subject matter itself, the nature of the discrepancy that has to be bridged,
the kind and availability of the data that is sought and exactness of the interpretations that
have to be made are related to the direction the inquiry will take. Therefore the two
structures, knowledge and inquiry are inseparable in actual practice (Falk, 1980: 20; Van

(a) Falk's traditional subject outcomes (1980: 60) for the acquisition of
inquiry skills.

Learners should demonstrate:

1. The ability to define the problem under investigation.
2. Ability to formulate a hypothesis.
3. Ability to devise and perform experiments.
4. Ability to record data.
5. Ability to make calculations.
6. Ability to classify data.
7. Ability to make inferences.
8. Ability to make predictions.
Isaac's traditional subject outcomes (Samuels, 1995: 51) for the development of inquiry skills.

Learners should demonstrate:

1. Ability to identify problems.
2. Ability to formulate hypotheses.
3. Ability to design experiments or investigations to test hypotheses.
4. Ability to perform basic laboratory skills such as slides preparation and use of pipettes, burners and microscopes.
5. Ability to select and use the correct apparatus to carry out investigations/experiments.
6. Ability to make observations and record.
7. Ability to obtain information from reliable sources such as texts and journals.
8. Ability to select and organise information relevant to a particular theme, topic or problem.
9. Ability to make accurate calculations.
10. Ability to solve numerical problems.
11. Ability to generalise, summarise, draw conclusions, make deductions, form inferences, evaluate non-numerical and non-graphical information and make decisions based on it.
12. Ability to generalise, summarise, draw conclusions, make deductions, form inferences, evaluate numerical and graphical information and make decisions based on it.
13. Ability to determine limitations in the design of experiments, investigations and in the information presented (e.g. due to lack of proper controls, faulty reasoning, confusion between assumptions and facts and between opinion and valid conclusions.
14. Ability to demand evidence in support of claims.
15. Ability to communicate ideas orally and in writing.
16. Ability to distinguish the process of scientific inquiry from magic, superstition and witchcraft.

2.3.3.3. The acquisition of scientific attitudes and values

Falk (1980: 20) regards the acquisition of scientific attitudes and values as an important outcome for education than the products and processes of science. Scientific attitudes refer to characteristics of scientists such as integrity, objectivity, open-mindedness, self-reliance, self-confidence and independence (Falk, 1980: 12; Samuels, 1995: 54). Scientific attitudes are formulated as follows: intense curiosity, humility, scepticism, determination and open-mindedness (Carin, et al, 1980: 3).

Scientists are curious about reality around them. This curiosity compels scientists to make an investigation. Consequently curiosity forms the basis of the scientific inquiry (Carin, et al, 1980: 3). The unquenchable desire for knowledge makes scientists endless learners. However the more they know, the more they realise how little they know. This in turn foster attitudes such as humility and scepticism (Carin, et al, 1980: 4).

Being humble refers to freedom from arrogance and false pride. The scientists need to take into account the fact that people (including himself) have strength and weakness. He must therefore guard against tendencies of being dogmatic and avoid acceptance of things without questioning. Consequently scientists need to have healthy scepticism. Healthy scepticism refers to the ability to give a chance to thoughts that deviate from one’s own ideas (Carin, et al, 1980: 4).

One of the attitudes which scientists need to acquire is the ability to think positively about failure. The historical records are full of successes stemming from failures (Carin, et al, 1980: 5). Accordingly scientists succeed in the long run because of their failures.

Scientists must guard against their own biases and strive for objectivity. They must verify whether their findings are valid and can be repeated and bear same results.
Precision and objectivity in the observation and recording of data have improved as scientific instruments have become more sophisticated. Today, in most scientific experiments, scientists rely less upon their feelings, observations and senses in favour of more objective devices such as photography, data processors and electronic computers (Carin, et al, 1980: 6).

From the above discussion, it became clear that attitudes held by a scientist influences his discovery behaviours. The scientist's discovery behaviour in turn results in scientific method or processes of science (Carin, et al, 1980: 6).

(a) **Falk's traditional subject outcomes** (1980: 60) for the development of attitudes and values

Table 2.3: Moodley's traditional subject outcomes (1981: 39 - 43) for assessing scientific attitudes.

<table>
<thead>
<tr>
<th>OBJECTIVE</th>
<th>SCIENTIFIC ATTITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pursues a problem to its solution or to a practical point of termination</td>
<td>Persistence</td>
</tr>
<tr>
<td>2. Improvises apparatus, searches out relevant information.</td>
<td>Resourcefulness</td>
</tr>
<tr>
<td>3. Works willingly with the group&lt;br&gt;- materials and apparatus are used economically with care.&lt;br&gt;- Keeps the workplace neat and tidy&lt;br&gt;- Follows safety regulations in the laboratory</td>
<td>Co-operation</td>
</tr>
<tr>
<td>4. Shows initiative, provides new ideas and makes suggestions for new and further investigations.</td>
<td>Enthusiasm</td>
</tr>
<tr>
<td>5. Shows willingness to handle living things with care and to take proper care of them.</td>
<td>Sensitivity</td>
</tr>
<tr>
<td>6. Accepts or rejects views, statements and conclusions only for valid reasons.</td>
<td>Objectivity</td>
</tr>
<tr>
<td>7. Suspends judgements in the absence of proper evidence.</td>
<td>Fair-mindedness</td>
</tr>
</tbody>
</table>

Learners should demonstrate:

1. Desire for knowledge and understanding.
2. Belief in scepticism and open-mindedness.
3. Demand for verification.


4. Respect for logic.
5. Awareness of implications and consequences.

2.4 Some approaches to the teaching of biology

2.4.1 Teaching Biology by means of a process approach

It was stated in the preceding paragraphs that effective biology teaching and learning are possible if the product, process, attitude and values dimensions of science are stressed. It is of paramount importance that the implications and significance of teaching biology through the process approach be taken into consideration. Biology teaching should be treated more like science, because biology is a science.

2.4.1.1 The meaning of process

The meaning of the process approach is explained by the commission of science education of the American Association for the Advancement of Science, known as “Science - A Process Approach” or SAPA. The SAPA identifies the following two conceptions as the most important meaning of “process” (Van Aswegen, 1993: 15; Sund, et al, 1973: 203; Renner & Stafford, 1972: 219).

The first meaning of the word “process” is the fact that the teaching of science should be in line with what scientists do, that is the processes that they carry out in their own scientific activities. The processes through which scientists acquire knowledge are observation, classifying, measuring, inferring, hypothesising and performing experiments. This conception stresses the importance of introducing the scientists methods of gaining information to teaching and learning of science, at school. Accordingly understanding science depends upon being able to look upon and work with the world in ways that a scientist does.

As it was stated at the beginning of paragraph 2.3.1, biology teaching and learning should be treated more like science. There is a need that biology students be introduced to a
scientific way of acquiring knowledge. The scientific method of gaining information is based on observation, classifying, measuring, inferring, hypothesising and performing experiments.

The second and most important meaning of the process refers to human intellectual development. This view implies that processes are in a broad sense ways of processing information. Consequently processes become more complex as the child develops from early childhood. Processes develop from the concrete and specific to the abstract and general.

The third meaning stresses processes at the expense of knowledge as well as attitude and values structures. According to Gagne (Sund, et al, 1973: 203) an emphasis on process implies a corresponding de-emphasis on the specific science content. The science content is limited to the examination and exploration of solid objects, liquids, gases, plants, animals, rocks and even moon photographs.

### 2.4.1.2 Processes and intellectual development

The process approach enables the pupil to develop a sound knowledge of science and its methods. The pupil gets acquainted to a number of processes which constitute a set of skills the scientists uses to conduct scientific investigation. In that way the pupil is given an opportunity to have better understanding of the subject content, once he becomes familiar with the processes of science.

The processes as identified by SAPA include basic process skills to be used from kindergarten to standard three and integrated processes that should receive attention after the learner has mastered the basic skills.
2.4.1.3 The basic process skills

These skills are used for small children ranging from those at crèche or kindergarten to standard three. The basic process skills as proposed by Van Aswegen, et al (1993: 15); Friedl (1991: 1) and Victor (1985: 7/8) include the following:

(a) Observing:

Observation involves all senses, that is, touch, seeing, hearing, taste and smell. It lays the foundation of the chain of events leading to the scientific discovery. Observation is classified into two levels, which are the simple and complex level. At the simplest level, it refers to identification, classification into categories of the objects and process under investigation. At the complex level it refers to the ability to distinguish, differentiate and systematise the information obtained from observations.

Two forms of observation are identified, that is, natural and experimental. Natural observations are concerned with the identification of general elements in the natural environment. Activities such as recording of similarities and differences between organisms, samples and populations, measuring and counting are carried out. Experimental observation is aimed at testing an hypothesis under experimental conditions involving different variables.

The following principles need to be taken into consideration in order to improve the pupils' ability to observe:

- Accuracy: Observation can only be accurate if the observed material is accurate.

- Relevancy: The material to be observed must be arranged in such a manner that the learner has a chance to observe relevant materials.

- Realism: Where possible pupils should observe the realia, that is, the actual thing or situation.
Comprehensibility: When selecting the material to be observed, the teacher must bear in mind the pupil's level of development. The new subject matter must link with previously experienced subject matter.

Interest: The pupils' observation ability improves if they experience the experiment observed or the observed investigation as interesting. The pupils' interest is aroused if they find the experiment to be understandable, has importance, is useful to them and satisfies their curiosity.

(b) Using space/time relationships

This skill concerns the use of shapes, direction and spatial arrangement, motion and speed, symmetry and rate of change. The process involves studies such as shapes of plants and animals, changes in positions and movement of objects.

(c) Using numbers

Numbers are frequently used by scientists, for example, to measure, count, draw graphs, classify objects or work out equations. It is important that pupils be given exercises in the use of numbers.

(d) Measuring

Measuring that enables scientists to express their observations as quantitative data requires the use of devices, which have equal intervals. Examples of such devices and their significance for biological studies are the following: The heart pulses in minutes and seconds, the body temperature in degrees celsius or fahrenheit, the length of a umbilical cord in centimetres. The process approach poses a challenge for the biology teacher to assist pupils at an early stage to quantify their observations by using proper devices.
(e) Classifying

Scientists use classification in an attempt to bring order to their investigations about nature. Two forms of classification, the natural and the informal or artificial classification can be identified. Biologists use natural classification to sort organisms into categories according to their overall evolutionary relationships. The artificial classification is based on non-evolutionary consideration of leaves, for example, into compound, lobed, serrated or simple is based on the appearance or shape of the leaves.

(f) Communication

One of the tasks that scientists do is to communicate their inquiry and their discoveries to other people. There is a need, therefore, that pupils be encouraged to think and to communicate their thoughts into spoken word, written word, diagrams, drawings, graphs and mathematical equations. Communication in the classroom context can be done in small groups or pairs.

(g) Predicting

The process of prediction is of great importance in science. The scientific progress depends on questions which lead scientists to make predictions. Pupils need to be exposed to questions which make their minds to wonder about their observations and measurement.

(h) Inferring

An inference is a valid explanation based on observations and making connections with other ideas or information. A great value of inferences in science teaching is that they help the pupils to think clearly when making observations. Pupils could be asked to infer from what they observe. For example, observation: The pot plant’s leaves are wilting. Inference: The plant is not getting enough water.

It was stated at the beginning of this paragraph that the basic skills are used for small children. It could be said of these skills that they lay a foundations upon which
integrate skills are incorporated. In practice the basic skills are applied even in senior standards. Skills such as using numbers, measuring, observing, classifying and predicting form part and parcel of scientists' life.

However, the scientific knowledge is acquired by identifying problems, formulating hypothesis, interpreting data and experimenting. All these are called the integrated process skills.

2.4.1.4 The integrated process skills

Whereas the basic process skills are geared for small children, the integrated process skills are recommended for pupils in standard four to Grade 12. The integrated skills are recommended for older children because these learners' intellectual abilities are more developed than those of younger children.

(a) Making operations, definitions and stating problems.

It is important that pupils learn to identify and construct definitions which are operational. This process skill equip learners to communicate scientifically, using terms that have definite operational meanings. In that way, they develop the ability to construct operational definitions when they have to solve problems that are new to them.

This process skill enables the pupils to formulate a problem for research more properly, taking into consideration the following criteria: it should question the relationship between two or more variables; it should not include details of the experimental procedures; it should be specific and contain only one problem; it should be able to be tested by means of empirical methods (Van Aswegen, et al, 1993: 17).
(b) **Formulating hypotheses.**

Hypotheses are tentative explanations of what the scientists anticipate to be the outcome of his research. It is an educational ‘guess’ to a problem. From the stated hypothesis predictions are made, which are tested through experimentation, the outcome of the experiment are obtained which either support or reject the hypothesis.

Dekker, et al (1993: 41) support the idea of pupils’ involvement in formulating hypothesis in what he calls the investigative approach. To get the pupils to do meaningful investigation there is a need to explain the theoretical background so that pupils may understand. Difficult ideas must be discussed in advance.

(c) **Interpreting data**

Through this process skill pupils learn to analyse results, both qualitative and quantitative in nature, in order to determine validity of hypothesis. They learn to structure information obtained from the experiments and draw generalisations supported by the experimental outcomes.

The information is written down in the notebooks, in a specific way to be presented as a report. The report can be in various forms, for example, a table, a graph, a chart or a flow diagram. A conclusion is made from the information. This conclusion is compared with the hypothesis. The hypothesis is then either rejected or accepted (Dekker, et al, 1993: 44).

(d) **Controlling variables**

It is important that the pupils be able to distinguish the different variables, if they are to successfully carry out a research project. Three such variables are the following:

- Independent or manipulated variables.
This variable is the treatment that is expected to produce an outcome. The independent variable is deliberately manipulated by the researcher to either affirm or reject the stated hypothesis.

- **Dependent or responding variables**

The dependent variable is a variable that changes in response to the independent variable, that is, it depends on the treatment it receives. It is a condition to be measured as it represents the outcome in response to the treatment.

- **Controlled variables**

These are conditions which the researcher controls so that they may not affect the outcome of an experiment.

This process skill plays an important role in an investigation. Without a thorough knowledge of the various variables and the contributions they make during an investigation, the scientist cannot carry out his task successfully.

### Experimenting

Experimenting can be regarded as the final process, because in this process all the basic and integrated skills are combined. Pupils acquire skills such as, stating the problem and testing hypothesis through the manipulation and controlling of variables. They learn to interpret and present results in the form of a report which other student can read and repeat the experiment (Van Aswegen, et al, 1993: 18).

The experiment follows a particular sequence which include the following steps:

- Stating the problem. Formulating a testable hypothesis.

2.4.1.5 Outcomes which are acquired through the process approach

Gagné (Sund, et al, 1973: 208 -210) suggests the following as outcomes of the process approach.

1. General Education

The goal of the process approach is not to produce students of science that have a large amount of specialised knowledge. However the aim is to provide each child with an opportunity to gain a highly generalised method of gaining an understanding of himself and his living environment.

2. Preparation for a systematic study of scientific discipline.

The students must be provided with some basic ideas, which are important to the understanding of systematic science. It is these ideas which are represented as the processes of the process approach.

3. Generalizability of knowledge

The process approach aims at providing the child with knowledge that is generalizable to new situations. This is accomplished by the use of a variety of content and asking the child to make generalisation from one field of science to another.

4. Level of achievement

The program aims for high quality of level of achieving in understanding science which is not limited to science only.
5. **Intellectual challenge**

The materials of the process approach aim at presenting children with intellectual challenges. Such as remembering a few facts, thinking, to use reasoning and to invent methods and explanations.

6. **Pupil’s Interest**

Pupil’s interest is stimulated by using the principle of preceding from the familiar to the unfamiliar. In this way an appeal is made to the pupils’ initial interest, and it is maintained as new problems arise.

7. **Achievement motivation**

The exercises of the process approach program are aimed at all children, not solely the bright ones. The objectives are intended to be not too difficult for the vast majority of children to achieve. When children achieve the objectives, they feel rewarded and therefore their interest is maintained for further exploration of science and its processes.

2.4.1.6 **Implications of a process approach for biology teaching**

The emphasis placed on observation, using numbers, time and space, measuring, classifying, communicating and predicting, as basic process skills are of great importance for biology teaching. If pupils acquire these skills at an early age, they (pupils) are equipped to learn biology in a more meaningful way. The basic skills lay a foundation for the incorporation of integrated process skills. The later skills are geared for older learners who can learn independently from the teacher, or with a lesser teacher’s assistance.

Therefore it is important that pupils have knowledge of how problems are formulated, hypothesis are stated, interpretations of data, how variables are identified and manipulated, as well as experimenting. One way of acquiring this knowledge is by familiarising pupils
with the process approach. The process approach is a suitable method for teaching and learning of biology.

There are a number of advantages in using a process approach in biology teaching. The following are advantages of the process approach as proposed by Van Aswegen, et al (1993: 18).

- It stimulates critical thinking and active involvement in the information seeking process by the pupils.

- It gives more meaning to the learning activities because pupils attach significance to what they do in a biology class.

- Pupils experience the different process skills as enjoyable and as such become more motivated to make greater achievement.

- Pupils who learn by experiencing, understand and retain this knowledge better, so that they can relate it to new situations.

2.4.1.7 Reasons for the failures of the process approach.

The process approach looked impressive on introduction, but this glory was short-lived. Soon schools started to face problems with the implementation of the new curriculum. The following are some of these problems:

1. School-systems found it very difficult to adopt pre-packed materials with the rest of the elementary curriculum (Victor, 1985: 8; Fried1, 1991: 1).

2. Many activities were too complex for the average teacher's science background (Victor, 1985: 8; Friedl 1991: 1).
3. Due to inflation the project materials became too expensive to secure and maintain (Victor, 1985: 8; Friedl, 1991: 1).

4. Some programs ignored science content, process had taken over completely. Consequently process without products did not produce results (Friedl, 1991: 1).

Another factor which may be contributory to the failure of the process approach was the reason that some educators were critical of the new approach. Some of these criticisms as recorded by Samuels (1995: 74 - 76) are the following:

(a) A process approach is equally undesirable and just as likely to fail as its content-based equivalent.

(b) It is misleading to portray the “method of science” as a set of discrete processes which begin with observation and leads on via classification to inferring and hypothesising.

(c) There is no general consensus amongst science educators, historians and philosophers as to whether science has a method, and if so, what it is.

(d) It ignores the affective aspects of tacit knowledge, e.g. pupils attitudes in a particular task.

(e) It fails to assess tacit knowledge.

(f) The processes of observing, classifying, inferring and hypothesising are regarded as features of general cognition which may not need formal instruction to acquire.

Despite all these criticisms the process approach has shed light on the significance of finding a method of teaching science through an investigation, inquiry and discovery, moving away from content-dominated approach (Samuels, 1995: 76). Its weakness is that
it also over-emphasised "method" or "process" at the expense of knowledge (Sund, et al, 1973: 207). To overcome these extremes of content dominated and method-centred approaches, Friedl (1991: 1) and Falk (1980: 13) suggest that a program which gives equal consideration to the "processes" and the "products" would be more effective for science learning than a programme that concentrate on one at the expense of the other.

2.4.1.8 The process approach and assessment.

The biology teacher must strive to incorporate the process approach in his/her evaluation activities. Tests and examination that put high value on memorisation and stress "what" questions rather than "how" questions have little to do with the science of biology. Rather than stressing facts and definitions the biology teacher must reward critical thinking and problem solving in tests and examinations (Van Aswegen, et al, 1993: 19).

It is fundamental that more attention be given to critical thinking and problem solving as emphasised by the process approach. However a reasonable attention be given to acquisition of concepts and principles.

Concepts stated in paragraph 2.3.3.1 are fundamental propositions in biology, and form the building blocks for understanding the structure of the subject. The value of memory work is over inflated by the former DET Biology Syllabus which allocate about 60% of the examination marks to recall questions and 40% awarded for higher skills (DET Biology Syllabus Std 10; 1989). On the contrary it could be expected that a lower percentage will be allocated to memory and recall of information and a higher percentage to higher skills such as the process skills.

The significance of the process approach for the teaching and learning of biology as a science cannot be over emphasised. Pupils who get exposed to the process approach become motivated to take an active part in problem-solving activities and it gives them new meaning to the learning of biology. It is necessary that pupils become acquainted with the various processes at an earlier stage of their careers. Consequently the biology teacher must have a thorough knowledge of the different processes and their possibilities for the
teaching and learning of the subject. He/she must be willing to incorporate these skills in his/her teaching.

Another important aspect which came to the surface is the fact that correct biology teaching implies integration of media. Much as the scientific method requires learning through observation, classifying objects, measuring and performing experiments, it stands to reason that media must be used.

2.5 Concept mapping as an approach to the teaching of biology

2.5.1 Definition

Concept mapping is a meta-learning strategy based on Ausubel-Novak-Gowin's theory of meaningful learning. It relates directly to such theoretical principles as prior knowledge, subsumption, progressive differentiation, cognitive bridging and integrative reconciliation (Wandersee, 1990: 927). It is a strategy that is designed to help students learn how to learn science or learn meaningfully.

