

**A PILOT STUDY OF THE USE OF GROUPWORK IN BIOLOGY
EDUCATION AT THE GRIFFITHS MXENGE COLLEGE OF
EDUCATION**

A RESEARCH PROJECT

**SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF**

MASTER OF EDUCATION

OF

RHODES UNIVERSITY

BY

FREDERICK NTOW KWAYISI

**SUPERVISORS: MRS GILL BOLTT
 DR. JAAP KUIPER**

JANUARY 1999.

CONTENTS

PAGES

- I. Declaration of originality**
- II. Dedication**
- III. Acknowledgements**
- IV. Abstract**

CHAPTER 1

- 1. Introduction** 1
- 1.1 Background and context** 1
- 1.2 Implications for the introduction of Outcomes Based Education** 3
- 1.3 Philosophical and learning theories underpinning Curriculum 2005 and Outcomes Based Education** 4
- 1.4 National education and Outcomes Based Education** 6
- 1.5 Goals of the Research** 7

CHAPTER 2

- 2. Literature review-on groupwork as a teaching strategy** 10
- 2.1 Introduction and definition** 10
- 2.2 Benefits of groupwork** 11
 - 2.2.1 Higher achievement** 11
 - 2.2.2 Deeper understanding** 12
 - 2.2.3 Enjoyable learning** 12
 - 2.2.4 Leadership skills** 12
 - 2.2.5 Positive attitudes** 12
 - 2.2.6 Self-esteem** 13
 - 2.2.7 Inclusive learning** 13
 - 2.2.8 A sense of belonging** 13
 - 2.2.9 Skills for the future** 14
- 2.3 Procedure for structuring groups** 14
 - 2.3.1 Factors to consider** 14
 - 2.3.2 Group objectives** 14
 - 2.3.3 Group size** 15
 - 2.3.4 Assigning participants to groups** 15

2.3.5	Room arrangement	15
2.3.6	Distribution of materials	19
2.3.7	Assigning roles	19
2.3.8	The need for intervention	20
2.3.9	Assessing and evaluating how well the group functioned	20
2.4	Factors that must be present for co-operative learning to work best	21
2.4.1	Positive interdependence	21
2.4.2	Face to face interaction	21
2.4.3	Individual accountability	21
2.4.4	Interpersonal skills	21
2.4.5	Group processing	22
2.5	Group teaching methods	22
2.5.1	Buzz sessions	22
2.5.2	Group discussions	22
2.5.3	Problem solving activities	22
2.5.4	Mediated feedback sessions	22
2.5.5	Group projects	23
2.6	Managing group differences	24
2.7	Implications for teachers	26

CHAPTER 3

3.	Methodology	28
3.1	Background educational paradigm and theory	28
3.2	Research strategy	29
3.3	Participants in the Research	30
3.3.1	The Rector	30
3.3.2	Lecturer participation	31
3.3.3	Student participation	31
3.4	Group formation	32
3.5	Data collection	33
3.5.1	Group techniques and lectures used to promote interaction among groups	33

3.5.2 Lectures used in the research project	36
3.5.2.1 Expected co-operative group outcomes from the exercise given	37
3.5.2.2 Project work on aquatic ecosystem	38
3.5.2.3 Exercise on food tests	40
3.5.2.4 Exercise on classification	41
3.5.3 Questionnaires to students	42
3.5.4 Student Interviews	43
3.5.5 Lecturer participation	44

CHAPTER 4

4. Analysis of data	45
4.1 Interviews with students	45
4.2 Student responses on the dynamics of groupwork using Questionnaires (Closed questions)	47
4.3 Student responses on the dynamics of groupwork; open questions of the questionnaire	48
4.4 Observation of staff member: Closed questions	50
4.5 Interpretation and inferences	52
4.5.1 Interviews	52
4.5.1.1 Ineffective group dynamics identified	52
4.5.1.2 Effective group dynamics identified	53
4.5.1.3 Responses to closed questions	54
4.6 Results of student responses to open questions of the questionnaire	55
4.6.1 Dynamics of ineffective groups identified	55
4.6.2 Dynamics of effective groups identified	55
4.6.3 Result of lecturer observation on group activity	56
4.7 Discussion	57

CHAPTER 5	64
5. Conclusion	64
5.1 Findings from the research	64
5.2 Limitations of the research	64
5.3 Suggested solutions to problems arising from the research project	66
6. Critical reflections on the research	70
7. References	74

APPENDIXES

Appendix 1	-	Interview Schedule
Appendix 2	-	Groupwork observation schedule
Appendix 3	-	Questionnaire on groupwork – students
Appendix 4	-	1st Interview
Appendix 5	-	2nd Interview
Appendix 6	-	3rd Interview
Appendix 7	-	4th Interview
Appendix 8	-	5th Interview

DECLARATION OF ORIGINALITY

I hereby declare that the whole work in this research project is mine except where I have given direct quotation or given references.