This strategy is based on Ausubel's learning theory which suggests that individuals learn meaningfully by building knowledge on the basis of what they already know (Okebukola, 1992: 218; Novak, 1981: 13; Briscoe & Lamaster, 1991: 214).

The construction of knowledge is a personal activity in which selection, interpretation and re-organisation of sensory data depends on the individual's prior knowledge.

Concept mapping requires learners to plot concepts and their interrelations in a meaningful organisation and hierarchical network. Conversely this strategy does not promote the linear representation of text, but a hierarchical one.

The key concept must be identified and arranged from the general to specific and relate to each other in a meaningful way. Concepts in a map relate to each other by linking lines that define propositions or specific relationships. These linking lines are labelled to represent
meaning in an explicit hierarchical framework (Wandersee, 1990: 127). The student is required to think in multiple directions and switch back and forth between different levels of abstraction.

e.g. A concept map on respiration used for textbook.

![Concept map](image)

Fig 2.3: Concept map for textbook 1 (Soyibo, 1995: 346)

### 2.5.2 The value of concept-mapping in biology teaching

One of the challenges that faces science teachers is primarily how to organise better instructional material and how to help students learn this material. The following are merits of concept mapping recorded by various biology educators:

- It is an important tool that help students learn to learn meaningfully and help teachers become effective teachers (Novak, 1990: 941).
- It is regarded as a strategy that can be employed to achieve learning excellence in biology (Van Aswegen, et al, 1993: 32).

- Okebukola (1992: 218) reported that concept mapping improves problem solving skills, reduce anxiety level in biology classrooms, and promote meaningful learning of science concepts. It helps to change experience from a region of the unknown to a region of the known.

- It boosts achievement significantly (Okebukola, 1992: 220).


- One good value of concept mapping is its possibility of being used together with other techniques (Brumby, 1983: 16). In addition when used as a teaching tool, it explicitly shows students the importance of making links between new and existing knowledge. Students become actively engaged in resorting ideas, relating them to each other as they construct a concept-map of a particular topic. This exercise is significant because it overcomes the passive-rote learning of isolated bits of knowledge.

2.6 Outcomes-Based Education

2.6.1 Introduction

What is outcomes-based education (OBE)?

This concept is founded on two words, namely, outcome and based. An outcome is defined as a culminating demonstration of the entire range of learning experiences and capabilities that underlie it, and it occurs in a performance of content that directly influences what it is and how it is carried out (Conradie, 1997: 8).
Based means to define, direct, derive and determine what is done according to learning results that has to happen at the end of the learning process (Conradie, 1997: 8). An outcomes-based approach stresses the learner’s ability to demonstrate or apply knowledge and skills to new situations (Department of Education, 1997A: 134).

According to this document decisions about the learning programme for learners should be driven by outcomes which learners should display at the end of their learning experiences, as opposed to the inputs of the traditional syllabus-driven education and training system (Conradie, 1997: 8).

From a South African context, it is a paradigm shift, from the traditional aims and objective approach to outcomes-based education. Table 2.4 shows the differences between the old or aims and objectives approach and the new outcomes-based approach.

Table 2.4 Differences between the old and new approaches (Department of Education, 1997A: 6/7)

<table>
<thead>
<tr>
<th>OLD APPROACH</th>
<th>NEW APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive learners</td>
<td>Active learners</td>
</tr>
<tr>
<td>Exam-driven</td>
<td>Learners are assessed on an on-going basis</td>
</tr>
<tr>
<td>Rote-learning</td>
<td>Critical thinking, reasoning, reflection and action</td>
</tr>
<tr>
<td>Syllabus is content-based and broken down</td>
<td>An integration of knowledge; learning relevant and connected to real-life</td>
</tr>
<tr>
<td>into subjects</td>
<td>situations</td>
</tr>
<tr>
<td>Textbook / worksheet-bound and teacher</td>
<td>Learner-centred, teacher is facilitator, teacher constantly uses group-work</td>
</tr>
<tr>
<td>centred</td>
<td>and teamwork to consolidate the new approach.</td>
</tr>
<tr>
<td>Sees syllabus as rigid and non-negotiable</td>
<td>Learning programmes seen as guides that allow teachers to be innovative and</td>
</tr>
<tr>
<td></td>
<td>creative in designing programmes</td>
</tr>
<tr>
<td>Teachers responsible for learning,</td>
<td>Learners take responsibility for their learning, pupils motivated by constant</td>
</tr>
<tr>
<td>motivation dependent on the personality of</td>
<td>feedback and affirmation of their worth</td>
</tr>
<tr>
<td>teacher</td>
<td>Emphasis on outcomes - what the learner becomes and understands</td>
</tr>
<tr>
<td>Emphasis on what the teacher hopes to</td>
<td></td>
</tr>
<tr>
<td>achieve</td>
<td></td>
</tr>
<tr>
<td>Content placed into rigid time-frames</td>
<td>Flexible time-frames allow learners to work at their own pace</td>
</tr>
<tr>
<td>Curriculum development process not open</td>
<td>Comment and input from the wider community is encouraged</td>
</tr>
<tr>
<td>to public comment</td>
<td></td>
</tr>
</tbody>
</table>
A closer look at the characteristics of outcomes-based approach reveals that this approach demands more active, critical thinking, reasoning and motivated learners. This approach could be more relevant in biology teaching, since biology is a practical, investigative and exploring subject in which learners are expected to be active participants.

2.6.2 Basic premises of the outcomes-based approach.

Outcomes-based education is founded on three basic premises, proposed by Spady and Marshall (Killen, 1996, 2).

1. All students can learn and succeed (but not in the same time or in the same way).
2. Success breeds success.
3. Schools and teachers control the conditions that determine whether or not students succeed.

To these three premises can be added a philosophical base suggested by Mammary (Killen, 1996, 2) as follows:

1. All students have talent and it is the responsibility of the school to develop it.
2. The role of the school is to find ways for students to succeed, rather than finding ways for students to fail.
3. Mutual trust drives all good outcomes based schools.
4. Excellence is for every child and not just a few.
5. By preparing students everyday for success the next day, the need for correctives will be reduced.
6. Students should collaborate in learning rather than compete.
7. As far as possible, no child should be excluded from any activity in a school.
8. A positive attitude is essential.
The basic premises as suggested by Spady and Marshall, and the philosophical base of Mammary, as stated above, have implications on both the schools and teachers. Teachers have to assume certain responsibilities which are suggested by Killen (1996: 6) as follows:

1. Teachers must prepare the students adequately so that they can succeed.
2. Teachers must create positive learning environments in which students know that they will be helped in their learning.
3. Teachers must help their students to understand what they have to learn, why they should learn it, including what use it will be to them in the future.
4. Teachers must provide students with sufficient opportunities to practise using the new knowledge and skills that they gain.

An assessment of the basic premises of an outcomes-based approach and the philosophical base reveal that schools or teachers determine the success of education.

They control the conditions which determine the students success or failure. The methods and resources employed in learning are some of the determinants for the success or failure of the learning process.

2.6.3 Outcomes for Natural Sciences

The outcomes based curriculum for science is directed by broad outcomes which are known as specific outcomes for natural sciences. The natural sciences comprise “the physical, life and earth sciences (Department of Education, 1997B: 133). It can therefore be inferred that biology forms part of the natural science learning area. The following are specific outcomes for natural sciences as outlined in the discussion document, (Department of Education, 1997B: 134).

Natural Sciences

Specific outcomes:
1. Use process skills to investigate phenomena related to the Natural Science.
2. Demonstrate an understanding of concepts and principles, and acquired knowledge in the Natural Sciences.
3. Apply scientific knowledge and skills to problems in innovative ways.
4. Demonstrate an understanding of how scientific knowledge and skills contribute to the management, development and utilisation of natural resources.
5. Use scientific knowledge and skills to support responsible decision-making.
6. Demonstrate knowledge and understanding of the relationship between science and culture.
7. Demonstrate an understanding of the changing and contested nature of knowledge in the Natural Sciences.
8. Demonstrate knowledge and understanding of ethical issues, bias and inequities related to the Natural Sciences.
9. Demonstrate an understanding of the interaction between the Natural Sciences and socio-economic development.

The specific-outcomes outlined in the preceding paragraph, correspond to the three components of the nature of science, which are knowledge, processes and a way of life of the scientist.

Each of these specific outcomes is linked to assessment criteria. Assessment criteria provide information about what learners should do in order to achieve each of the specific outcomes. (Department of Education 1997B: 137). A closer look on the range statements of these assessment criteria shed light that learners are expected to acquire knowledge through scientific methods or processes.

A process of investigation encompasses different process skills such as questioning; observing; hypothesising; predicting; the collection; recording; analysis; evaluation and interpretation of data; as well as communication of findings and conclusion. (Department of Education, 1997B: 130 - 164).
A second dimension which is revealed by the specific outcomes is the need for the provision of facilities and other resources, especially in rural areas, on a need-to-have, able-to-use bases linked with teacher in-service training (Department of Education 1997B: 132).

2.7 CONCLUSION

From the discussion in this chapter, it becomes evident that the process of education, in general, is directed by critical cross-field outcomes. However, critical cross-field outcomes are broad and difficult to implement in the course of lessons. Consequently, to serve as meaningful guides for classroom teaching they must be developed into traditional subject outcomes which learners are able to achieve at the end of the lesson, or learning programme. It follows that teaching, in general, is directed by outcomes.

The discussion clearly showed that teaching biology is also based on traditional subject outcomes. These outcomes are derived from the three components of the nature of biology; namely: biological knowledge or products, processes or scientific methods as well as attitudes and values which guide the scientist in his/her practice (Carin & Sund, 1980: 2; Falk, 1980: 12; Samuels, 1995: 42). However, acquisition of these outcomes of teaching biology, can be enhanced by the use of various approaches and techniques. For the purpose of this study, three approaches, namely: concept maps, the process approach, and outcomes-based education were discussed.

The latter is a new approach that is being implemented in the democratic South Africa. If properly implemented, this could bring a radical paradigmatic shift in the whole system of education in South Africa.

The discussion on this chapter leads one to question whether media make any significant contribution in the acquisition of the traditional subject outcomes of teaching biology. The next chapter focuses on the use of media their functions and how media contribute in the acquisition of the traditional subject outcomes of teaching biology.
CHAPTER THREE

3 EDUCATIONAL MEDIA AND DIDACTIC PRINCIPLES

3.1 Introduction

Educators in the past pioneered in the use of media, as a way of accepting the challenge to improve methods of instruction, be it in the teaching of languages or that of science. A need to make the didactic activity interesting and effective, has become a common phenomenon which cannot be ignored. Historically, various factors have made an appeal to educators to reflect on the classroom activity. Some were provoked by the hostility and cruelty that pupils had to suffer in the hands of their educators, while others were challenged by a need towards excellency as well as a concern to improve achievement by the learners (Van Aswegen, Frazer, Nortje, Slabbert & Kaske, 1993: 24).

Educators in the twentieth century are even faced with a greater challenge of making the school both relevant and economically viable. Today's society, that is, parents, government and the occupational world, look upon the school to provide for the various needs (Fourie, Oberholzer & Verster, 1985: 132).

In an attempt to accept these challenges, educators have done research in the teaching-learning activity. Some of the researchers have identified the use of media as one of the factors which must be taken into account if teaching and learning is to be effective.

This chapter surveys literature on the use of media in the classroom. This review is divided into five sections. The first section comprises the historical overview, where ideas of a few educators on the role of media in teaching are surveyed. The second section covers various types of media and their role in the actualisation of didactic principles in the teaching of biology. The third part of the survey is about multimedia systems and their merits. The fourth section deals with functions of media. The fifth section concludes the chapter.
3.2 The historical overview

As highlighted above, the role played by media in the teaching-learning activity is not new. John Amos Comenius (1592) advocates the use of media in the teaching of languages; as he states that children acquire knowledge of words by objects. “While learning words they should be taught things.” (Curtis & Boulwood, 1975: 175). Comenius (1592) feels that there is a need to improve education through the introduction of media, that is, things or objects. Consequently media were introduced firstly in language instruction. Later on, the use of media was applied in the teaching of all subjects. According to him, the best method should appeal to senses. Media assist the learner's intellect to attain knowledge. The rules for the acquisition of understanding is that, if the learner observes accurately he acquires true understanding, that is, he shall never assume what is false as true (Curtis, et al, 1975: 175, 184/185).

If therefore knowledge acquisition is facilitated by using media, biology teachers should employ media to enhance acquisition of biological content by the learners.

The use of media in teaching and learning is further taken into account by Jean Heinrich Pestallozi (1746 - 1827) and John Locke (1632 - 1704). They regard learning without objects as meaningless and uninteresting. Learning should be through observation. Pestallozi (1746-1827) advocates for the experimental method in teaching sciences as a way of emphasising observation in learning. Real objects such as plants must be collected in a garden, his pupils must observe snow changing into water (Curtis, et al, 1975: 499). The significance of observation in learning sciences is still upheld by the present educators.

Both Maria Montessori (1870-1952) and John Locke (1632-1704) argues that media stimulate interest and motivation in the learner. Montessori suggests that a good method should appeal to all senses of the learner, such a method must employ media. Media motivate the pupils, so that learning becomes spontaneous, free from severity and compulsion (Curtis, et al, 1975: 193). She argues that a method which employs media will make punishment unnecessary and it will help learners not to underachieve. To her, underachievement is caused by bad methods of content presentation by the teachers, who stimulate the sense of hearing only (Curtis, et al, 1975: 193).
Locke states that media make learning pleasant and interesting for children. Pupils who learn through the use of media, seek learning as another form of play. The importance of interest in learning is stressed by Montessori who argues that learning should be through interested activity (Curtis, et al, 1975: 499).

Comenius, like Locke and Montessori, acknowledges that media stimulate interest when he says "pictures were intended to entice witty children to it, that they may not conceit as torment to be in the school, but dainty fare" (Heinich, et al, 1989: 75). The same view is held by John Dewey (1859-1952) who says that the learner has a need to experience learning as interesting, free from the burden of rote learning and symbol interpretation (Curtis, et al, 1975: 465).

Media usage as propagated by Montessori and Pestallozi, offers the learner the opportunity to learn at his own individual pace, and renders punishment and restraint in learning unnecessary.

The principle of activity is realised by employing media. The acquisition of knowledge is essentially based on activity followed by reasoning (Curtis, et al, 1975:197). Pestallozi (1746 – 1827) recommends learning by doing, that is, the activity method, by imitating, by drawing, by collecting and above all by observation.

The discussion above indicates that educators in the past have identified that media have a significant role to play in teaching and learning. Media facilitate acquisition of knowledge. Media enhance the methods of teaching and learning. One of the greatest merits of media, is their potential to overcome underachievement or failure in learning. Interest and motivation are better stimulated by media. Through the employment of media, learning becomes fun - or a form of play. Each pupil is given an opportunity to learn at an individual pace. Each learner becomes actively involved in learning.

It can, therefore, be said of these educators that they have identified what has become known as the didactic principles of motivation, interest, activity and individualisation.
According to these educators, these principles are best actualised by employing media. These principles play an important role in the teaching and learning of biology.

Biology is a science in which knowledge is basically and essentially acquired through investigation, observation and discovery. Learning through empty verbalism without concrete objects is not recommended for biology teaching. Realia, that is, animals and plants as well as models, pictures, televisions, video, radio, tape recorder, boards films and computer are media which may enhance acquisition of outcomes of teaching biology.

3.3 Educational media and their attributes

Educational media are classified into the following groups (Freysen, et al., 1989: 77)

- Realia and models
- Auditory media
- Visual media
- Audio-visual media
- Programmable media

In each group of media the researcher will select a few that form representative of the particular group. The merits or values of each group of media, particularly in the teaching-learning activity of the biological sciences, will receive attention.

3.3.1 Realia or concrete objects and models

3.3.1.1 Realia

Reality and all its aspects that serve as stimulus for learning are often known as realia (Freysen, et al., 1989: 78). Realia include real objects and events which are used to convey the learning content to the learner. For example, specimen of flowers, plants and animals, for the purpose of teaching and learning in biology is regarded as realia.
Realia’s value in learning is that they promote effective learning because they enable the learner to experience specific situations. The learner is given an opportunity to observe the concrete objects in their natural environment (Freysen, et al, 1989: 78; Engelbrecht & Lubbe, 1981:86; Heinich, et al, 1989: 100).

Realia have the following merits for effective teaching and learning; as indicated by Freysen, et al (1989: 78/79):

- They promote pupil involvement, for example; when the learners are engaged in the collection of different types of insects.

- Pupils are enabled to make comparison of concrete aspects of objects - for example comparison of monocot and dicot flowers.

- They give authenticity to an experience, in that way media narrows the gap between classroom teaching and reality.

- Senses such as touch and smell which are rarely involved in classroom teaching are employed.

- Realia are most accessible, intruding and involving materials (Heinich, et al, 1989: 100).

- Real objects must be shown to fulfil whatever educational outcome or purpose (Hills, 1986: 58).

Realia are of great value in the teaching of biology, however they may sometimes be inaccessible.

Whenever real objects are not accessible models may be employed.
3.3.1.2 Models

Models are employed in biology teaching because reality is not always accessible to the learners. There are various reasons for the inaccessibility of realia, such as scarcity, danger, size, availability, for example, human organs.

The following are a few advantages of models:

- Unlike pictures, models are three-dimensional representation of objects.

- Models enlarge or reduce real objects to observable size, for example the unicellular organisms.

- Internal views of objects can be displayed by means of a cut-away model, for example, the internal structure of a kidney.

- A series of models can display different stages of a long-term process, for example, the stages of the development of silkworm.


Models receive high preference from learners basically because they provide learners with hands on opportunity rather than passive learning. “Please touch” is a most welcome invitation (Heinich, et al, 1989: 102).

According to Heinich, et al, (1989: 101/102) the construction of models appeals to learners and stimulate inquiry and discovery skills. Assembly activities sharpen both cognitive and psychomotor skills. Models facilitate realism in learning. They also provide for different learning styles.
Taking the values mentioned above, it becomes evident that the usage of models in the biology teaching enhances effective learning and acquisition of the outcomes of teaching biology.

3.3.1.3 Realia, models and actualisation of didactic principles.

Educators such as Freysen, et al, (1989: 78/79) and Heinich, et al (1989: 100-102) argue that realia and models provide learners with direct purposeful experience. Accordingly media arouse the learners’ interest to learn. In this way, they promote the pupils’ involvement. The learner becomes an active learner rather than a passive one. The principles of involvement and activity are actualised.

Realia and models are recommended when realism is essential to learning: three-dimensional concepts, tasks that require identification by size, shape or colour, hands-on or laboratory practice (Heinich, et al, 1989: 101). They enhance the principle of observation and perception. From the premise that these media make use of all the learners, these media, therefore facilitate actualisation of the principle of totality. Another group of media that should receive attention in biology teaching is the auditory media.

3.3.2 Auditory media

These are media other than human media, which convey the learning content by sound. They are directed to the learner’s sense of hearing (Freysen, et al, 1989: 91).

The general auditive media used in teaching are the radio, tape recorder and record player.

Auditive media are inexpensive and so well suited for developing areas such as Thohoyandou Inspection Area. They are readily available and very simple to use. Audio media can present stimulating verbal messages more dramatically than can print (Heinich, et al, 1989: 162/163).
3.3.2.1 The audio-cassette

The audio-cassette can be used at different lesson phases. A documentary programme on specific subject, for example, in biology teaching, can be used to introduce a subject for discussion. The audio cassette can be used to supplement other media in order to explain certain aspects. In 1985 at the University of Windsor the audio-cassette was used as a supplement for a computer's CAI, computer assisted instruction. The programme was computerised simulations of biological processes and phenomena. It relieved students from "read then do" approach because it supplied the audio.

When the learner listens to the audio-cassette, he may also carry out other activities (Freysen, et al, 1989: 106/107; Habowsky, et al, 1990: 232).

Audio-cassette provides a form of individualised instruction, for the student can interrupt, speed up or replay portions of a tape at will. It is an indispensable aid for delivering content, facilitating the use of equipment resources and directing hands-on activities.

3.3.2.2 The radio

Radio based instruction has a number of advantages:

- It is an effective instructional medium when supplemented by appropriate printed materials.
- It overcomes physical distribution problems, such as lack of roads and mail.
- It has low electrical energy requirements.
- Radio messages can be rebroadcasted for flexibility at a little extra cost.
- For many types of instruction, audio is the primary stimulus and the visual channel is not required.
- Students can listen to lessons at home, on a tractor, in a car or in a formal learning environment (Kirk & Gustafson, 1986: 164/165).

The radio has been used to provide quality instruction to a large number of users in countries such as Nicaragua, Venezuela, Iran and Australia. In the rural areas of Australia,
for example, the radio was used together with filmstrips, projectors, audio cassettes, educational games, library books and school magazines to instruct students. These students who were instructed in this manner, later has to attend schools in large towns, and were found to be articulate (Kirk, et al, 1986: 164/165).

3.3.2.3 The auditory media and actualisation of didactics principles

According to Freysen, et al, (1989: 106/107) and Habowsky, et al, (1990: 232), auditory media, for example, the audio-cassettes provide a form of individualised instruction. The student can interrupt, speed up or replay portions of a tape at will. The principle of observation and perception is limited to the sense of hearing. If used with worksheets, the learner's interest can be aroused, he/she may be kept involved. The learner is kept active by answering questions after listening to the audio-cassettes. These media enhance actualisation of a number of principles; namely: individualisation, observation and perception, interest and activity as well as involvement.

The audio-media are commendable for developing countries because they are relatively cheap and they can use batteries as their source of energy. They should be employed in the teaching of biology with due consideration of outcomes of the lesson and their merits.

Heinich, et al (1989: 66) reports that the learner learns about 11% through hearing and 83% through visual experiences. It is therefore important that visual media be integrated in the teaching of biology.

3.3.3 Visual Media

The visual media convey their information in a verbal and iconic symbol systems which are perceived by the learner’s sense of sight. Visual media are divided into projection and non-projection materials. Perception of visuals have to be explained by verbal symbols if effective learning has to take place (Freysen, et al, 1989: 115; Heinich, et al, 1989: 68).
As stated in paragraph 3.3.2.3. research findings report that one learns about 11% through hearing and 83% through visual experiences. This implies that if visuals are neglected in learning, the learner is deprived of 83% opportunities of effective learning. It is also recorded that the learners remember 20% of what they hear and 50% of what they see (Heinich, et al, 1989: 66). It is on the basis of these merits that these media should receive attention in the teaching of biology.

3.3.3.1 Wall charts, graphs, pictures, photos and posters

These media are used in instruction of biology when the real objects are not accessible to the teacher and the learner.

Van Aswegen, et al (1993: 107/8) identifies the following as functions of these group of media.

- The recall of experience, for example, a picture of an animal may be used to identify what mammals are.

- The building of new experiences.

- Preparing pupils for further experiences, for example, in ecological survey on the plant community of a specific ecosystem, an aerial photograph of the area may be shown to prepare the pupils for possible problems that they may encounter.

- The correction and prevention of possible misconceptions; in the situations where instruction is not given in home language, these media may be used to clarify possible misconceptions.

- The exposition of important details. These are details which are not easily observable in living or preserved material. Photos can be used to highlight important details.
- Demonstration and explanations of a process, for an example, metamorphosis.

- Conceptualisation and meaningful learning. Visuals may be used to overcome the problem of rote learning which is a product of learning without understanding.

- Contrasting and comparing characteristics. Take for instance comparison between a dicotyledonous and monocotyledonous stems.

- Summarising of learning events.

However biology teachers cannot depend on pictures only, they need also to write definitions, explain processes, write down ideas, make drawings and graphs. In this regard writing boards become necessary.

3.3.3.2 Boards

There are a variety of boards, such as chalkboards, flannelboards, plastic boards, magnetic and bulletin boards.

For the purpose of this study the chalkboard or writingboard will receive more attention. The value of other boards for the teaching and learning of biology will be indicated.

3.3.3.2.1 The writingboard or chalkboard

One can never imagine a school without a writingboard (Freysen, et al, 1989: 125). Boards are of value in the teaching of biology, because they have the following functions:
drawings, diagrams, graphs, for jotting down ideas that develop during a lesson, summarising and outline problems and answers, noting of technical terms, key words and definitions (Engelbrecht & Lubbe, 1981: 92).

Van Aswegen, et al (1993: 109) identifies the following as characteristics of writing boards - that is they are relatively cheap, they have a low maintenance cost and are easy to use. They accommodate both verbal and graphical symbols. They are accessible to both the teacher and the pupils. Boards fit the tempo of any presentation. They are used in a step-by-step build-up wherein physiological processes are explained, for example, photosynthesis.

3.3.3.2.2 The feltboards

The merit of the feltboards is that they have been used successfully in the teaching of biochemistry, protein synthesis, ecological foodwebs, ecological pyramids and enzyme actions.

This is possible because visuals can be easily moved around on a feltboard, to illustrate a process or a sequence. According to Heinich, et al (1989: 122) displaying student’s work on feltboards, exemplifies the motivational use of these media, for it foster pride in achievement, reinforces students efforts to do a good job. One group of media that may be classified as visual media are textbooks.

3.3.3.3 The textbooks

The textbook as an instructional medium is considered as one of the most important sources of information. The content is arranged logically and systematically for the purpose of explaining, demonstrating and showing progression or connection between matters (Freysen, et al, 1989: 120).

Some advantages of the textbook are, that it offers a permanent and systematised record of the learning content. It assist the learner to understand more clearly. It has a good

Research has demonstrated a consistent effect of textbooks on student’s achievement in developing countries, for example, Thailand and Sri Lanka (Levin & Lockheed, 1993: 9). According to Levin and Lockheed (1993: 9) in Thailand high achieving schools are those which received sufficient contributions from their local communities to purchase sets of supplementary text materials for the curriculum.

According to Frazer, Loubser and Van Rooy (1990: 143) when used as a method of instruction, the textbook brings into board the principles of activity, individualisation and perception. This is done by giving students assignments, based on the textbook. These assignments should result in learner activity. Individualisation is brought into board when a learner is required to do his own reference work. The interpretation of graphs, maps, etc. relies a lot on perception.

Textbooks can be supplemented by newspapers and magazines, for example, at the Gonakelle School in Sri-Lanka (Levin, et al, 1993: 9).

3.3.3.4. Newspapers and magazines

Newspapers, if used properly, can play an important role in the learning of biology. The newspaper such as the “City Press”, encloses supplements which deal with specific subject contents which are relevant to Grade 12 curricula. Some of these supplements contain information relevant to biology Grade 12 curriculum. Periodicals such as the “Educamus” deal with different subjects contents and biology being one of these subjects, they could be used in biology teaching.

All media discussed from paragraph 3.3.3.1. to 3.3.3.4 are regarded as non-projected visual (Heinich, et al, 1989: 68; Freysen, et al, 1989: 115). The overhead projector serves as one of the projected visuals.
3.3.3.5. The overhead projector

The popularity of OHP is ascribed to the specific characteristics and practical techniques which are unique to it (Heinich, et al, 1989: 135; Freysen, et al, 1989: 144).

- Line drawings, diagrams and graphic representations are easily drawn on transparencies.
- A variety of practical techniques can be applied during presentation.
- OHP is easy and straightforward to use.
- Transparencies are easily made and stored by the individual teacher.
- The pace of presentation can be controlled and adjusted.

Heinich, et al (1989: 136) reports that the study by the Wharton Applied Research Centre found that the OHP has the following implications for instruction; individuals responded positively to recommendations made by presenters who used the OHP. Presenters who used the OHP were regarded as being effective.

In addition to these characteristics van Aswegen, et al (1993: 114) and Engelbrecht and Lubbe (1981: 98/99), identify the following as appropriate application of the OHP for biology teaching. OHP fitted with polarisation unit can be used to express movement. If an overlay technique is used, the teacher can illustrate step-by-step construction of related problems. Each individual component is highlighted until the whole phenomenon has been exposed and explained, for example, the water cycle. Objects such as leaves, plant seeds, small animals can be placed directly on the OHP to produce a shadowed image of the actual object. OHP may be used for simple teacher demonstrations.

3.3.3.6 Visual media and the actualisation of didactic principles.

Visual media promote observation that is limited to the learner’s sense of sight. Heinich, et al (1989: 122) states that visual media, arouse motivation in the learner. Frazer, et al (1990: 143) argues that visual media such as textbooks, bring on board the principles of activity,
individualisation, observation and perception. The learner is kept actively involved by giving him/her assignments to do. Individualisation is introduced when a learner is required to do his/her own reference work.

From the above it has become clear that visual media play a vital role in biology instruction. They enhance acquisition of the traditional subject outcomes of teaching biology. Visual media such as text books, newspapers and periodicals assist the learner to acquire biological knowledge and scientific attitudes. Consequently they improve the learners achievements. These media may prove to be more suitable for conditions experienced in the developing countries. Developing countries experience problems such as shortage of facilities and equipment, as well as shortages of electricity. However where possible the providers of education should strive to provide other forms of media such as audio-visual media.

3.3.4 Audio-visual media

Audio-visual media are media that present the learning content to the learner according to fixed, pre-planned and pre-recorded programmes that makes use of sound and image (Freysen, et al, 1989: 173).

Audio-visual media include the following: films, television, video and sound slides.

3.3.4.1 Television, video and film

Television or video is a rich medium that has a variety of characteristics. Its value in instruction lies on the fact that a number of attributes are utilised simultaneously and the fact that these attributes merge to form a whole (Freysen, et al, 1989: 185).

The educational value of the educational film, television and video in teaching biology are the following:
- Movement: moving images have advantages over other visuals, where motion is required to master the learning content. Processes such as turgor movement of leaves are easily observed.

- Close up sequences, time lapse photography and slow motion viewing: operations in which sequential movement is essential can be shown effectively by means of motion media, for example, a chameleon catching its prey.

- Safe observation: Visual recordings allow learners to make observation of phenomena that might be dangerous to view directly. For example, experiments done with radioactive material.

- Skill learning: Recorded programme afford the learner with the opportunity to master skills through repeated observation.

- Animation: Biochemical process, such as the movement of messenger RNA during protein synthesis are made observable by means of animation.

- Problem solving: Open-ended events may be shown, giving viewers an opportunity to draw conclusions.


In addition to merits stated in the previous paragraphs, communication by television, video and film is effective because a large variety of audio-visual material can be transmitted. These media bring reality to the classroom. In that way they enable the learner to see objects that he might, otherwise, have only heard or read about. The learner is given an opportunity to see the objects in their original forms. Therefore television, video and film save time for both the teacher and the learner. They also hold the learner's attention (Engelbrecht & Lubbe, 1981: 101/102).
From the discussion it can be deduced that these media enhances achievement of the traditional subject outcomes for teaching biology. These traditional subject outcomes of teaching biology are stated by educators such as Falk (1980: 60), Samuels (1995: 51) and Carin, et al (1980: 6) and are outlined in paragraphs 3.3.3.1 - 3.3.3.3.

3.3.4.2 Audio-visual media and actualisation of didactic principles.

These media present learning content to the learner through the senses of hearing and sight. They are ideal for teaching biological processes where movement is required to master the learning content, for example, the function of the heart. The audio-visual media capture the interest of the learner because they have a variety of characteristics. If well integrated, they provide the learner with the opportunity of becoming actively involved in learning. These media promote both individualised and group instruction (Freysen, et al, 1989: 194).

From the discussion above, it can be deduced that the audio-visual media enhances actualisation of didactic principles such as observation and perception, motivation and interest, individualisation as well as activity.

Skinner (Heinich, et al, 1989: 306/307) advocates for a principle of reinforcement in learning. According to him “a reinforcer is any event or thing that increases the likelihood of a preceding behaviour’s being repeated or learned” (Heinich, et al, 1989: 307). This principle led into what is presently known as programmed instruction and programmable media.

3.3.5 Programmable media

The term “programmable media” is used to refer to non-human media with software structured in such a way that the learner can work through it independently, at his own pace and in accordance with his own abilities; while the software should also make provision for continual evaluation and feedback (Freysen, et al, 1989: 205). These media range from printed material, the computer and interactive video.
Programmable media are of great value in instruction because they have proven to be very effective in remedial instruction. They can function as a kind of tutor for slow learners in situations where personalised attention may be impossible, for example, in overcrowded classrooms. Their success is enhanced by their “failure proof” design. By being broken into small steps, by allowing the student to take as much time needed for each step, and being evaluated and revised carefully prior to publication, these materials are likely to provide the slow learner with a successful experience (Heinich, et al, 1989: 312).

According to Freysen, et al (1989: 204) the following didactic principles are actualised by programmed instruction:

(i) The principle of motivation: The fact that the learner is provided with immediate feedback and kept informed of his progress, the learner becomes motivated to learn. Programmable media also include the element of play. Take, for example, video games that kids enjoy. Most software programmes are based on principles such as surprise, marvel and fantasy.

(ii) The principle of individualisation: The learner is provided with an opportunity to progress at his own pace of working.

(iii) The principle of ordering learning context: Learning content is selected in accordance with specific outcomes and systematised in small steps that can be mastered gradually.

(iv) The principle of activity: The learner is allowed active participation in the exercises, on evaluation and on the feedback that is given.

Programmable media are most suited for individualised learning, however group activities should be scheduled to supplement programmed instruction and to meet other desired educational outcomes (Heinich, et al, 1989: 312).

As stated at the beginning of paragraph 3.3.5. the computer forms part of the programmable media.
3.3.3.5.1. **The computer:**

A computer is a fast and accurate electronic data manipulating system, designed to accept data, make difficult calculations quickly and accurately and store a large quantity of information in a relatively small space and then be able to withdraw it easily in processed form (Blignaut, 1994: 53).

The computer has the following characteristics, that is, speed, accuracy, storing, productivity and decision-making (Blignaut, 1994: 53/54; Heinich, et al, 1989: 356).

3.3.5.1.1 **The role of computers and computer-related teaching media in the teaching of biology.**

The following are ten functions of the computer in the teaching of biology as enlisted by Van Aswegen, et al (1993: 129/130):

- The manipulation, organisation and storage of data.
- Statistical calculations, for example calculation of the mean, correlation coefficients.
- Graphic representation, which include the plotting of graphs and generation of pictures.
- Laboratory interfacing, determining pH, as well as the influence of temperature, adrenaline, and other "chemicals" on laboratory simulation.
- Simulation and modelling of biological processes.
- Computer - assisted learning (CAL)
- The development and improvement of numeracy.
- Classroom testing and items analysis.
- Simulation of dissections, dangerous and expensive experiments.
- Games and quizzes.
Heinich, et al (1989: 357) identifies the CAI, Computer Assisted - Instruction, as one form of computer programme instruction. The methods that the computer can facilitate most effectively are drill and practice, tutorial, gaming, simulation, discovery and problem solving.


He outlines the following as specific advantages of the computer instruction:

- It provides individualised instruction.
- High-speed personalised responses to learner actions yield a high rate of reinforcement.
- The patient, personal manner that can be programmed provides a more positive affective-climate, especially for slower learners.
- Colour, music and animated graphics can add realism and appeal to drill exercises, laboratory activities and simulations.
- Memory capacity allows student’s past performance to be recorded and used for future planning.
- Computer-based instruction can improve efficiency and effectiveness. Effectiveness refers to improved learner achievement while efficiency means achieving objectives in less time or at lower cost.

The text, graphics and animations on computer screens is regarded by some educators as multimedia (Dwyer, 1993: 193).
3.4 Multimedia systems.

The term multimedia systems is defined as systems where information is presented through two or more media, for example, slides and sound may be regarded as multimedia. These systems, therefore implies the involvement of more than one sense in perception (Haney & Ullmer, 1970: 134; Dywer, 1993: 193). Multimedia systems are also multi-sensory and thus stimulate learning as it takes place in the world outside the classroom. Learning in real world is indeed multimedia and multisensory. "We are constantly learning via all our senses and via a multitude of stimuli, that is newspapers, books, radio, television, pictures etc." (Heinich, et al, 1989: 184). Multimedia systems do not merely refer to a multitude of media. It is concerned with how each medium, within the multimedia system complement the others; so that the whole system is greater than the sum of its parts (Heinich, et al, 1989: 184; Kaam, 1990: 17, Van Aswegen, et al, 1993: 105).

Each individual instructional medium has certain unique characteristics and user potential, which determine their suitability for application in a specific teaching-learning situation. Consequently more than one medium need to be used in the teaching and learning situation to transmit correct information (Blignaut, 1994: 78). Research findings indicate that no matter how good a medium may seem to be, it also has limitations (Blignaut, 1994: 78; Freysen, et al, 1989: 220).

Therefore media are used effectively when they are employed in combination with a variety of other media or instructional material. If media are used in combination with other media, the shortcomings of one medium can be nullified by the outstanding characteristics of another (Blignaut, 1994: 78; Freysen, et al, 1989: 220).

Woelfle (1975: 175) concur with this idea when he states that multimedia presentations means that by using the most effective medium for each item the maximum overall effectiveness is obtained. Media in a multimedia system are chosen to enhance the realisation of the stated traditional subject outcomes.

A multi-media system may comprise of any number of media which are used in combination and their use is structured.
However multimedia systems are divided into two groups. The first group being instructional media. These are media used by the teacher to enhance lessons and lectures. The second group being the student tools or individualised media, which are used by students to learn and complete assignments. These multimedia categories are an organiser, they overlap because tools used by teachers are often used by students and vice versa (Dwyer, 1993: 193; Heinich, et al, 1989: 185).

3.4.1 Instructional multi-media tools

These are packages intended to assist the teacher in presenting lessons effectively. A variety of media are used at particular times in the lesson. The method and procedure and the media to be integrated are prescribed in the package. These types of packages are used with small or large groups, that is, the medium permitting (Blignaut, 1994: 79; Maddux, 1994: 23).

These packages may comprise of different but integrated items such as transparencies, slides, films, videos, computer programs, sound cassettes, models, realia, charts, pictures, photo diagrams, books, pamphlets (Brown, et al, 1977: 389). Certain floor and board games, activity charts, flash cards, workbooks and manuals can also be used to advantage in multimedia packages (Heinich, et al, 1982: 187). By implication any lesson presentation employing more than one medium is a multimedia lesson presentation (Blignaut, 1994: 79).

3.4.2 The self-study packages or the student tools.

These packages are compiled exclusively for use by individual learner. They are programmed for independent self-study (Brown, et al, 1977: 389). They contain a variety of self-instruction and self-testing material and methods for undertaking the self-study. A variety of media that can be handled by the learner are included in the package (Brown, et al, 1977: 388). Multi-media packages are successfully applied in individualised learning.
The value of multimedia system in education as stated by Heinich, et al (1989: 186) are the following:

They stimulate interest, are exciting to use and make learning enjoyable. They provide multisensory learning; and active participation on the part of the learner. They promote individualised instruction or instruction of a small group of learners who have the same educational needs.

Multimedia have a great promise for bringing megachange in education. They break the monotony of traditional teaching. Where the teacher present information, the students absorb it and the teacher tests the students. Multi media incorporate innovations such as active learning, critical thinking and discovery learning. The role of the learner change from that of a passive receptor to that of an active participant (Johnson, 1994: 1-2).

Multimedia materials enhance the principle of motivation. These materials are structured in such a way that they are appealing to the learner’s interest: The learner is actively involved in the learning activities. Self activity is automatically reinforcing and thus it is also motivating (Toth, Megyesi & Molnar, 1995: 15).

Research findings on multimedia usage report that students who learned via multimedia experience changes in learning. Students may participate in simulated life experiences, make decisions, and learn the consequences. They can experiment with data and scientific equipment which was not accessible prior to multimedia use. In other multimedia implementations the methodology by which students learn changed drastically, where students created their own multimedia materials. Learning style became more individualised (Dwyer, 1993: 233).

Multimedia implementations made at the University of Windsor found that computerised simulation of biological processes and phenomena are excellent. They also discovered that media technologies improve hands-on skills, problem-solving abilities and overall performance of students, when compared to conventional laboratory approaches (Habowsky, et al, 1990: 234).

Computer-assisted instruction, CAI, has had beneficial effects on learner achievement in a wide variety of instructional settings. Research has shown that CAI improves the learners' achievement by as much as fifty percent. CAI has been effective with different learners and in many different types of instructional settings. The CAI improves the affective outcomes of instruction such as the learners attitude and self-esteem (Dalton, 1985: 149).

Multimedia systems enhance acquisition of the traditional subject outcomes of teaching biology. From the above discussion it can be noted that these media provide the learner with the opportunity to learn through discovery, critical mind, to acquire scientific attitudes and to develop a positive self-concept. The learner is assisted to develop hands-on skills, problem-solving abilities, to acquire biological knowledge, to develop interest and make learning enjoyable. What is interesting about these systems is that they do not have to be expensive materials only, but even cheap materials can serve the purpose. Materials such as clay, waste papers, posters, cardboard, plastic bottles, wires, etc. can be used. If that be the case, then teachers in the developing areas, such as Thohoyandou Inspection Area, can be encouraged to improvise and employ them.

From the above discussion it has become clear that various media have different attributes. These attributes serve as guidelines for the selection of media in biology teaching and learning. Media should be used to fulfil a particular purpose or function, as dictated by their attributes.

3.5 Functions of media as criteria of media usage.

(a) Focusing pupils' interest and attention.

Media aid pupils to relate new learning experience to well founded previous experiences. Therefore pupils' interest and enthusiasm are maintained when a variety of methods and materials are used.

(b) Showing and explaining the basic structure of a concept:

As stated under the paragraph: nature and structure of the subject biology, this subject is a science comprising of facts, concepts and principles. These content is made clear to the pupil's mind by appropriate use of media. For example, the structure of parenchyma and collenchyma tissues are best illustrated by diagrams.

(c) Explaining complicated relationships.

In the preceding paragraph it was stated that biology is a science of facts, concepts and principles. There is a need to teach and learn these concepts and principles in an integrated way. For example, ecology is an integrated science which can best be taught in a natural environment, where the relationships between the different components can best be experienced. The compilation of data and drawing of graphical presentation enhances the explanation of the concepts to be exposed.

(d) Relating abstract images to concrete examples.

It is important that pupils form an accurate mental pictures of the concepts being taught, so that they may achieve effective learning. The biological science comprises of many complicated theories. It is difficult to teach these theories because the abstract nature of the content and underlying principles. The use of media may provide visuals which enhance the pupils' understanding of these theories and principles. Consider, for example, the functions of RNA and DNA during protein synthesis. The pupils' understanding of this biochemical process is enhanced by the use of models of molecules, animated video and sound film productions.
(e) Conceptualisation and integration of fragmented units of knowledge.

When the inductive approach is used, the subject-matter is broken into primary concepts, which are then mastered. The mastery of primary concepts is followed by drawing or formulating a principle. The presentation of fragments of knowledge may create misconceptions, particularly if pupils fail to relate conceptions and definitions with the underlying themes in totality. The use of video and sound films has the advantage that specific themes can be viewed after the theory had been discussed with the pupils. The viewing of a video on protein synthesis after explanation on theory, can be of good value.

(f) Multimedia approach and the enhancement of learning

Multimedia approach has the advantage of stimulating more of the students' senses during teaching (Sund, et al, 1967: 167). This approach puts emphasis on individual differences, as a result, pupils learn better. Learners achieve more success by one specific method than by another (Freysen, et al, 1989: 220). However it must be remembered that the success of multimedia usage lies on the success these media complement each other. Therefore teachers should strive to select media which enhance the realisation of selected teaching objectives.

(g) Bringing about change in attitude and behaviour.

Teaching is geared at changing the behaviour and attitude of the pupil. One of the educational outcomes of teaching biology is to develop a respect for all living organisms and a recognition of the urgent need for nature conservation (DET: 1989).

This outcome is better achieved by the use of media. If, for example, pupils are to be persuaded that nature conservation is in the interest of the individual and society, it can best be done by the use of appropriate media. A film on the topic of nature conservation, could be self explanatory, because pupils will experience for themselves what the influence of pollution on the environment could be.
Individual differences are most adequately served by a variety of teaching media. Students often learn better by one method than by another.

Media provide opportunities for frequent changes of pace.

To consolidate and generalise a concept or something that has been learnt.

To motivate pupils.

To obtain and maintain the attention and interest of the pupils.

To involve pupils to a greater extent in classroom activities and to encourage them to be creative.

To improve the thought processes and the reasoning ability of the pupils.

To remember subject-matter more easily.

To expand the experience and background of the pupils.

3.6 CONCLUSION:

The use of media in teaching and learning must always be goal directed. From the discussion above, it has become clear that media play an important role in instruction.

Educators as early as the sixteenth century, for example, Amos Comenius, discovered that there are principles which must receive priority in teaching and learning. These principles were passed on to educators from generation to generation. To date they are known as the following:
- The principle of observation and perception; educators from different quarters are convinced that learning becomes meaningful if the learner is provided with concrete objects to observe, analyse and perceive.

- The principle of activity and involvement, educators are advocating for active participation by the learner in the teaching and learning activity. This principle takes into account learner involvement as a matter of significance for effective teaching and learning. The idea is that, the lesson should be planned in such a manner that media which enable the learner to take an active role in his learning are included. The principle of activity takes interest into account. The learner must experience the learning activities as interesting.

- The principle of individualisation, is based on the fact that learning becomes effective if the pupil learns at an individual pace, and the individual’s needs are taken into consideration. There are particular media that lend themselves more positively for individualised learning. Example of such media are the multi-media packages and computer assisted instruction or CAI.

- The principle of motivation is of great importance in teaching and learning biology, because it is acknowledged that a motivated learner learns more efficiently than an unmotivated learner. Engelbrecht and Lubbe (1989: 18), argue has effective motivation can be obtained by building on the child’s activities and interests.

Media are varied and they also have different characteristics or attributes. These attributes play an important role during media selection. Media attributes determine which media have to be included at a particular phase of a lesson. The fact that media have different characteristics draws one to conclude that, much as media have merits, they also have limitations. Multimedia systems or packages have been devised as an attempt to overcome the problem of media limitations. It is argued that when media are used in combination, the weaknesses of one medium are overcome by the outstanding merits of another medium. What is exciting about multimedia systems is that, they have so many merits.
It has been noted that the use of media in teaching and learning enhances acquisition of traditional subject outcomes of teaching biology. From the discussion above, it has become clear that media enables pupils to learn biology through inquiry, observation and discovery. Learners develop critical mind, they acquire scientific knowledge and attitudes as well as scientific methods. Media such as microscopes, for example, enables learners to acquire information that could not be gained through a naked eye. Models stimulate discovery and inquiry skills. Media enables learners to give authentic answers to biological questions.

Despite the learning success achieved in other countries due to the implementation of media, one wonders whether the problem of poor learning and poor achievement in the Northern Province can be solved by implementing media in the teaching of various subjects, and of biology in particular. To answer these question, it is necessary to look into the prevailing conditions in the teaching and learning environment in the Northern Province. The next chapter forms an inquiry into:

- the suitability of biology teachers to teach the subject with regard to their qualifications both academically and professionally; as well as the extent of their media training.

- the availability of physical resources, namely; classrooms, laboratories and educational media.

- the financial capacity of schools, at the Thohoyandou Inspection Area, to finance the purchase of educational media, batteries and generators as well as electrical wiring of schools.

- the suitability of media lecturers at colleges of education and Venda University found in region 3 to offer media training to pre-service trainee teachers.
CHAPTER 4

4 RESEARCH DESIGN, METHODOLOGY AND DATA ANALYSIS

4.1 Setting for investigation.

This investigation was conducted at different secondary schools found in the Thohoyandou Inspection Area of Region 3 in the Northern Province of the Republic of South Africa, and colleges of education found in Region 3 as well as the University of Venda.

In most schools in this inspection area, biology is a common subject in the curricula for students who do general subjects as well as students that do science subjects. Biology is a requirement to obtain matric exemption for students who take it as the only science subject. This subject is compulsory for admission in medical sciences, for example, medicine and nursing.

4.2 The selection of population and sampling method.

The population was selected according to the stratified sampling method. Stratified sampling as a method was used to obtain a greater degree of representativeness.

Sampling was done on 43 secondary schools which were divided into two groups. A variable considered in the division of the sample was availability and non-availability of electricity. One group consisted of schools which are electrified and the other group consisted of schools without electricity.

Questionnaires were distributed amongst sixteen secondary schools, which forms 37.2 percent of all secondary schools in this inspection area.

The schools were randomly selected. A number was allocated to each of the 43 secondary schools. These numbers were written on pieces of paper numbered 1 to 18 for electrified schools and 1 to 25 for schools without electricity and each group was separately placed in a container.
An independent person was requested to toss the papers and pick out one piece at a time and write down its number. After noting the number, the piece of paper was placed back in the container and tossed again. Whenever a piece of paper with a number that was already noted was picked again, it was placed back in the container and tossing was repeated. This process was repeated until 20 secondary schools were selected, 10 electrified and 10 schools without electricity.

Questionnaires were again, distributed to three colleges of education and the University of Venda. These colleges were selected on the basis of their proximity to the Thohoyandou Inspection Area.

The following are the nature and characteristics of the three groups selected:

Sample 1: Consisted of Grade 10 to 12 biology teachers selected from 16 of the sampled secondary schools in the Thohoyandou Inspection Area.

Sample 2: Consisted of the principals from these sixteen secondary schools.

Sample 3: Consisted of 4 media lecturers from the three colleges of education and one media lecturer from the University of Venda.

The above population was selected for the following reasons:

(i) Secondary school biology teachers were selected because it was held that these teachers are involved in the day to day teaching, and as such they have first hand information. The contributions from these teachers should be more reliable. Furthermore, secondary school biology teachers were selected because the problem of high failure rate is nationally identified at matric level, and in the Northern Province in particular.

(ii) Principals of the secondary schools were selected because it was assumed that their authority and power in the purchase of educational media and
electrical wiring of schools may not be underestimated. The purpose was to identify their attitudes towards the importance of media, as well as the financial capacity of the school to purchase them.

(iii) Media lecturers were selected because it was held that, at universities and colleges of education, they are personally involved with pre-service media training of teachers. They are informative as far as time allocated to media training and its sufficiency.

(iv) In order to avoid bias, schools to be sampled were divided into two groups, namely:
- Schools that have electricity and
- Schools that do not have electricity.

4.3 Permission to conduct research

Permission to conduct research at secondary schools and colleges of education was obtained from the Regional Director for Education, Arts, Culture and Sports Region 3. A copy of this letter is attached as appendix B.

4.4 Pilot work

Questionnaires were compiled and sent to the promoter to check their validity and correctness. After their approval by the promoter they were circulated at a pilot school in a different inspection area.

4.5 Circulation of questionnaires.

Questionnaires were personally delivered to schools. An average of two teachers per school was expected to respond. Teachers were requested to return the questionnaires to the principal’s office where they were collected. However some were delivered at the circuit office where they were collected.
4.6 Problems encountered

- One selected school did not have biology in its curriculum.

- Some teachers were unwilling to answer the questionnaires because they thought that the study was a government project, which was meant to assess provisioning of school needs.

- Teachers were busy administering examinations and as such they did not have time to complete questionnaires promptly.

- The researcher could not deliver questionnaires to three schools, that were selected, because of lack of time.

- The researcher experienced financial problems because she did not have sponsors and had to travel 500 kilometres to consult the promoter and to visit the library.

- Reference materials were not always available at RAU library and the researcher had to visit other universities.

- The schools where questionnaires were delivered were far apart and travelling to these schools was strenuous.

- Roads to some schools were unkept and it was therefore difficult to travel to these schools by car. Due to lack of time, distance and money, colleges of education were selected on the basis of their proximity to the Thohoyandou Inspection Area.

4.7 Data analysis

One of the objectives of this study is to investigate the suitability of biology teachers in the Northern Province to teach the subject, with regard to their:
(i) qualifications, both professional and academic;
(ii) knowledge of the nature, traditional subject outcomes of teaching biology;
(iii) media utilisation frequency and knowledge of functions of media, as well as;
(iv) availability of facilities and media at their schools.

Further the study aims at establishing the attitudes of principals towards media and the ability of the school budgets to purchase media and to electrify the schools.

Since the MEC of the Department of Education, Arts, Culture and Sports in the Northern Province has declared that teachers are under qualified and under trained, this research aims at determining the level of media training that is received by teachers during their pre-service training at colleges of education and universities.

From the explanation made above, three types of data are analysed, namely: questionnaires to the biology teachers, questionnaires to the principals of schools and questionnaire to the media lecturers.

4.7.1. QUESTIONNAIRES TO THE BIOLOGY TEACHERS

Questionnaires to the biology teachers are analysed section by section.

Section A: General Information

In this section the respondents were required to provide information regarding gender, professional status, academic and professional qualifications. They were further required to indicate their highest academic and professional qualifications to teach biology. Since the research study is an inquiry focused on the use of media in biology teaching; the respondents were also requested to provide their qualifications on educational media science.
Experience in teaching and marking biology Standard 10 external examinations were regarded as variables that have a bearing on the teachers methods of teaching. Eventually this plays a role on the pupil’s achievement. Thus the respondents were required to provide their experience in teaching and in marking biology Standard 10 external examinations.

The following questions were presented to the biology teachers:

1. Your sex.
2. Your professional status.
3. Your qualifications.
   3.1 Academic qualifications
   3.2 Professional qualifications.
   3.3 Your highest qualifications to teach biology.
   3.4 Your professional qualification to teach biology.
   3.4.1 Have you done biology as one of your subject/method subject?
   3.4.2 Have you done a diploma specialising on the methods of teaching biology?
   3.4.3 Have you done a diploma specialising on educational media science.
4. Your experience:
   4.1 Experience in teaching in general.
   4.2 Experience in teaching biology.
   4.3 Experience in marking biology standard 10 (Ten) external examinations.

Overview: Responses to questions and interpretation of data.

**Question 1: Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>36</td>
<td>83.72</td>
</tr>
<tr>
<td>Females</td>
<td>7</td>
<td>16.28</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>
A high percentage (83.72%) of the respondents were males as compared to female respondents (16.28%). This is reflected on table 4.1.

**Question 2: Professional Status**

This question inquired into the professional status of biology teachers who responded. It was established that a high percentage (93.02%) of biology teachers are educators, while a low percentage (6.98%) of biology teachers are Heads of Department. This is shown on table 4.2.

<table>
<thead>
<tr>
<th>Professional status</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educators</td>
<td>40</td>
<td>93.02%</td>
</tr>
<tr>
<td>H.O.D's</td>
<td>3</td>
<td>6.98%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Question 3: Academic and professional qualifications in general (3.1 - 3.2)**

The investigation established that a high percentage (48.84%) of biology teachers have passed matric as their highest academic qualification. Biology teachers who obtained university degrees showed low percentages. Table 4.3 below indicates this status quo:

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matric</td>
<td>21</td>
<td>48.84%</td>
</tr>
<tr>
<td>B.A</td>
<td>9</td>
<td>20.93%</td>
</tr>
<tr>
<td>B.Sc</td>
<td>6</td>
<td>13.95%</td>
</tr>
<tr>
<td>B.A. Hons.</td>
<td>4</td>
<td>9.30%</td>
</tr>
<tr>
<td>B.Sc. Hons.</td>
<td>2</td>
<td>4.65%</td>
</tr>
<tr>
<td>M.A.</td>
<td>1</td>
<td>2.33%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100%</td>
</tr>
</tbody>
</table>
It was further established that most of biology teachers have done diplomas after matric i.e. STD (69.77%) and J.S.T.C. (9.30%); while a lower proportion have trained after obtaining university degrees i.e. H.E.D. (4.65%) and U.E.D. (16.28%). This is indicated on table 4.4. below.

Table 4.4

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>HED</td>
<td>2</td>
<td>4.65</td>
</tr>
<tr>
<td>UED</td>
<td>7</td>
<td>16.28</td>
</tr>
<tr>
<td>J.S.T.C.</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Questions 3.3 - 3.4.2

3.3 **Highest academic qualifications to teach biology.**

Biology teachers who have passed matric without any further academic qualifications to teach the subject constitute 41.86 percent. However 20.93 percent have passed biology III. Those teachers who passed biology I are 16.28 percent. See table 4.5.

Table 4.5

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matric</td>
<td>18</td>
<td>41.86</td>
</tr>
<tr>
<td>Biology I</td>
<td>7</td>
<td>16.28</td>
</tr>
<tr>
<td>Biology II</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>Biology III</td>
<td>9</td>
<td>20.93</td>
</tr>
<tr>
<td>Botany II</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Zoology III</td>
<td>2</td>
<td>4.65</td>
</tr>
<tr>
<td>BSc. Hons</td>
<td>2</td>
<td>4.65</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>
The impression which one gets is that a high percent (58.14%) is qualified to teach biology, that is, teachers who passed Biology I - III, Botany II, Zoology III and B.Sc. Hons.

**3.4.1 - 3.4.2 Pre-service and in-service training.**

Table 4.6

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>38</td>
<td>88.37%</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>11.63%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.7

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>21</td>
<td>48.84%</td>
</tr>
<tr>
<td>No</td>
<td>22</td>
<td>51.16%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.6 indicates that a high percent (88.37%) of biology teachers received pre-service training to teach the subject; while table 4.7 shows that 51.16 percent have not received in-service training to teach the subject. One can conclude that although many biology teachers have received pre-service training to teach the subject, they are not being serviced.

**3.4.3 Diploma specialising in educational media science**

Table 4.8

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9</td>
<td>20.93%</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>76.74%</td>
</tr>
<tr>
<td>Do not know</td>
<td>1</td>
<td>2.33%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 4.8 shows that 76,64 percent have not done this diploma, while 20,93 percent did a diploma specialising in educational media. It is clear that the majority of biology teachers have not done a diploma course specialising in educational media.

**Question 4**

4.1 - 4.3. Experience in teaching in general and in teaching biology as well as experience in marking biology Grade 12 external examinations.

### Table 4.9

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Number of respondents</th>
<th>Percentages of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0 - 5) years</td>
<td>9</td>
<td>20,93</td>
</tr>
<tr>
<td>(6 - 10) years</td>
<td>19</td>
<td>44,19</td>
</tr>
<tr>
<td>(11 - 15) years</td>
<td>10</td>
<td>23,26</td>
</tr>
<tr>
<td>(16 - 20) years</td>
<td>5</td>
<td>11,62</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4.10

<table>
<thead>
<tr>
<th>Intervals</th>
<th>Number of respondents</th>
<th>Percentages of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0 - 5) years</td>
<td>12</td>
<td>27,91</td>
</tr>
<tr>
<td>(6 - 10) years</td>
<td>18</td>
<td>41,86</td>
</tr>
<tr>
<td>(11 - 15) years</td>
<td>11</td>
<td>25,58</td>
</tr>
<tr>
<td>(16 - 20) years</td>
<td>2</td>
<td>4,65</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4.11

<table>
<thead>
<tr>
<th>Interval</th>
<th>Number of respondents</th>
<th>Respondents in percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>26</td>
<td>60,46</td>
</tr>
<tr>
<td>1 - 5</td>
<td>10</td>
<td>23,26</td>
</tr>
<tr>
<td>6 - 10</td>
<td>7</td>
<td>16,28</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>
It is established from table 4.9 that the general experience of a high percent (44,19%) of biology teachers in this inspection area ranges between six to ten years, and eleven to fifteen years is 23,26 percent. On the third place are biology teachers who have a minimum experience of five years, 20,93 percent; while those who have an experience of sixteen to twenty years make the lowest proportion (11,28%). The same trend is followed when it comes to the experience to teach biology, see table 4.10 where a high percent (41,86%) have been teaching biology for a period ranging between six to ten years, followed by those who taught biology for a period between eleven to fifteen years (25,58%). Again the lowest percent (4,65%) have taught biology for a period ranging between sixteen to twenty years. With regards to experience to mark biology Grade 12 external examinations, see table 4.11 the majority of biology teachers (60,47%) have never marked. A small percent (23,26%) have marked biology Grade 12 external examinations for a period ranging between one to five years, while those biology teachers who have marking experience ranging between eleven and fifteen years make the lowest proportion (16,28%).

From tables 4.9 - 4.11 one can deduce that the majority of biology teachers have little experience to teach the subject. This has an impact on their methods of presenting the subject matter. Furthermore it is shown from these tables that biology teachers lack experience of marking biology Grade 12 external examinations. Consequently they are not familiar with criteria of answering examination questions as set by examiners. Eventually these may be setbacks which result in biology candidates underachieving.
SECTION B

The nature and traditional subject outcomes of teaching biology

5. The nature of biology

It is interesting and encouraging to note that as indicated on table 4.12 the majority of biology teachers (65.12%) agree that the nature of biology is composed of knowledge or products structure, process or methods structure, and attitudes that guide the biologist in his/her practice, while a smallest percent (2.33%) disagree to this nature of biology.

Table 4.12

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>12</td>
<td>27.91</td>
</tr>
<tr>
<td>Agree</td>
<td>28</td>
<td>65.12</td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Do not know</td>
<td>2</td>
<td>4.65</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

According to Dekker, et al (1993: 33) the nature of biology provides reasons for teaching the subject and how it must be taught. From the responses of biology teachers (table 4.12) high percentages 65.12 and 27.91 agree and strongly agree respectively, with the nature of biology. Consequently these teachers know why and how biology must be taught.

6. The specific outcomes of teaching biology.

From figure 4.1 it is shown that the percent of biology teachers who responded that they strongly agree ranges between 46.51 percent and 6.98 percent. The highest percent of biology teachers (46.51%) responded that they strongly agree with outcome number 6.4, while the smallest percent (6.98%) that they strongly agree to outcome number 6.8. However the response, strongly agree received an average of 29.46 percent.
<table>
<thead>
<tr>
<th>The specific outcomes</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Use process skills to investigate phenomena related to biology.</td>
<td>30,23</td>
<td>51,16</td>
<td>13,95</td>
<td>4,65</td>
</tr>
<tr>
<td>6.2 Demonstrate an understanding of concepts and principles, and acquired knowledge in biology.</td>
<td>44,19</td>
<td>34,88</td>
<td>9,30</td>
<td>11,63</td>
</tr>
<tr>
<td>6.3 Apply scientific knowledge and skills to problems in innovative ways.</td>
<td>34,88</td>
<td>44,19</td>
<td>9,30</td>
<td>11,63</td>
</tr>
<tr>
<td>6.4 Demonstrate an understanding of how scientific knowledge and skills contribute to the management, development and utilisation of natural resources.</td>
<td>46,51</td>
<td>32,56</td>
<td>11,63</td>
<td>9,30</td>
</tr>
<tr>
<td>6.5 Use scientific knowledge and skills to support responsible decision making.</td>
<td>30,23</td>
<td>37,21</td>
<td>23,26</td>
<td>9,30</td>
</tr>
<tr>
<td>6.6 Demonstrate knowledge and understanding of the relationship between science and culture.</td>
<td>23,58</td>
<td>34,88</td>
<td>32,56</td>
<td>9,30</td>
</tr>
<tr>
<td>6.7 Demonstrate an understanding of the changing and contested nature of knowledge in biology.</td>
<td>25,58</td>
<td>48,84</td>
<td>16,28</td>
<td>9,30</td>
</tr>
<tr>
<td>6.8 Demonstrate knowledge of ethical issues, bias and inequities related to biology.</td>
<td>6,98</td>
<td>37,21</td>
<td>39,53</td>
<td>16,28</td>
</tr>
<tr>
<td>6.9 Demonstrate an understanding of the interaction between biology and socio-economic development.</td>
<td>23,26</td>
<td>48,84</td>
<td>16,28</td>
<td>11,62</td>
</tr>
<tr>
<td>Average percentages</td>
<td>29,46</td>
<td>41,08</td>
<td>19,12</td>
<td>10,34</td>
</tr>
</tbody>
</table>
The percentages of biology teachers who responded that they agree with the specific outcomes of teaching biology ranges between 51.16 percent and 32.56 percent with an average of 41.08 percent. The majority of biology teachers 51.16 percent, responded that they agree with outcome number 6.1. See figure 4.2.
The nine specific outcomes of teaching biology.

Fig 4.2.

It is indicated on figure 4.3 that percentages of teachers who responded that they disagree with the nine specific outcomes of teaching biology ranges between 39.53 percent and 9.30 percent and drew an average of 19.12 percent. However the majority of biology teachers indicated that they disagree with specific outcome number 6.8 and lesser percentages disagree with outcomes number 6.2 and 6.3.
The nine specific outcomes of teaching biology.

Fig. 4.3.

Figure 4.4 shows that percentages of biology teachers who strongly disagree with the nine specific outcomes of teaching biology ranges from 4.65 percent, being the lowest, and 13.95 percent being the highest. The lowest percent of biology teachers (4.65%) responded that they strongly disagree with the specific outcome number 6.1 and the highest percent of biology teachers (13.95%) responded that they strongly disagree with outcomes
number 6,3 and 6,8. The average percentages of biology teachers who responded that they strongly disagree with the specific outcomes for teaching biology are 10,34 percent.

Fig. 4.4.
The highest average percent of responses is 41,09 percent, followed by 28,99 percent, 19,12 percent and 10,34 percent, being the number of biology teachers who responded to responses, agree, strongly agree, disagree and strongly disagree respectively. If the average percentages of biology teachers who strongly disagree (10,34%) and those who disagree (19,12%) are added together, a sum of 29,46 percent is obtained, while the average
responded that they agree (41.08) are summed-up an aggregate of 70.54 percent is obtained. It can be concluded that the majority of biology teachers agree with specific outcomes of teaching biology as outlined in the document curriculum 2005, as reasons for teaching biology.

SECTION C: AVAILABILITY OF FACILITIES AND MEDIA

7. The availability and non-availability of media.

Table 4.14

<table>
<thead>
<tr>
<th>Types of media</th>
<th>Not available at the respondents' schools</th>
<th>Available at the respondents' schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of respondents</td>
<td>Percent</td>
</tr>
<tr>
<td>1. Models</td>
<td>21</td>
<td>48.84</td>
</tr>
<tr>
<td>2. Tape recorders</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>3. Radio</td>
<td>28</td>
<td>65.12</td>
</tr>
<tr>
<td>4. Television</td>
<td>25</td>
<td>58.14</td>
</tr>
<tr>
<td>5. Video tapes</td>
<td>26</td>
<td>60.47</td>
</tr>
<tr>
<td>6. Film strips</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>7. Slides</td>
<td>29</td>
<td>67.44</td>
</tr>
<tr>
<td>8. Wall charts</td>
<td>17</td>
<td>39.53</td>
</tr>
<tr>
<td>9. Graphs</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>10. Pictures from books</td>
<td>19</td>
<td>44.19</td>
</tr>
<tr>
<td>11. Photos</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>12. Posters</td>
<td>24</td>
<td>55.81</td>
</tr>
<tr>
<td>13. Chalkboards</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14. Feltboards</td>
<td>41</td>
<td>95.35</td>
</tr>
<tr>
<td>15. Bulletin boards</td>
<td>37</td>
<td>86.05</td>
</tr>
<tr>
<td>16. Newspaper supplements</td>
<td>28</td>
<td>65.12</td>
</tr>
<tr>
<td>&amp; Magazines</td>
<td>31</td>
<td>72.09</td>
</tr>
<tr>
<td>17. Overhead projector</td>
<td>35</td>
<td>81.40</td>
</tr>
<tr>
<td>18. Computer</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>19. Textbook</td>
<td>30</td>
<td>69.77</td>
</tr>
<tr>
<td>20. Potometer</td>
<td>20</td>
<td>46.51</td>
</tr>
<tr>
<td>21 Fermentation flasks</td>
<td>29</td>
<td>67.44</td>
</tr>
<tr>
<td>22. Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average percentages</td>
<td></td>
<td>59.62</td>
</tr>
</tbody>
</table>

A declaration by the MEC of Education, Arts, Culture and Sport in the Northern Province that there is "complete under-provision of resources such as classrooms, libraries,
laboratory equipment etc." (Keynote address by the Northern Province MEC for Education, Arts, Culture and Sport at UNESCO Conference on Informatics held in Moscow, 3rd July 1996: 2); is confirmed by figure 4.5 which indicates that a high percent of biology teachers have responded that a large number of media, as listed in the questionnaires are not available at their schools. However all biology teachers, 100 percent and 90 percent have responded that chalkboards and biology textbooks are available at their schools respectively. The average percent of biology teachers who indicated that media listed on table 4.14 are not available at their schools is 59.62 percent as opposed to 40.38 percent of biology teachers who responded that these media are available at their schools. This is a clear reflection of the poverty and lack of facilities experienced in this inspection area.
8. The average enrolment of biology students per class.

Table 4.15

<table>
<thead>
<tr>
<th>Average class enrolment</th>
<th>Number of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 24</td>
<td>2</td>
<td>4.65</td>
</tr>
<tr>
<td>25 - 35</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>36 - 45</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>46 - 55</td>
<td>5</td>
<td>11.63</td>
</tr>
<tr>
<td>56 - 65</td>
<td>12</td>
<td>27.90</td>
</tr>
<tr>
<td>66 - 75</td>
<td>4</td>
<td>9.30</td>
</tr>
<tr>
<td>76 - 100</td>
<td>11</td>
<td>25.58</td>
</tr>
<tr>
<td>Do not know</td>
<td>1</td>
<td>2.33</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

The prevailing conditions in this inspection area as far as enrolment of students per class is concern, is shown by table 4.15. The majority of biology teachers (27.91%) responded that the average enrolment per class ranges between fifty six and sixty five (56 - 65) followed by 25.58 percent who responded that average enrolment per class ranges between seventy six and hundred (76 - 100) students. Further more teachers who responded that they teach an average enrolment per class ranging between forty six and fifty five (46 - 55) are 11.63 percent. However 4.65 percent of biology teachers responded that they teach average enrolment per class ranging between (1 - 24) of students. These are probably teachers who teach at the former private schools, which are presently classified as model C schools.

The agreement signed between the department of Education, Arts, Culture and Sport and teacher unions is that the accepted class enrolments at secondary schools should be 1: 35. Average class enrolment which are above the ratio 1: 35 as reflected on table 4.15 are an indication that most biology classes are overcrowded. This has a negative impact on the teachers' methods of presentation and may result in underachievement. It becomes difficult, for example, to perform experiments.
9. **Availability of standardised laboratory.**

Table 4.16 indicates that a large number of biology teachers 81.40 percent responded that there are no standardised laboratories at their schools. A small percent (18.6%) of biology teachers have indicated that there are standardised laboratories at their schools. It is noted in the records of the Thohoyandou Inspection Area that out of forty three schools, only two schools have standardised laboratories. One can therefore infer that teachers who reported that there are laboratories in their schools, must be teaching at the two schools in record. One therefore wonders that if there are no laboratories how are biology practicals done?

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>35</td>
<td>81.40</td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>18.60</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

9.1 **Due to lack of standardised laboratory, biology practicals are: never done, done in classrooms, done outdoors.**

Due to lack of standardised laboratories, a high percent (54.29) responded that biology practicals are never done, while 42.86 percent reported that practicals are done in the classrooms. It is worth noting that 2.85 percent of teachers are motivated to do biology practicals to an extent that they report that they sometimes do practicals outdoors.

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never done</td>
<td>19</td>
<td>54.29</td>
</tr>
<tr>
<td>Done in classrooms</td>
<td>15</td>
<td>42.86</td>
</tr>
<tr>
<td>Done outdoors</td>
<td>1</td>
<td>2.85</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
<td>100</td>
</tr>
</tbody>
</table>

From the information shown on table 4.17 one is persuaded to think that biology is not taught as it should, due to lack of facilities.
10 - 10.1 The availability of electricity and batteries or generator as sources of power.

Table 4.18

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>16</td>
<td>37.21</td>
</tr>
<tr>
<td>Yes</td>
<td>27</td>
<td>62.79</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

The information reflected on table 4.18 show that a large number (62.79%) of biology teachers who responded, teach at schools that have electricity, while 37.20 percent teach at schools which are not electrified. The availability of electricity is of high significance in teaching because it offers the possibility of using educational media, which depend on electricity as a source of power. The fact that 37.21 percent of biology teachers teach at schools that do not have electricity means that such schools must use batteries or generators as sources of energy.

Table 4.19

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>12</td>
<td>75</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.19 indicates that 75 percent of biology teachers who responded to question 10, that they teach at schools which are not electrified, have indicated that there are no generators nor batteries at their schools that can be used to generate power. However 25 percent of biology teachers responded that they use batteries or generators as sources of power to watch television and video tapes. It must be stated immediately that among them are those teachers who have indicated that they bring to school their personal batteries, video, video tapes and television sets to be used for instructional purposes. This is an indication that there are teachers who are strongly convinced that media have great merits and should be used in the teaching of biology.
11. Technology has innovated media which require intensive training for teachers in service to use.

Table 4.20

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>23</td>
<td>53,49</td>
</tr>
<tr>
<td>Agree</td>
<td>17</td>
<td>39,53</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>2,33</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>2</td>
<td>4,65</td>
</tr>
<tr>
<td>Do not know</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

The majority of biology teachers 53,49 percent and 39,53 percent strongly agree and agree respectively that media that are currently innovated require that, biology teacher in service, be retrained so that they can use them effectively. The biology teachers who strongly disagree and disagree 4,65 percent and 2,33 percent respectively form the lowest proportion. The information on table 4.20 suggests that there is a great need felt by biology teachers, in this inspection area, for in-service training that would service teachers on the use of media.

12. The biology teacher need to be resourceful to an extent that he can produce his own media.

Table 4.21

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>21</td>
<td>48,84</td>
</tr>
<tr>
<td>Agree</td>
<td>18</td>
<td>41,86</td>
</tr>
<tr>
<td>Disagree</td>
<td>1</td>
<td>2,33</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>2</td>
<td>4,65</td>
</tr>
<tr>
<td>Do not know</td>
<td>1</td>
<td>2,33</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

The information on table 4.21 shows that a large number of biology teachers strongly agree (48,84%) and agree (41,86%) that biology teachers must be resourceful to an extent that they can produce their own media. This is an indication that biology teachers in this
inspection area, are aware that they may have to depend on their own creativity and resourcefulness to improve the effect of instruction.

13. **Low cost material may be used to produce media which play a significant role in biology teaching.**

Table 4.22

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>19</td>
<td>44.19%</td>
</tr>
<tr>
<td>Agree</td>
<td>18</td>
<td>41.86%</td>
</tr>
<tr>
<td>Disagree</td>
<td>4</td>
<td>9.30%</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>1</td>
<td>2.33%</td>
</tr>
<tr>
<td>Do not know</td>
<td>1</td>
<td>2.33%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100%</td>
</tr>
</tbody>
</table>

In responding to this question 44.19 percent and 41.86 percent of biology teachers responded that they strongly agree and agree respectively that media can be made by low cost material, see table 4.22. These responses reaffirms the stand taken on question 12, that a resourceful biology teacher should be able to make his/her own media.

14. **Do you know where to order commercial media?**

Table 4.23

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
<td>44.19%</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td>55.81%</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100%</td>
</tr>
</tbody>
</table>

One problem that hinders schools from purchasing educational media, as indicated on table 4.23 lack of knowledge of the companies that sell them. In responding to this question a high percent (55.81%) of biology teachers indicated that they do not know where they can order commercial media. The biology teachers who responded that they know where they can purchase educational media are 44.18 percent. This may be an indication that some schools do receive letters from the suppliers while other do not. There is a need therefore, to introduce these schools to suppliers.
15. Indicate your frequency of media utilisation in biology teaching by circling 0, 1, 2, 3, 4, 5, or 6 using the following key:

6. Everyday
5. A few times a week.
4. Once a week.
3. A few times a month.
2. Once a month or less.
1. A few times a year.
0. Never.

Table 4.24 contains a summary of the frequency of media utilisation by biology teachers of the Thohoyandou inspection area, expressed in percentages. The summary reflects the utilisation of twenty one different media. Overall, chalkboards are most utilised (93.03%)
with textbooks (90.69%) second, pictures from books and magazines (32.56%) third, wallcharts (16.28%) fourth, posters (13.95%) fifth, real objects (11.64%) sixth and models (11.56% seventh).

If the information on table 4.24 is assessed on the basis of average percentages, one realises that 47.73 percent of biology teachers indicated that they never use media, except chalkboards and textbook, 14.39 percent responded that they do use different media six times a week, and 10.63 percent use media a few times a year. The fact that an average percent of 47.73 percent of biology teachers responded that they never use media correlates with the responses given on table 4.14, wherein biology teachers have indicated that the different media listed on table 4.14 are not available at their schools.

16. Functions of media.

A list of functions of media. Indicate your decisions by circling either 0,1,2,3, or 4 according to the following key:

4. Strongly agree = SA
3. Agree = A
2. Disagree = DIS
1. Strongly disagree = SDIS
0. Do not know = DNK

Table 4.25 contains a list of functions of media and a summary of the responses of biology teachers expressed in percentages. A large number of biology teachers (62.79%) strongly agree that media motivate pupils, function number 6.10; 55.81 percent strongly agree that media help pupils to remember subject-matter more easily and 53.49 percent strongly agree that media can be used to obtain and maintain attention and interest of the pupils.

When taking the average percentages as reflected on table 4.25 into consideration, it becomes evident that high percentages of biology teachers strongly agree (37.50%) and agree 38.81% with the fifteen functions of media listed on table 4.25. Biology teachers who disagree (9.49%) and strongly disagree (7.59%) form a small proportion. It can be concluded that even if a larger number of biology teachers (47.73 average percent) have
responded on question 15, table 4.24, that they rarely use media, they are aware of the merits of using media. The fact that they do not use media should not be blamed on the teachers’ ignorance of the values of using media.

Table 4.25

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>RESPONSE IN PERCENTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1 To obtain and maintain the attention and interest of the pupils.</td>
<td>53.49 27.91 6.98 9.30 2.33</td>
</tr>
<tr>
<td>16.2 Show and explain the basic structure of a concept.</td>
<td>48.84 32.56 6.98 9.30 2.33</td>
</tr>
<tr>
<td>16.3 Explain complicated relationships</td>
<td>46.51 34.88 4.65 11.63 2.33</td>
</tr>
<tr>
<td>16.4 Relate abstract images to concrete examples</td>
<td>39.53 41.86 6.98 6.98 4.65</td>
</tr>
<tr>
<td>16.5 Conceptualise and integrate fragmented units of knowledge.</td>
<td>37.21 44.19 9.30 6.98 2.33</td>
</tr>
<tr>
<td>16.6 Multimedia approach enhances learning</td>
<td>27.91 51.16 11.63 4.65 4.65</td>
</tr>
<tr>
<td>16.7 Bring about change in attitude and behaviour</td>
<td>27.91 51.16 9.30 9.30 2.33</td>
</tr>
<tr>
<td>16.8 Provide for individual differences.</td>
<td>13.96 51.16 27.91 4.65 2.33</td>
</tr>
<tr>
<td>16.9 Consolidate and generalise a concept.</td>
<td>27.91 46.51 16.28 6.98 2.33</td>
</tr>
<tr>
<td>16.10 Motivate pupils</td>
<td>62.79 20.93 4.65 9.30 2.33</td>
</tr>
<tr>
<td>16.11 Involve pupils to a great extent in classroom activities and encourage them to be creative.</td>
<td>51.16 32.56 6.98 6.98 2.33</td>
</tr>
<tr>
<td>16.12 Improve the thought process and reasoning ability of pupils.</td>
<td>39.53 41.86 6.98 9.30 2.33</td>
</tr>
<tr>
<td>16.13 Help pupils remember subject matter more easily.</td>
<td>55.81 27.91 4.65 9.30 2.33</td>
</tr>
<tr>
<td>16.14 Expand the experience and background of pupils.</td>
<td>34.88 46.51 9.30 6.98 2.33</td>
</tr>
<tr>
<td>16.15 Provide opportunities for frequent changes of pace.</td>
<td>18.60 51.16 16.28 6.98 6.98</td>
</tr>
<tr>
<td>16.16 Others (add)</td>
<td>13.95 18.60 2.33 2.33 62.80</td>
</tr>
<tr>
<td>Average percentages</td>
<td>37.50 38.81 9.49 7.59 6.61</td>
</tr>
</tbody>
</table>

17. **Biology can be taught successfully without the use of any other media, except textbooks, chalkboard and the teachers’ own voice and personality.**

The idea that biology can be taught successfully without any media except textbooks, chalkboard and the teacher’s own voice and personality, was strongly rejected by a high percent (53.49%) and 23.26 percent of biology teachers disagreed. Biology teachers in this
inspection area are not convinced that effective teaching in biology can be achieved without the use of media. This information is summarised by table 4.26.

Table 4.26

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>4</td>
<td>9,30</td>
</tr>
<tr>
<td>Agree</td>
<td>3</td>
<td>6,98</td>
</tr>
<tr>
<td>Disagree</td>
<td>10</td>
<td>23,26</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>23</td>
<td>53,49</td>
</tr>
<tr>
<td>Do not know</td>
<td>3</td>
<td>6,98</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

Questions 18,19 and 20

This questions inquire into the involvement of students:

- in making notes and drawing diagrams,
- in performing biological experiments, and
- in handling apparatus with confidence, respectively.

The responses as shown on tables 4.27 - 4.29 indicates that 93.02 percent responded that their students make notes and draw diagrams which are controlled by teachers. Whereas 53.49 percent of biology teachers agree that their students are able to perform experiments under the teacher’s supervision; 46.51 percent responded ‘no’ to this question, that is, their students cannot perform experiments under their supervision. Taking into consideration the fact that 44.19 percent of biology teachers reported on question 9.1 that experiments are never done at their schools, one would not be surprised if the students in question 19 and 20 have never had the opportunity of observing experiments being performed. In responding to question 20, 58.14 percent of biology teachers indicated that their students are not able to handle apparatus with confidence, and 41.86 percent have agreed that their students can handle apparatus with confidence.
### Table 4.27

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>3</td>
<td>6.98</td>
</tr>
<tr>
<td>Yes</td>
<td>40</td>
<td>93.02</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4.28

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>20</td>
<td>46.51</td>
</tr>
<tr>
<td>Yes</td>
<td>23</td>
<td>53.49</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4.29

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>25</td>
<td>58.14</td>
</tr>
<tr>
<td>Yes</td>
<td>18</td>
<td>41.86</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100</td>
</tr>
</tbody>
</table>

### 4.7.2 QUESTIONNAIRE TO THE PRINCIPALS.

1. **Educational media play a significant role in general instruction.**

   The significance of educational media in general instruction is unanimously accepted by all principals who responded, that is 92.86 percent, and 7.14 percent indicated that they strongly agree and agree respectively. This is a clear indication that principals of schools in this inspection are aware of the values of using educational media in teaching and learning.

### Table 4.30

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>13</td>
<td>92.86</td>
</tr>
<tr>
<td>Agree</td>
<td>1</td>
<td>7.14</td>
</tr>
<tr>
<td>Disagree</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>
2. Purchase of instructional media should receive first priority in the school budget.

In responding to this question, a large majority of principals, in this inspection area, 50 percent, and 35.71 percent strongly agree and agree respectively, that media ought to receive first preference on the school budget. However 14.29 percent are explicitly opposed to the idea that instructional media should top the priority list in the school budget. The fact that a large number of principals are willing to give first priority in the purchase of media on the school budget is an indication of positive attitude towards acquisition of educational media.

Table 4.31

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>7</td>
<td>50,00</td>
</tr>
<tr>
<td>Agree</td>
<td>5</td>
<td>35,71</td>
</tr>
<tr>
<td>Disagree</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>2</td>
<td>14,29</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

3. Instructional media play an important role in teaching but are too expensive to be purchased from school fees.

An analysis of table 4.32 indicate that although principals regard educational media to be of significance in teaching and learning, they find them too expensive to be purchased from school fees.

Table 4.32

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly agree</td>
<td>8</td>
<td>57,14</td>
</tr>
<tr>
<td>Agree</td>
<td>6</td>
<td>42,86</td>
</tr>
<tr>
<td>Disagree</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>
4. Requisition of instructional media should be the responsibility of the subject teachers.

Principals have unanimously indicated that they regard selection of educational media to be the responsibility of subject teachers. Table 4.33 shows that 92.86 percent agree to this proposal.

Table 4.33

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>13</td>
<td>92.86</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>7.14</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

5. Is your school electrified?

In responding to this question, 57.14 percent of principals in his inspection area indicated that their schools are electrified. It must be mentioned immediately that according to records this inspection area have 18 electrified schools and 25 schools without electricity. The most important question is whether these schools, that are without electricity, have generators and batteries that can be used as sources of power.

Table 4.34

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>8</td>
<td>57.14</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>42.86</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

5.1 Does your school have batteries or a generator that can be used as a source of power?

The responses to this question are summarised by table 4.35 where 100 percent of principals, who head schools which are not electrified, have responded that they neither have generators nor batteries that can be used as sources of power at their schools. It implies that media that use electricity, batteries or generators are never utilised in these schools.
Table 4.35

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

5.2 Does your school have the financial capacity to fund its electrification?

The problem of lack of electricity is worsened by the fact that principals of schools that do not have electricity have unanimously indicated that their schools do not have financial capacity to fund their electrification. It implies that such schools must depend on the provincial department of education to be electrified.

Table 4.36

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

6. Companies which produce commercial media send catalogues to inform schools of the type of media they have.

Table 4.37 shows that although a high percentage of principals (50%) have indicated that they receive commercial media catalogues once a year, 42.86 do not receive them at all. There is, therefore, a great need of information flow between the principals or schools and the producers.

Table 4.37

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twice a year</td>
<td>1</td>
<td>7.14</td>
</tr>
<tr>
<td>Once</td>
<td>7</td>
<td>50.00</td>
</tr>
<tr>
<td>Never</td>
<td>6</td>
<td>42.86</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>
7. Who should carry the responsibility to supply educational media?

Tucker (1986: 25) states that whatever system is employed, the decision to integrate, or even suggest the integration of media into the curricula carries with it the responsibility of provision. A large majority of principals, 85.71 percent, who responded to this question, accede to this proposal. Principals have indicated that the department of education should carry the responsibility to provide educational media. See table 4.38.

<table>
<thead>
<tr>
<th>Response</th>
<th>Number of respondents</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>The School</td>
<td>2</td>
<td>14.29</td>
</tr>
<tr>
<td>The Department of Education</td>
<td>12</td>
<td>85.71</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

4.7.3 QUESTIONNAIRE TO THE MEDIA SCIENCE LECTURERS

SECTION A: General Information

The information shown on tables 4.39 - 4.43 indicates that the majority of media lecturers (75%) are females who have the status of lecturer. A great number of them (75%) have trained to become teachers after passing matric, however 25 percent have passed honours degrees, while 50 percent have passed masters in education degrees. It is encouraging to note that a high percent (50%) of these lecturers have done diplomas specialising in educational media science after pre-service training, and 25 percent have done masters degree on educational media science.

Question 1 & 2 Gender, Professional status.

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>25%</td>
</tr>
<tr>
<td>Females</td>
<td>75%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 4.40

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer</td>
<td>100</td>
</tr>
<tr>
<td>Senior Lecturer</td>
<td>-</td>
</tr>
<tr>
<td>H.O.D.</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

3.1 - 3.2 Academic and professional qualifications

Table 4.41

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.A.</td>
<td>25</td>
</tr>
<tr>
<td>B.Ed</td>
<td>25</td>
</tr>
<tr>
<td>M.ED</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4.42

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>TED, STD</td>
<td>75</td>
</tr>
<tr>
<td>B.A. PAED</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

3.3 Highest qualification to teach media

Table 4.43

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma in media</td>
<td>25</td>
</tr>
<tr>
<td>M.Ed media science</td>
<td>25</td>
</tr>
<tr>
<td>No qualification</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

4.1-4.2 General experience in teaching and experience in teaching educational media.

The lecturers’ experience in offering educational media training to pre-service trainee teachers, ranges between five and ten (75%) and eleven and fifteen years (25%). See table 4.44 and table 4.45 shows general experience in teaching and experience in teaching educational media, respectively.
### Table 4.44

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-15 years</td>
<td>75</td>
</tr>
<tr>
<td>25-30 years</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4.45

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 years</td>
<td>75</td>
</tr>
<tr>
<td>11-15 years</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

### SECTION B: Media availability, functions and utilisation.

A closer scrutiny of table 4.46 indicates that media lecturers at colleges of education and the university responded that a high percent of media listed on the questionnaire are available at their institutions.

#### 5. Availability of media expressed in percentages.

### Table 4.46

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>AVAILABLE</th>
<th>NOT AVAILABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1. Models</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>5.2. Tape recorders</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.3. Radio</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.4. Television</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.5. Video tapes</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.6. Film strips</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>5.7. Slides</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>5.8. Wall charts</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.9. Graphs</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.10. Pictures from books and</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>magazines.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11. Photos</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.12. Posters</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.13. Chalkboards</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.14. Feltboards</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.15. Bulletin boards</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.16. Newspaper supplements &amp;</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17. Overhead projector</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.18. Computer</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>5.19. Textbook or guides</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5.20. Others</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
It must be noted that media such as computers are not used in the training of student teachers. These tools are allocated for media lecturers’ personal office use. Institutions that have computers installed for students training, do not have competent lecturers who can introduce the trainee teachers to computer studies or computer literacy.

6. **Media utilisation frequency, during media training of teachers, by the media lecturers; expressed in percentages.**

Media that receive the highest utilisation frequency in the pre-service training of teachers are chalkboards and textbooks or study guides.

Table 4.47

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1. Real objects (animals and plants)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.2. Models</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.3. Tape recorders</td>
<td>25</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.4. Radio</td>
<td>50</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.5. Television</td>
<td>50</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.6. Video tapes</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.7. Film strips</td>
<td>50</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>6.9. Wall charts</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>6.10. Graphs</td>
<td>50</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.11. Pictures from books &amp; magazines</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>6.12. Photos</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>6.13. Posters</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>50</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>6.14. Chalkboards</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>6.15. Feltboards</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.16. Bulletin boards</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>75</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.17. Newspaper supplements &amp; Magazines</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.18. Overhead projector</td>
<td>75</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.19. Computer</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.20. Textbook</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>6.21. Others</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
7. **Time allocated for media training in terms of hours and minutes.**

Time allocated for media training per week, ranges between 3 hours and 35 minutes. On one hand lecturers (50%) who indicated that time allocated for media training is 35 minutes find this time insufficient to effectively train pre-service teachers in media. On the other hand, those (50%) who indicated that time allocated per week ranges between 2 hours and 3 hours find time allocated to be sufficient to train teachers on the skills of producing and using media. This is indicated by Table 4.48 and 4.49 below.

<table>
<thead>
<tr>
<th>Table 4.48</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td>35 - 40 minutes</td>
</tr>
<tr>
<td>1 hour</td>
</tr>
<tr>
<td>2 hours</td>
</tr>
<tr>
<td>3 hours</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

8. **Do you think time allocated for media training is sufficient to effectively train students?**

<table>
<thead>
<tr>
<th>Table 4.49</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

9. **Functions of media.**

On average a great majority of media lecturers agree with functions of media as listed on the questionnaire. A large number (75%) of these lecturers are strongly convinced that media motivate pupils, consolidate and generalise a concept, bring about change in attitude and behaviour, as well as the fact that multi-media approaches enhances learning. This is shown by Table 4.50 below.
Table 4.50

<table>
<thead>
<tr>
<th>Functions of media</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1 To obtain and maintain the attention and interest of the pupils.</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>16.2 Show and explain the basic structure of a concept</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.3 Explain complicated relationships</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.4 Relate abstract images to concrete examples</td>
<td>25</td>
<td>-</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>16.5 Conceptualise and integrate fragmented units of knowledge.</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.6 Multimedia approach enhances learning</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>16.7 Bring about change in attitude and behaviour</td>
<td>-</td>
<td>25</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>16.8 Provide for individual differences.</td>
<td>-</td>
<td>25</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>16.9 Consolidate and generalise a concept.</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>16.10 Motivate pupils</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>16.11 Involve pupils to a great extent in classroom activities and encourage them to be creative.</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.12 Improve the thought process and reasoning ability of pupils</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.13 Help pupils remembers subject-matter more easily.</td>
<td>-</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.14 Expand the experience and background of pupils</td>
<td>25</td>
<td>-</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>16.15 Provide opportunities for frequent changes of pace.</td>
<td>25</td>
<td>-</td>
<td>50</td>
<td>25</td>
</tr>
</tbody>
</table>

A closer look on information obtained from media lecturers reveal that media training is done by people who have no expertise in this field. These lecturers need institutions that would provide them with in-service training in the form of educational media science diploma and degree, so that they may render their services in a more competitive manner. It is therefore no surprise that media that receive high utilisation frequency during pre-service training are traditional ones, for example, chalkboards and textbooks. The differences in time allocation stems from reasons such as lack of classrooms and the implementation of the new curricula in the training institutions. Colleges of education experience high shortages of facilities to an extent that they have to cut down their time allocation per lesson from 1 hour to 40 minutes or 35 minutes.
4.8. CONCLUSION

At a closer scrutiny of the empirical data it can be deduced that:

- Biology teachers lack experience in teaching biology and in marking biology std 10 external examinations.

- Biology teachers comply with the lowest basic requirement of teaching the subject because they have received pre-service training in the methods of teaching biology, after passing std 10.

- Biology teachers lack expertise to teach the subject because they never receive in-service training, both in the methods of biology teaching and media utilisation skills, and they lack academic qualifications.

- Biology teachers have a good understanding of the nature of biology, specific outcomes of teaching biology as outlined in the discussion document, curriculum 2005 (Department of Education, 1997: 134) as rephrased in the questionnaire. It is worth noting that these teachers do not think that one of the purposes of teaching biology is to demonstrate knowledge of ethical issues, bias and inequities related to biology. However they are explicitly convinced that one of the specific outcomes of teaching biology is to enable learners to use process skills to investigate phenomena related to biology.

- There are great shortages of educational media, laboratories and classrooms in most schools in this inspection area. These shortages lead to overcrowding of classrooms, and teaching and learning of biology becomes difficult. Consequently teaching styles in this inspection area are mainly expository. In this way learners are denied the opportunity to learn the subject through inquiry and discovery methods.

- Biology teachers in this inspection area lack training in media production and usage. The same situation is reported by Tucker (1986: 35) who says that reports
from different countries express lack of training given to teachers in the effective use of media. It is inevitable that teachers' media utilisation frequency is influenced by skills in media usage. However biology teachers' frequency of media utilisation such as real objects, animals and plants is marginalised by lack of expertise on the side of teachers.

- The media lecturers lack expertise to train teachers on the production and use of media. A great number of them did not receive extra training in the field of educational media science.

- Time allocated to media training at pre-service level is insufficient.

- Biology teachers in this inspection area are well familiar with functions of media in the teaching of the subject. They have supplemented the list of functions as outlined on the questionnaire by the following functions:
  - media encourages creativity,
  - media encourages discipline and working together of students, and promote self-activity.
  - media promote active participation.

These findings serve as guidelines that have to be taken into account in the future planning of education provision. The next chapter deals with guidelines on the teaching of biology in developing areas such as Thohoyandou Area in Region 3 of the Northern Province.
CHAPTER 5

5 ACHIEVEMENT OF OUTCOMES THROUGH INTEGRATION OF MEDIA IN BIOLOGY TEACHING.

5.1. Introduction

Information obtained from the empirical data in chapter four reveal that the following are prevailing conditions in the Thohoyandou Inspection Area:

- There are great shortages of educational media, laboratories and classrooms in most schools, in this inspection area. These shortages of physical facilities lead to overcrowding, where a high percent of biology teachers report that the average class enrolment of biology students ranges between (76 - 100).

Due to overcrowding and shortages of equipment teaching styles are mainly expository. In this way learners are denied the opportunity to learn biology through inquiry and discovery methods.

- Biology teachers comply with the lowest basic requirement of teaching the subject because they have received pre-service training in the methods of teaching biology after passing std 10. This is a minimum admission requirement for teacher training. These teachers lack expertise to teach the subject because they never receive in-service training, both in the methods of teaching biology and media utilisation skills. A great number of these biology teachers have university education, however the majority of these qualifications are outside the scope of biological sciences. Accordingly these teachers are misplaced, since they are teaching biology without the necessary biological academic qualifications.

- A large number of media lecturers found in colleges of education in Region 3, did not receive further studies in the field of educational media science in the form of a diploma or a degree.
In this regard these lecturers are not competent to train teachers on the production and utilisation of media. The great number of biology teachers (93.02%) have indicated that they need retraining in order to use current educational media effectively. These teachers are not confident of the type of media training that they have received during pre-service training. The question one has to ask is what does teacher education and media training entails? The following paragraphs attempt to describe pre-service teacher education with regard to media training in South Africa.

5.2. Teacher education and media training

5.2.1. Introduction

Tucker (1986: 23) regards the training of teachers and pupils who are to use the media to be of significance for effective media integration in teaching and learning. Accordingly teachers and learners must receive thorough media training both in the use of hardware and how to read the software. Contrary to this idea, the amount of training in the use of media varies considerably, often being limited to an hour a week for part of a course. In many instances it is not an obligatory element in teacher training. There is a need that the powers that control both pre-service and in-service training demonstrate their belief in the importance of the media by making that element obligatory.

Report from different countries express lack of training given to teachers in the effective use of media. A sad matter is that colleges of education are often the least places in which to find good practice in the integration of media into teaching. Audio-visual media are often treated as something apart from the content and methods and in many cases as an optional course (Tucker, 1986: 35).

From the above, it becomes necessary to look into what media training entails in South Africa. In an attempt to answer the question, the researcher wishes to use the Department of Education and training syllabus as a way of defining the components of media training at colleges of education under the jurisdiction of the DET.
According to Kruger and Mulder (Monobe, 1991:10) media selection, preparation, integration and evaluation form the theoretical and practical component of training of teachers in media education.

5.2.2. The theoretical component in media training.

The theoretical component is composed of the following: media selection, media preparation and media integration.

5.2.2.1. Media selection and objectives.

According to Freysen (1993: 14) outcomes are prescriptive for media selection. The objectives should determine which learning activities should take place. The learning activity will give an indication of which media attributes are needed. These attributes in turn serve as guides to select media that are suitable for this task. Engelbrecht, Yssel, Griesel and Verster (1985: 10) and Welch (1982: 2) propose that the relevance of media is determined by its ability to achieve teaching objectives.

Brown, Lewis and Harcleroad (1977: 75/76) identify the following as criteria for media selection:

a. Content: Does the item deal with significant curricular content?

b. Purposes: For what instructional purpose may the item be used?

c. Cost: Is the item likely to be worth what it costs?

d. Technical quality: Is the item technically satisfactory.

The following are generalised principles of media selection as proposed by Brown, et al (1977: 71):

1. No one medium is best for all purposes.
2. Media uses should be consistent with objectives.
3. Users must familiarise themselves with media content.
4. Media must be appropriate for the mode of instruction.
5. Media must fit students capabilities and learning styles.
6. Media are neither good nor bad because they are either concrete or abstract.
7. Media should be chosen objectively not on the basis of personal preference or bias.
8. Physical conditions surrounding uses of media affect significantly the results obtained.

When selecting media in biology teaching, the teacher must take the objectives of teaching biology into consideration. After selecting the right medium or media for the lesson, there is need to prepare for its integration into the lesson.

5.2.2.2 Media preparation

One basic plan for utilising educational media is described as requiring the instructor to prepare, present and follow-up. This involves five steps which are proposed by Brown, et al (1977: 67/68) as follows:

1. Prepare yourself:

The teacher has to prepare himself/herself by viewing, operating, listening, examine ... the medium in advance of the lesson presentation.

2. Prepare the environment:

Arrange necessary materials and equipment required for proper viewing and hearing. See that the equipment is ready for use when time comes.

3. Prepare the class:
Introduce the item, explain why it is being used, stress what its importance is for learning, tell students what they will be expected to do after using the item.

4. Use the item:

Make sure that the item is properly and effectively used.

5. Follow-up:

After use, allow students opportunity to ask questions or answer questions. Review the experience. When preparations are satisfactorily done, the next step is to decide the phase of the lesson at which media is to be integrated.

5.2.2.3. Media integration

Media are integrated in a lesson for the purpose of providing learners with both an opportunity of learning directly by experiencing reality as well as learning indirectly from recreation of situations that occurred in the past or a place that cannot be reached for actual experience (Freysen, et al, 1989: 39). Media are integrated at different phases of the lesson (Engelbrecht, et al, 1985: 11).

In the introductory phase, media can be used for the following purposes: arousing interest, linking up with existing knowledge, setting a problem (Brown, et al, 1997: 63; Freysen, et al, 1989: 39; Engelbrecht, et al, 1985: 11).

During unlocking phase, media can be integrated in order to unlock the learning content. Media should also serve to assimilate the newly acquired knowledge to the existing framework. The following methods of presentation can be distinguished:

- reality itself or real objects
- the teacher’s own experiences
- other person’s experiences

Application phase: According to Briel (Freysen, et al, 1989: 40) Media can be used in the application/functional phase.

5.2.3. The practical component

For the purpose of this study media training is viewed from a DET syllabus (DET 1990 structure) perspective. According to the DET syllabus, teacher training for both secondary and primary schools extends over three years. Teaching practice is divided into two-parts; namely institute practicum and school practicum. It is during the teaching practice periods, that pre-service teachers are expected to receive training in educational media.

The syllabus for teaching practice extending over a period of three years is summarised by the following table.

<table>
<thead>
<tr>
<th>PERIODS PER YEAR</th>
<th>1st YEAR</th>
<th>2nd YEAR</th>
<th>3rd YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INSTITUTE PRACTICUM</td>
<td>98 periods</td>
<td>112 periods</td>
<td>42 periods</td>
</tr>
<tr>
<td>Educational media (chalkboard work excluded)</td>
<td>32 periods</td>
<td>42 periods</td>
<td>28 periods</td>
</tr>
<tr>
<td>Chalkboard work</td>
<td>33 periods</td>
<td>28 periods</td>
<td>-</td>
</tr>
<tr>
<td>Skills practice (micro-teaching and demonstration lesson)</td>
<td>33 periods</td>
<td>42 periods</td>
<td>14 periods</td>
</tr>
<tr>
<td>2. SCHOOL PRACTICUM</td>
<td>98 periods</td>
<td>84 periods</td>
<td>98 periods</td>
</tr>
<tr>
<td>a. Alternative weeks</td>
<td>10 school days</td>
<td>20 school days</td>
<td>20 school days</td>
</tr>
<tr>
<td>b. Block teaching practice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.1 Summary of teaching practice syllabi (DET,1990).

5.2.3.1. Institute Practicum

"Institute Practicum includes: the making of educational media, the use of educational media (with emphasis on chalkboard work), skills practice sessions and demonstration lessons" (DET, 1990: 1).
Table 5.1 reveals that 32 periods, 42 periods and 28 periods are allocated for first, second and third years respectively, for training in educational media. This allocation excludes chalkboard work, that is allocated 33 periods, 28 periods during the first and second years of training respectively. On the third year time allocation for chalkboard work is left at the discretion of each college.

On the first year of training, educational media training entails theoretical aspects such as how media function as well as practical demonstration. The syllabus recommends that student teachers must be introduced to materials and equipment which can be used in the making of educational media.

During the second and third years, the theoretical aspect includes the following:

a. Choice, types and requirements: effectiveness with regard to subject.

b. Usage: refers to planning, when, where and how to use media.

c. Storage: refers to ways of storing different types of media.

On the second and third years of training, practical work includes planning and making of educational media in collaboration with subject didactics lecturers. In this regards the following are recommended for the student teachers:

a. Each student teacher is required to complete a minimum of eight media assignments per year of study.

b. Students use a wide variety of material to produce different types of media, for example, waste materials, wire, clay, wood, leather, polystyrene, transparencies and paper cardboard.

c. The media should be applicable to a specific lesson, indicating a standard, subject and topic for which it is intended.
Practice in the use of educational media should be integrated into lesson presentations during school practicum sessions and subject didactics periods. Micro-teaching lessons also offers opportunities where student teachers may practice the use of educational media.

Tucker (1986: 23) argues that media training must be made compulsory. The DET Syllabus (1990 structure) instils an element of obligation by demanding that at least eight media assignments for each of the second and third years of training must be done. The Northern Province Teaching Science Forum has endorsed an element of obligation, as far as media training is concerned, by specifically allocating marks for media integration in their evaluated lessons.

Taking into consideration that 102 periods are allocated for media training during the three years of pre-service and that more than 61 periods are allocated for chalkboard work only as well as unspecified periods which are awarded to at least two subject didactics for secondary teachers diploma, it may be argued that a reasonable amount of time has been allocated to media training. The question is how well is this time utilised in media training and to what extent are the student teachers prepared and motivated to use educational media in their teaching experiences?

5.2.3.2. School Practicum

According to the DET Syllabus (1990: 2) the School Practicum consists of observation assignments, presentation of practice lessons to be assessed by college lecturers, ideally in a school environment. School Practicum should be closely linked to Institute Practicum in order to integrate theory and practice.

According to Ferguson (Prinsloo & Criticos, 1991: 24) students must be encouraged to see the theoretical, analytical and production aspects of Media Education as of equal importance and indissolubly linked together.
The duration of School Practicum is a minimum of 50 school days distributed over three years with a total of 280 periods. Students teachers get the opportunity to observe school teachers presenting lessons. The student teachers, therefore, get the chance of training on educational media, particularly the integration aspect. The syllabus recommends that school teachers must be actively involved in the training of student teachers during this period (DET, 1990: 2).

5.3. Media and outcomes acquisition in the teaching of biology.

In chapter two, it is stated that biology should be taught from the premise of its nature. The nature of biology is composed of three parts, viz.: the products, processes and attitudes and values of the scientist who practices science. The outcomes for teaching biology are, consequently derived from these three components of the nature of biology. The rationale for teaching biology should be achievements of traditional subject outcomes which are developed from these three outcomes (Falk, 1980: 33; Carin, et al, 1980: 2 - 8; Victor, 1985: 13).

In chapter two traditional subject outcomes developed from the three general outcomes of teaching biology, as proposed by educators such as Carin, et al (1980: 2); Falk (1980: 33 - 42); and Victor (1985: 13) are listed. In paragraph 5.2.2.1 it is stated that media selection must be based on the ability of such an object to achieve teaching outcomes (Freysen, et al, 1993: 14; Engelbrecht, et al, 1985: 10; Welch, 1982: 2). Accordingly in biology teaching when media are selected, the outcomes for teaching biology, as derived from the general outcomes of teaching biology must be borne in mind.

5.4. The use of media and approaches of teaching biology.

Different approaches are used to teach biology. Approaches such as concept-mapping, process approach and outcomes-based education are outlined in chapter two. The question that biology teachers have to ask is; what is the value of media in the actualisation of these approaches? The following serve as guidelines on the implementation of media, that is available at the Thohoyandou Inspection Area.
5.4.1. Media centred concept-mapping

It is stated in chapter two, paragraph 2.5.1 that concept-mapping is a strategy that is designed to help students learn how to learn science meaningfully. It requires learners to plot concepts and their interrelations in a meaningful organised and hierarchical network.

A variety of media can be integrated in biology teaching to enhance actualisation of this strategy. The following are media that were indicated in chapter four as being available in most of the schools in the Northern Province.

The chalkboard and feltboards

When using the chalkboard the biology teacher can help his/her learners to learn biology meaningfully. He/she must strive to integrate new concepts with the learners’ existing knowledge in a meaningful way. The chalkboard work must be developed in a hierarchical network not in a linear format. Relations between concepts must be indicated by linking lines. Different topics can be treated by making use of this strategy.

Feltboards can be used, with concept-maps. One way of using feltboards is where the teacher prepares a number of feltboards and concepts on pieces of paper, or concepts in the form of pictures. Students are then divided into groups of six or five and are entrusted with the task of making concept maps of the topic already introduced. Each group then reads its concept map for the whole class.

Realia are media that can be used with the strategy of concept-maps. Consider, for example, the case where students are expected to study and differentiate between monocotyledonous and dicotyledonous plants, learners can be provided with real plants. After being divided into small groups they are requested to draw concept-maps of the two types of plants by identification of their external features. External features may include leaves, stems, roots and flowers.
Another example where realia can be used with concept-maps is where the teacher introduces a topic on vertebrate animals to the class. He/she makes use of different vertebrate animals by dividing the class into groups of five or six. Each group is provided with different vertebrates animals. The students draw relations between these animals from observation of their features. They then draw conclusion in the form of concept-maps.

5.4.2. Media centred process approach

The meaning of the process-approach as stated in chapter two, paragraph 2.4.1 is that teaching of science should be in line with what scientists do, that is the processes that they carry in their own scientific activities. The processes through which scientists acquire knowledge are observation, classifying, measuring, inferring, hypothesising and performing experiments. In this respect educational media facilitate the implementation of the process approach.

Taking observation as one of the processes through which scientists acquire knowledge, it becomes evident that media play an important role in the actualisation of the scientific processes. Media promote observation through all the senses. The biologist classify living organisms into either animal or plat kingdom, phylum, class, order, family, genus, species and common name. This type of classification becomes more meaningful if real plants or animals are provided. However if realia are inaccessible, then pictures must be used.

Biology teaching and learning becomes effective if the thermometers, measuring cylinders and rulers are used. Measuring apparatus must be provided whenever the need of measuring arises. These media promote the acquisition of inquiry skills as stated in chapter 2, paragraph 2.3.3.2.

Media, for example, measuring tools provide substance for rejection or acceptance of hypothesis. They provide a valid bases for making inferences.
Educational media facilitate performance of experiments. Performing experiments is one of the hassles that faces biology teachers in the Northern Province.

As revealed from empirical data in chapter four, the Northern Province has high average class-enrolments of biology students ranging between (76 - 100) and no laboratories. Practical work cannot be completely relegated to the background. These problems can be solved by making sacrifices and perform practicals in classrooms in the afternoon. In this regard students must be divided into small groups. Another way of providing students with experience in practical work is by using video tapes that show the relevant experiments. It is recommended that schools that are not electrified, use generators to view video tapes and films. In this way the learners are introduced to the traditional subject outcome for the acquisition of inquiry skills.

Realia are some of the resources which should be used to perform experiments where they are relevant to the topic of the learning content; for example, potatoes or egg membranes as media that enhance understanding of the process of osmosis.

5.4.3. Media centred outcomes-based education

In chapter two, paragraph 2.6.1, the following are listed as some of the characteristics of outcomes-based education:

- active learners,
- critical thinking, reasoning, reflection and action,
- integration of knowledge, learning relevant and connected to real-life situations,
- the use of group work and team work to consolidate the new approach,
- learners take responsibility for their learning, pupils are motivated by constant feedback and affirmation of their work,
- allowing learners to work at their own pace.

Media enhances actualisation of these characteristics of the outcomes-based education. In chapter three, for example, it is stated that various media, if well integrated enable learners
to be actively involved in learning. One group of media that keep learners actively involved in learning are realia and models. Realia and models are well known for providing hands-on activities to the learners. The Thohoyandou Inspection Area in predominantly rural and rich in realia such as animals and plants.

It is therefore recommended that these resources be used in the teaching of biology. Realism can be brought on board by using media such as locusts, frogs, fern plants, monocot and dicot plants, when relevant aspects are being taught in class. In this way learning becomes more real, unlike when the teacher depends on the textbook without reference to reality.

One of the characteristics of outcomes-based education is group or teamwork. There are media that lend themselves more to group teaching, and they must receive first preference over others. The following are examples of these media:

- Audio-visual-media, for example, the video. To promote teamwork, learners must be provided with questions for discussion after viewing a video programme.

- Realia and models - if learners are provided with question that lead them to discuss either anatomy or physiological structure of the human digestion system, for example, group work is promoted.

- Visual media, for example, feltboards, learners should be provided with main concepts or pictures that covers a particular topic. The teacher then introduces the topic on the chalkboard for the class as whole, after which learners are divided into smaller groups that discuss and arrange concepts or pictures on the feltboard.

From the discussion above, it becomes evident that the use of media can alleviate the problem of large group teaching experienced in this region. One of the characteristics of the outcomes-based education is to provide learners with the opportunity to take responsibility for their own learning, constant feedback and to learn at their own pace. Media that promote actualisation of these characteristics must be utilised. It is stated in chapter 3, paragraph 3.3.5, that programmable media, for example, printed materials, the
computer and interactive video, enhance actualisation of these characteristics. Considering the fact that teachers in the Thohoyandou Inspection Area, as reported in chapter four, have stated that there are no videos nor computers at their schools, one recommends the use of printed materials. The teachers should make use of printed materials which make provision for constant feedback and learning at individualised pace.

Teachers should bear in mind the basic premises of outcomes-based education as stated in chapter 2, namely; that all students can learn and succeed, success breeds success and that schools and teachers control the conditions that determine whether or not students succeed. Teachers should use media as a form of guarantee that learners are provided with the chance to succeed.

5.5. Guidelines on media usage in biology teaching, Northern Province context.

It is stated in chapter two that South Africa is in a great transition, from the era of apartheid to a democratic rule. According to Perold (Prinsloo & Criticos 1991: 39) media education build democratic education. Ferguson (Prinsloo & Criticos, 1991: 24) states that media education is just one of the pathways by which education can become truly democratic, open, fearless in its spirit of inquiry, enjoyment and intellectual rigour, and above all of relevance to all the people of South Africa.

Before education can be really democratic, there are realities which the new government have to reckon with. In chapter one it is stated that the Northern Province has been declared an education disaster area by the Deputy President, Thabo Mbeki.

The declaration was made after the Deputy President had acknowledged that the Northern Province suffers great shortages of facilities and resources, such as classrooms and laboratory equipment. The Deputy President's declaration is confirmed by findings from the empirical data, as recorded in chapter four. Consequently the Northern Province schools are characterised by large groups or overcrowding as well as instances where some classes are taught outdoors.
The challenge that faces teachers in the Northern Province is how biology, a science of inquiry, can be taught effectively under such conditions? Whilst acknowledging the status quo in South Africa, Ferguson (Prinsloo & Criticos, 1991: 17) "raises the issue of resources for media education and what might be considered to be the minimum resources for work to begin". According to him if students are exposed to billboards or radio's or other media, regardless of how unsophisticated they might be technologically, teaching should begin. The same sentiment is shared by Barker (Brook & Race, 1974: 445) who argues that even if equipment are not available, "yet ways had to be found. We could not just throw our hands in the air in despair".

The stance taken by both Ferguson and Barker need to be adopted for the Northern Province. Something has to be done, biology must be taught by using just what is there. But what is it that which is there? "The low cost material" (Warren, 1973: 107) or the usable junk (Farmer, et al, 1980: 290) as well as textbooks, newspapers, chalkboards, feltboards, audio tapes, models and live materials.

5.5.1. Low cost materials or inexpensive equipment.

According to Farmer, et al (1980: 290) low cost materials refers to the most ordinary objects which are available from the supermarkets, found in the garage, kitchen cupboard, sewing basket, school cafeteria, art class, repair shops and even objects on the way to the trash can, which could be used in the teaching of biology.

Different methods or modes can be enhanced by using a variety of items which may be classified as usable junk. For example large inflated balloons connected by a piece of thread make a good demonstration of static electricity. If these balloons are suspended by the connecting thread and each one is rubbed on the students' hair, they become charged. Then wool or other synthetic cloth are tried. The value of these apparatus, for the large groups instruction, is that they are large enough for all to see and sensitive enough to be convincing (Farmer, et al, 1980: 292).
The principle that has to be borne in mind is that when selection of media for demonstration, for large groups is done, large objects should receive preference.

5.5.2. The low-cost materials and laboratory

Low-cost materials may be used to conduct the laboratory skills. The following is an illustration of how low-cost materials can be used to determine water loss by leaves through the process of transpiration, as proposed by Farmer, et al (1980: 294):

Plastic bags are great for measuring the amount of transpiration from leaves. Students are instructed to weigh their bag, fasten it over a group of leaves of a plant with twist-type fasteners, leave it for 24 hours, and then remove and weigh the moist bag.

The difference in weight in grams equals the weight of water lost in one day by the number of leaves enclosed. An estimate of the percentage of total leaves covered makes possible an approximate calculation of total daily water loss by transpiration.

5.5.3. The low cost materials and individual projects.

Individual projects may be provided to those students who may be interested in dissecting a wider variety of plants and animals than can be done during class and laboratory time. Single-edged razor blades make good scalpels. Pineboards scraps from the shop make fine dissecting boards and cake tins filled with wax make dissecting trays. Common pins, strings, household tweezers and flashlight lenses all substitute well for their commercial counterparts (Farmer, et al, 1980: 294).

5.5.4. The chalkboards

In developing countries, like the Northern Province, writing boards or chalkboards are readily available. They are used with a variety of teaching methods. Hence they enhance methods in the achievement of outcomes of teaching biology. One of the greatest merits of using chalkboards in the developing countries, is that if conscientiously used, they can
accommodate for large group instructions. In the Northern Province, for example, chalkboards are used supported by an easel, outdoors or under the trees. The teacher stimulates both senses of hearing and seeing simultaneously when using the chalkboards. Both outcomes structures of knowledge or products and process can be achieved by using chalkboards.

5.5.5. Bulletin boards.

Bulletin boards can be prepared by using low-cost materials. According to Farmer, et al (1980: 295) an unused part of the chalkboard can be transformed into a vertical demonstration table. This is done by using loops of masking tape on movable coloured cut-out shapes. Photographs that illustrate examples of various habitats are brought in to make a collage of their examples.

Another form of bulletin boards is prepared by attaching large pieces of coloured paper to the chalkboard with masking tape. The names of major animal phyla are used as titles for each section. Students bring in magazine photographs and glue them together to make montages of the phyla (Farmer, et al, 1980: 296).

Boards may be used together with printed materials.

5.5.6. Printed materials

By printed materials, reference is made to textbooks, magazines, study materials and newspapers.

5.5.6.1. Textbooks:

Textbooks are supplied by the Provincial Department of Education in the Northern Province, consequently each student possesses a personal copy of a biology textbook.
Textbooks have a number of merits which are proposed in paragraph 3.3.3.3. Textbooks can be integrated with a strategy such as concept-mapping. As indicated in chapter two, this approach is geared to introduce students to meaningful learning of science. Students are led to integrate new learning material on the basis of existing knowledge, in a more meaningful way. Therefore concept mapping can be enhanced by using textbooks as revealed by reports of research conducted by Soyibo (1995: 344-350) on the structure of textbooks used to teach biology to Caribbean students.

It must be stated that textbooks cannot achieve all traditional subject outcomes of teaching biology, for example, it cannot provide laboratory experience and develop true inquiry skills. These are outcomes which are achieved by other methods and materials (Sund, et al, 1967: 168). Consequently the textbook need to be supplemented by the use of other media and methods that enhance achievement of objectives of teaching biology. The Northern Province takes no exceptions, that is, other media, which are available, must be integrated in the teaching of biology.

5.5.6.2. **Study guides and study materials**

The study guides are commercially obtainable while study materials can be prepared by the teacher himself/herself. These materials may be use to supplement the textbooks.

5.5.6.3. **Magazines and Newspapers.**

Newspapers such as “City Press” enclose supplements dealing with different subject contents, sciences included. Teachers must encourage their students to use these supplements. Teachers themselves should show value to these supplements by integrating them in their day to day teaching. Learning is enhanced if many senses are stimulated. Therefore visual media should be complemented by Audio-media.

5.5.7. **Audio-media**

Whilst Farmer, et al (1980: 298) and Sund, et al (1967: 168) suggest that audio-media, such as the tape recorder can be used to bring a variety of sound, for example, bird call, the
University of South Africa has introduced instruction through audio tapes in its distance education. This media could be implemented to bring the individualised instruction into board. If used together with worksheets, the audio tape can drastically improve instruction (Sund, et al, 1967: 174). Students could take tapes home or use them in the afternoon. One of the value of this medium, is that the learner learns at his/her own pace. He/she stops and rewind the tape at will. Hence repetition and reinforcement are achieved.

Besides media which are either visual or audio, there are media which are both visual and audio simultaneously. These type of media are known as audio-visual media.

5.5.8. The audio-visual media.

Audio-visual media refers to films, television or video and sound slides. These media are valuable in the teaching of biology, however one big limitation of these media is their dependence on electricity. In the Thohoyandou inspection area, of region three of the Northern Province, on which this study is based, out of forty two schools, only twelve are electrified. These problems are not insurmountable. Students in this area do see cinema films through the resourcefulness and innovative abilities of both school teachers and principals. Electricity is provided by generators.

It must be acknowledged that viewing of films, TV and video’s may be limited by the availability of these media, availability of money to purchase generators and fuel which is used to run the generators. Taking these factors into consideration, one could propose that films and television be discriminately integrated into teaching in general and in biology to enable students achieve objectives which may not be achieved otherwise.

5.5.9. Models

The value of models for teaching biology are highlighted in chapter three. Models are three dimensional and show simplified representation of reality. Commercial models maybe be purchased. The creative teacher may produce personal models by using cheap materials. Models for the DNA strands, enzyme and substrate molecules may be produced by using
hardboard papers (DET, 1989). Commercial models, if well looked after are durable, some are large enough to be used with a large group of students.

5.5.10. Live animals and plants.

It is stated in chapter two that biology is a science that studies living organisms. Teachers at Thohoyandou Inspection area of Region Three of the Northern Province, can make the study of biology more meaningful by employing live materials.

5.6 CONCLUSION

South Africa is undergoing great changes in the educational arena. These changes are initiated by political changes from the apartheid era to democracy. The political change can be enhanced by education, because education has been acknowledged as the cornerstone of the development of nations and societies (Tucker, 1986: 171).

Media Education is seen as a tool that offers the individual the opportunity to participate in the development of his/her society. Ferguson (Prinsloo & Criticos, 1991: 23) accedes to the significance of media education for the development of societies as he states that media education is of particular relevance as South Africa moves into a period of rapid change towards democracy.

The apartheid era was characterised by discriminatory policies in as far as financing of education is concerned. Blacks received little state finance. Consequently black schools are in dire need and shortages of facilities and resources. However it is widely accepted that media have many functions which play an important role in the achievement of outcomes (Freysen, 1993: 14; Engelbecht, et al, 1985: 10; Welch 1982: 2).

It was established that there is close relationship between traditional subject outcomes and media employed in the teaching of biology. Outcomes of teaching are achieved through a variety approaches which in turn are enhanced by instructional media.
When biology teaching is viewed in relation to poor and harsh conditions experienced by blacks in the Northern Province. Special recommendations are made. These shall alleviate and uplift the deteriorating standards of education which were seen to be disastrous by the Deputy President, Thabo Mbeki.
6. SUMMARIES, CONCLUSIONS AND RECOMMENDATIONS

From the discussion in chapter two, it has become clear that biology is a science. Biology teaching is directed by the outcomes which are derived from its nature. The general aims of teaching biology are reformulated as specific outcomes in the discussion document, curriculum 2005 (Department of Education, 1997B: 134). These direct the teachers’ efforts because they indicate to the ultimate destination. The critical outcomes of teaching biology are acquisition of knowledge, inquiry skills or processes, and attitudes and values which guide the biologist in his practice. These three outcomes are interdependent and interrelated. Knowledge is acquired as one engages in processes of science. The processes of scientific investigation cannot be learnt in the absence of knowledge. These two, knowledge and processes are successfully acquired in the presence of a set of values (Falk, 1980: 13; Dekker, et al, 1993: 33; Sands, et al, 1985: 8).

It is from this premise that the process approach which stress the processes of science at the expense of knowledge, attitudes and values structures, is not acceptable. There is need for a holistic approach where each outcome receives its dues.

Biology should be taught to benefit both the learner as an individual and community as a whole. Critical outcomes are general statements which are difficult to translate directly into what to do. For teaching purpose they must be translated into traditional subject outcomes so that assessment is possible.

As stated in the paragraph above the process approach put emphasis on scientific method of gaining knowledge and ways of processing information. These ways of processing information become complex as the child develops. And again processes develops from the concrete and specific to the abstract and general. Incorporation of media in the teaching of biology enhances the development of the learners processes. The process approach have a third meaning which according to Gagne (Sund, et al, 1973: 203) is that emphasis on processes, implies a corresponding de-emphasis on the specific science content.
According to Gagne, the biology content is limited to the examinations and explorations of solid objects. This approach opposes the concept that the nature of biology comprises of knowledge, methods, as well as attitudes and values. Therefore this third meaning of the process-led approach is not acceptable. Objects must be used to facilitate methods and to enhance acquisition of knowledge as well as development of scientific attitudes and values.

The process-approach must be used, together with other approaches such as concept-mapping. Concept-mapping put emphasis on meaningful learning. It relates directly to principles such as prior knowledge, subsumption, progressive differentiation, cognitive bridging and integrative reconciliation (Wandersee, 1990:927). The construction of knowledge is a personal activity in which selection, interpretation and re-organisation of sensory data depends on the individual's prior knowledge. Some of the merits of using this strategy are the following:

- it can be employed to achieve learning excellence in biology (Van Aswegen, et al, 1993: 32).
- it boost achievement significantly (Okebukola, 1992: 220).
- it promote learning with understanding and it makes learning easier.
- it can be used with other techniques.

It is stated in chapter two that South Africa is undergoing political, economic and educational change. A new curriculum known as outcomes-based education (OBE) is being ushered in education. From a South African context, it is a paradigm shift, from the traditional aims and objectives approach to outcomes based education. According to this approach emphasis is placed on what the learner becomes and understands as opposed at what the teacher hopes to achieve. Spady and Marshall (1991: 67) argue that all students can learn and succeed, success breeds success and that schools and teachers control the conditions that determine the students’ success. The methods and resources employed in learning are some of the determinants for the success or failure of the learning process. Schools must provide or be provided with the learning materials that can guarantee success in learning.
Educational media play an important role in the teaching and learning of biology. Media facilitate acquisition of knowledge, actualisation of methods and development of scientific attitudes and values. Comenius, for example, states that children acquire knowledge of words through objects (Curtis, 1975: 175). Pestallozi advocates for the experimental method in the teaching of sciences as a way of emphasising observation in learning (Curtis, 1975: 499).

Media help learners to change their attitudes from being uninterested to being interested and motivated (Curtis, 1975: 499).

The didactic principles and approaches of teaching biology are better realised by employing media in instructions. From the premise that media stimulate the learners' interest, learners become active participants in the teaching and learning activity. Learners become more involved in learning, as such learning become more effective. Eventually the learners' level of achievement is improved. It must be remembered that media enables learners to learn biology through inquiry methods. This is regarded as ideal way of teaching and learning biology.

Media have functions which are listed in chapter three. On the bases of these functions the integration of media in teaching is not a matter of option but of necessity. However a number of factors have to be considered before media can be used. In the first place teacher education and media training must be considered. Teachers acquire skills in the use of media through training that they receive during pre-service and in-service training. Media lecturers in Region 3 of the Northern Province are not satisfied by time allocated for media training in the pre-service training. In this region there are no institutions where biology teachers can receive in-service training.

Secondly media integration depends on the availability of the media in question or alternatively being produced by the teachers. The Northern Province experiences high shortages of resources including media. The biology teachers have indicated that media available at their schools are mainly chalkboards and textbooks. These media fall-short to satisfy the outcomes of teaching biology. Biology teachers have no expertise in the field of
educational media science, as such are not capable of producing their own media from low cost materials.

Thirdly media usage is determined by the ability of the media in question to enhance acquisition of traditional subject outcomes and realisation of methods of instruction.

Given the facts that the Northern Province suffers shortages of physical facilities and resources, the biology teachers, and teachers in general, in this province, have to use whatever is there to achieve the traditional subject outcomes of teaching the subject. However to be able to improvise these teachers need rigorous media training in the form of in-service training. The need of teacher in-service training has been acknowledged by the National minister of Education in the document, Curriculum 2005 (Department of Education, 1997A: 1).

The case of the Northern Province must not be equated to conditions prevailing in any province in South Africa. It is unique because of the following reasons as revealed in this study:

- It is the only province that is declared the education disaster area by the Republic of South Africa's Deputy President, Thabo Mbeki (MEC's key address to UNESCO, 1996:2).

- It experiences the lowest pass-rate from 1995 - 1997.

- It has under-trained and under-qualified teachers to teach biology.

- It experiences high shortages of physical facilities such as classrooms, equipment and libraries.

- It has the highest unemployment rate, estimated at 47 percent in 1996 (MEC's key address to UNESCO).
It is on the basis of these findings and the premise that one of the goals of education of the democratic government of South Africa is to provide quality life-long learning to all its citizens, especially among those who were disadvantaged during the apartheid era, that the following recommendations are made:

1. On the basis that the Northern Province is one of the poorest provinces that have the high shortages of physical facilities and resources, the National Ministry of Education should provide funds for the building of classrooms, laboratories and libraries.

2. The Provincial Department of Education should make funds available for the purchase of educational media to be used in the instruction of sciences and other subjects.

3. Principals of schools be encouraged to make funds available for the electrical wiring of schools. Money can be raised through school funds and by asking for donations from the public.

4. Institutions should be focusing more intensively on programmes in the study area to provide teacher in-service training for Curriculum 2005 as well as media education. Teachers who receive in-service training should get incentives in the form of salary increment.

5. Biology teachers should be encouraged to improve their academic qualifications, in the field of sciences, so that they become suitable to carry their tasks in a more competent manner.

6. Media training should not be limited to teachers, but is must include learners as well. Learners must be trained at school level on both how to use hardware and how to read the software. This is necessary to enable learners to learn from media independently from the teachers.

7. A mechanism must be put in place, that will keep users of media or teachers, informed of places where to hire or purchase media.
8. Media should be used with greater understanding of their functions.

9. The introduction of computers in education raised a need for massive teachers' in-service training, in order to use these tools effectively. Lecturers at colleges of education where computers have been installed should go for courses in computer training.

10. The creativity of teachers should be developed, so that they can improvise their own media ("Science on a shoestring" idea).
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8. APPENDIX A

8.1. QUESTIONNAIRE TO BIOLOGY TEACHERS

The following instructions guide you on how to answer this questionnaire.

1) Whenever there is dotted line e.g. ........... fill in the required information.

2) Wherever there is a block, e.g. □ □ put a cross inside the block next to the answer selected e.g. No □ or Yes □

3) If the provided space is not sufficient, please feel free to write at the back of the page and number the information correctly.

4) Please try to complete the questionnaire without the influence of your colleagues.

5) You are humbly requested to submit the completed questionnaires to the principal’s office.
SECTION A: GENERAL INFORMATION

Note: This information is required for classification purposes only.

1. Your sex: .................

2. Your professional status (e.g. Educator, H.O.D., Deputy Principal, Principal)
   ........................................................................................................................................

3. You qualifications:
   3.1 Academic Qualifications: A. Matric

   B. Degree (s): 1. ........................................ 4. ........................................
   2. ........................................
   3. ........................................

   3.2 Professional Qualifications e.g. STD, HED, UED, PTC, etc.
   1. ........................................
   2. ........................................
   3. ........................................

   3.3 Your highest qualifications to teach biology.
   Academic Qualification e.g. Matric, Biology I, II & III or Botany I, Zoology III, etc.
   1. ........................................

   3.4 Your professional qualification to teach biology

   3.4.1 Have you done biology as one of your subject didactics/Method subject?
   Yes ______ or No ______
3.4.2 Have you done a diploma specialising on the methods of teaching biology?
Yes [ ] or No [ ]

3.4.3 Have you done a diploma specialising on educational media science?
Yes [ ] or No [ ]

4. Your teaching experience:

4.1 Experience in teaching ........................................ years
4.2 Experience in teaching biology ............................... years
4.3 Experience in marking biology standard 10 (Ten) external examination ...................... Years.

SECTION B: THE NATURE, AIMS AND OBJECTIVES OF TEACHING BIOLOGY

5. The nature of biology is composed of three parts viz. Knowledge or product structure, process or methods and values and attitudes which guide the biologist in his/her practice.

   a. Strongly agree [ ]  b. Agree [ ]
   b. Disagree [ ]  d. Strongly disagree [ ]

6. The table below shows a list of general aims or specific outcomes of teaching biology as a natural science subject as outlines in the discussion document, curriculum 2005 (2997: 134). Next to each aim indicate to what extent you agree with the stated aim. Indicate your decision by circling either 1,2,3,or 4 according to the following key:
1. Strongly agree  
2. Agree  
3. Disagree  
4. Strongly Disagree

<table>
<thead>
<tr>
<th>General Aims or specific outcomes</th>
<th>Degree of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use process skills to investigate phenomena related to biology.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>2. Demonstrate an understanding of concepts and principles, and acquired knowledge in biology.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>3. Apply scientific knowledge and skills to problems in innovative ways.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>4. Demonstrate an understanding of how scientific knowledge and skills contribute to the management, development and utilisation of natural resources.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>5. Use scientific knowledge and skills to support responsible decision making.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>6. Demonstrate knowledge and understanding of the relationship between science and culture.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>7. Demonstrate an understanding of the changing and contested nature of knowledge in biology.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>8. Demonstrate knowledge of ethical issues, bias and inequities related to biology.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9. Demonstrate an understanding of the interaction between biology and socio-economic development.</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>
7. The table below shows a list of media that can be used in the teaching of biology. Indicate by putting a cross in the spaces provided whether the medium is available or not available at your school.

Use the following Key:  
A - Available  
N - Not Available

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>A</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tape Recorder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video tapes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filmstrips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pictures from books and magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalkboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feltboards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulletin boards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newspaper Supplements &amp; Magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead Projector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textbook</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fermentation Flasks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. The average enrolment of biology students in my classes ranges between:

- 0 - 24
- 25 - 35
- 66 - 75
- 36 - 45
- 46 - 55
- 56 - 65
- 76 - 100

9. Is there a standardised laboratory in your school?

- Yes
- No

If your response to this question is no, then answer the following question.

9.1 Due to lack of a standardised laboratory, biology practicals:

- are done in the classroom
- are never done

10. Is there electricity at your school?

- Yes
- No

If your response is no to this question, answer the following question.

10.1 Generators and batteries are used as power sources to view film strips, video tapes and television.

- Yes
- No
11. Technology has innovated media which require intensive training for teachers in service to use.
   a. Strongly agree  
   b. Agree  
   c. Disagree  
   d. Strongly disagree  

12. The biology teacher need to be resourceful to an extent that he can produce his own media
   a. Strongly agree  
   b. Agree  
   c. Disagree  
   d. Strongly disagree  

13. Media need not be sophisticated and expensive but low cost (inexpensive) material may be used to produce media which play a significant role in biology teaching.
   a. Strongly agree  
   b. Agree  
   c. Disagree  
   d. Strongly disagree  

14. Do you know where to order commercial media such as filmstrips, charts, models, etc.
   Yes  
   No  

SECTION D : MEDIA UTILISATION

15. The table below shows a list of media that can be used in the teaching of biology. Indicate the frequency of media utilisation in biology teaching at you school.
Indicate your media utilisation frequency by circling 0, 1, 2, 3, 4, 5 or 6 using the following key:

6 - Everyday
5 - A few times a week
4 - Once a week
3 - A few times a month
2 - Once a month or less
1 - A few times a year
0 - Never

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>USAGE FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Objects (animals &amp; plants)</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Models</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Tape Recorder</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Radio</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Television</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Video tapes</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Filmstrips</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Slides</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Wall charts</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Graphs</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Pictures from books and magazines</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Photos</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Posters</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Chalkboard</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Feltboards</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Bulletin boards</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Newspaper Supplements &amp; Magazines</td>
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</tr>
<tr>
<td>Overhead Projector</td>
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<td>Computer</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Textbook</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>Others</td>
<td>6 5 4 3 2 1 0</td>
</tr>
</tbody>
</table>

16. The table below shows a list of functions of media which may serve as criteria for media integration. Next to each function indicate to what extent you agree with the stated function. Indicate your decision by circling either 1, 2, 3, or 4 according to the following key:
1 - Strongly agree  
2 - Agree  
3 - Disagree  
4 - Strongly disagree

<table>
<thead>
<tr>
<th>FUNCTIONS OF MEDIA</th>
<th>Degree of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To obtain and maintain the attention and interest of the pupils.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. Show and explain the basic structure of a concept</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Explain complicated relationships</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Relate abstract images to concrete examples</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. Conceptualise and integrate fragmented units of knowledge</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6. Multimedia approach enhances learning</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7. Bring about change in attitude and behaviour</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>8. Provide for individual differences</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9. Consolidate and generalise a concept</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10. Motivate pupils.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>11. Involve pupils to a great extent in classroom activities and encourage them to be creative.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>12. Improve the thought processes and reasoning ability of pupils.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>13. Help pupils remember subject-matter more easily.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>14. Expand the experience and background of pupils.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>15. Provide opportunities for frequent changes of pace.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>16. Others (add)</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

17. Biology can be taught successfully without the use of any other media except textbook, chalkboard and the teacher’s own voice and personality.

a. Strongly agree  
   b. Agree

   c. Disagree  
   d. Strongly disagree
18. Do your students draw diagrams in biology notebooks which are then controlled?

Yes [ ] No [ ]

19. Do your students perform experiments under your guidance?

Yes [ ] No [ ]

20. Are your students able to handle apparatus with confidence?

Yes [ ] No [ ]

THANK YOU FOR YOUR CONTRIBUTION.
8.2. QUESTIONNAIRE TO THE PRINCIPALS

The following instructions guide you on how to answer this questionnaire.

1. Wherever there is a dotted line e.g. ............... fill in the required information.

2. Wherever there is a block e.g.  put a cross inside the block

   next to the answer selected e.g. No  or Yes

3. If the provided space is not sufficient, please feel free to write at the back of the page and number the information correctly.

4. Please try to complete the questionnaire without the influence of your colleagues.

5. This completed questionnaire shall be collected from your office.
1. Educational media such as commercial charts, bulletin boards, flannel boards, radio, television, videotapes, models, etc. play a significant role in general instruction.

   (i) Strongly agree  [ ]   (ii) Agree  [ ]
   (iii) Disagree  [ ]   (iv) Strongly disagree  [ ]

2. The purchase of instructional media mentioned in (1) above should receive first priority in the school financial budget.

   (i) Strongly agree  [ ]   (ii) Agree  [ ]
   (iii) Disagree  [ ]   (iv) Strongly disagree  [ ]

3. Instructional media play an important role in teaching but are too expensive to be purchased from school fees.

   (i) Strongly agree  [ ]   (ii) Agree  [ ]
   (iii) Disagree  [ ]   (iv) Strongly disagree  [ ]

4. Requisition of instructional media should be the responsibility of the subject teachers.

   Yes  [ ]   No  [ ]

5. Is your school electrified?

   Yes  [ ]   No  [ ]

   If your response is no for question 5, answer the following questions 5.1 and 5.2.
5.1 Does your school have a generator or batteries as sources of power to be used for viewing filmstrips and television?

Yes [ ] No [ ]

5.2 Does your school have the financial capacity to fund its electrification.

Yes [ ] No [ ]

6. Companies which produce commercial media send catalogues to inform schools of the type of media they have.

(i) twice a year [ ] (ii) Once a year [ ] (iii) Never [ ]

7. The responsibility to supply instructional media rests with:

- the school [ ]
- the Department of Education [ ]

THANK YOU FOR YOUR CONTRIBUTION
8.3. **QUESTIONNAIRE TO THE MEDIA SCIENCE LECTURERS**

The following instructions guide you on how to answer this questionnaire.

1. Wherever there is a dotted line e.g. .......... fill in the required information.

2. Wherever there is a block e.g. put a cross inside the block next to the answer selected e.g. No or Yes

3. If the provided space is not sufficient, please feel free to write at the back of the page and number the information correctly.

4. Please try to complete the questionnaire without the influence of your colleagues.

5. This completed questionnaire shall be collected from your office.

[UNIVERSITY OF JOHANNESBURG]
SECTION A : GENERAL INFORMATION

1. Your sex: Male [ ], Female [ ]

2. Your professional status (e.g. Lecturer, Senior Lecturer, H.O.D.)

3. Your qualifications:

3.1 Academic Qualifications:

   B. Degree(s):

      1. ....................................
      2. ....................................
      3. ....................................

3.2 Professional Qualifications e.g. STD, HED, UED, PTC etc.

      1. ....................................
      2. ....................................
      3. ....................................

3.3 Your highest qualifications to teach media e.g. a degree course in media, a diploma in media, etc.

4. Your teaching experience:

   4.1 Experience in teaching ........................................ years.
   4.2 Experience in teaching media ............................... years.
5. The table below shows a list of media that can be used in teaching. Indicate by putting a cross in the spaces provided whether the medium is available or not available at your college.

Use the following key:  A - Available.  
N - Not available

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>A</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1. Models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2. Tape Recorder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3. Radio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4. Television</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5. Video tapes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6. Filmstrips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.7. Slides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.8. Wall charts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9. Graphs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.10. Pictures from books and magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11. Photos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12. Posters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13. Chalkboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.14. Feltboards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15. Bulletin boards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16. Newspaper Supplements &amp; Magazines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17. Overhead Projector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.18. Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.19. Textbooks or guides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20. Others</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. The table below shows a list of media that can be used in the training of student teachers. Indicate the frequency of media utilisation during media training of student teachers. Indicate your frequency for media utilisation by circling 0, 1, 2, 3, 4, 5 or 6 using the following key:

- 6 - Everyday
- 5 - A few times a week
- 4 - Once a week
- 3 - A few times a month
- 2 - Once a month or less
- 1 - A few times a year
- 0 - Never

<table>
<thead>
<tr>
<th>MEDIUM</th>
<th>USAGE FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Real Objects (animals &amp; plants)</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.2 Models</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.3 Tape Recorder</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.4 Radio</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.5 Television</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.6 Video tapes</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.7 Filmstrips</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.8 Slides</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.9 Wall charts</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.10 Graphs</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.11 Pictures from books and magazines</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.12 Photos</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.13 Posters</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.14 Chalkboard</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.15 Feltboards</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
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</tr>
<tr>
<td>6.17 Newspaper Supplements &amp; Magazines</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.18 Overhead Projector</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.19 Computer</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.20 Textbook</td>
<td>6 5 4 3 2 1 0</td>
</tr>
<tr>
<td>6.21 Others</td>
<td>6 5 4 3 2 1 0</td>
</tr>
</tbody>
</table>

7. What is the amount of time allocated for media training in terms of hours and minutes per week? ..................................................
8. Do you think time allocated for media training is sufficient to effectively train student teachers to use media?

Yes [ ] No [ ]

9. The table below shows a list of functions of media which may serve as criteria for media integration. Next to each function indicate to what extent you agree with the stated function. Indicate your decision by circling either 1, 2, 3, or 4 according to the following key:

1 - Strongly agree
2 - Agree
3 - Disagree
4 - Strongly disagree

<table>
<thead>
<tr>
<th>FUNCTIONS OF MEDIA</th>
<th>Degree of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1 To obtain and maintain the attention and interest of the pupils.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.2 Show and explain the basic structure of a concept</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.3 Explain complicated relationships</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.4 Relate abstract images to concrete examples</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.5 Conceptualise and integrate fragmented units of knowledge</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.6 Multimedia approach enhances learning</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.7 Bring about change in attitude and behaviour</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.8 Provide for individual differences</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.9 Consolidate and generalise a concept.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.10 Motivate pupils.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.11 Involve pupils to a great extent in classroom activities and encourage them to be creative.</td>
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</tr>
<tr>
<td>9.15 Provide opportunities for frequent changes of pace.</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9.16 Others</td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>

THANK YOU FOR YOUR CONTRIBUTION
The Regional Director  
Northern Region  
Private Bag 2250  
SIBASA  
0970  

Dear Sir

REQUEST TO CIRCULATE QUESTIONAIRES TO TEACHERS AT SECONDARY SCHOOLS AND COLLEGES OF EDUCATION IN REGION 3

I am currently registered for a M.Ed. degree at the Rand Afrikaans University. The title of my proposed thesis is: The use of educational media in the teaching of Biology in secondary schools.

My research demands of me to collect data through the circulation of questionnaires to biology teachers at secondary schools, lecturers and student teachers at colleges of education.

The data thus collected will be analysed to determine the didactic value of media usage in the teaching of biology in secondary schools.

It is envisaged that this investigation will bring an outcome which may improve the teaching of Biology in secondary schools.

I therefore wish to ask for permission to conduct an investigation as stated above.

Yours faithfully

M.S. Ramutumbu
The Regional Director
Northern Region
Private Bag 2250
Sibasa
0970

Dear sir

REQUEST TO BE SUPPLIED WITH STATISTICS FOR STANDARD TEN(10) RESULTS FOR THE FOLLOWING SCIENCE SUBJECTS: BIOLOGY, MATHEMATICS, AND PHYSICAL SCIENCE FROM 1995 TO 1996, IN REGION 3.

1. The above matter refers.
2. I am currently registered for a M.Ed. degree at the Rand Afrikaans University. The title of my proposed thesis is: The use of educational media in the teaching of Biology in secondary schools.
3. In my research I will need to analyse the pass rate of biology in comparison with other science subjects in Region 3.
4. I therefore am requesting your office to supply me with statistics as stated above.

Yours Faithfully

M.S. Ramutumbu
REQUEST TO CIRCULATE QUESTIONNAIRES TO TEACHERS AT SECONDARY SCHOOLS AND COLLEGES OF EDUCATION IN REGION 3.

1. The above mentioned matter refers.

2. Kindly be informed that permission to conduct research as indicated above at secondary schools and colleges in Region 3 is granted.

3. Your co-operation is appreciated.

REGIONAL DIRECTOR FOR EDUCATION AND CULTURE
/asd