DEDICATION

I dedicate this work to my wife Ama Christie, and my daughters, Adwoa Agyapomaa, Abena Adubea and Akua Kwayisibea.

ACKNOWLEDGEMENTS

I wish to record my gratitude to the following persons:

- 1. Dr. Jaap Kuiper and Mrs Gill Bolt, my lecturers for two years, who also served as my supervisors for this research project, for their invaluable support, direction and suggestions and their patience with me.**

- 2. The 1998 third year biology students of Griffiths Mxenge College of Education for their co-operation and help in this project;**

- 3. My colleagues Mr. Fourie, Mr. Ngaso and Vuyisile Ndzima for their help in various ways.**

- 4. Dr. Kofi Gavor of the Settlers Hospital, Grahamstown for his friendship and providing me with accommodation and meals during my course days and,**

- 5. My family for their patience and encouragement and especially to my wife, Ama Christie who was my secretary and typist. She sat through most nights with me.**

ABSTRACT

The Government of National Unity in 1994 introduced a new educational policy for the country. This represented a shift in paradigm from a transmission mode of teaching and learning to learner-centered education. The shift marks a transformation from a content-based curriculum to an outcomes based education (OBE). OBE, which is underpinned by Constructivism and Social Constructivism advocates for the use of groupwork as a strategy for achieving the outcomes envisaged in our learners.

The challenge facing teachers and educators is how to implement outcomes based education.

The intention of this research is therefore to serve as a pilot project to find out about how groupwork may be used in teaching. It looks at types of groups, considerations a teacher should have in forming groups, dynamics which come into play during teaching and gives suggestions as to how groupwork problems may be solved. Others issued are also raised which were not fully covered in the research.

It is the hope of the researcher that the project would be a basis for further research on the use of group work in teaching under outcomes based education.

CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND AND CONTEXT

In his article, *Foundations for a Post-modern Curriculum*, Doll (1989) quotes Prigogine and Stengers (1984:214-215) as saying:

Where classical science used to emphasize performance, we now find change and evolution; we no longer see in the skies the trajectories that filled Kant's heart with the same admiration as the moral law. We now, see strange objects: quasars, pulsars, galaxies exploding and being torn apart, stars that, we are told, collapse into 'black holes' irreversibly devouring everything they manage to ensnare (Doll 1989:243).

The vision of Prigogine and Stengers represents a vision of a new world order; a world which is no more limited to the simple, linear, stable and uniform cosmological order as postulated by thinkers such as Copernicus, Descartes, Einstein and Newton. Views postulated by such thinkers were of pre-modern thought, which did not encourage individuals to overstep their bounds or rise above their class (Doll 1993:19-38). Such views represented a closed vision of the universe. The rise of industrialism, John Locke's *tabula rasa* theory, the spectator theory of knowledge and the 19th century theory of association and mental impression to mention a few, represented modern thought. Even though modern thought brought forth concepts of freedom, individual accomplishment was not encouraged. Students were encouraged to learn by rote and to discover what was 'already known'. These are the views of education that post-modernism challenges. Modernism viewed the individual as fulfilling a preset role that is non-variant, absolute perfect and unchanging (Doll 1993:39-52).

Unfortunately, these are the characteristics, which had been passed on into the education systems of various countries including ours. The situation is made worse by the apartheid education policy – which perpetuated a policy of inferior education along racial lines. This policy discouraged individuals to overstep their bounds, and stifled initiative.

Doll quotes Prigogine and Stengers on a universe of a chaotic order of self-organization and dissipative structures. The world is moving ahead in all spheres, technologically, industrially, economically and individuals are needed who would have had appropriate education to fill positions to lead the country into the next century. Soltis (1993) in his foreword to Doll's (1993), A Post Modern Perspective on Curriculum said that the framework of shared understanding with children based on joint knowledge and action, structures activity more systematically than the discovering method of the Piagetian classroom. Doll envisions a post-modern curriculum that will allow human powers of creative organization and re-organization of experience to be operative in an environment that maintains a healthy tension between the need to find closure and the desire to explore. Such a post-modern curriculum built from constructivism allows students and their teachers in conversation and dialogue to create more complex orders and structures of subject matter and ideas (Doll 1993:39-52).

The Government of National Unity inherited a highly fragmented system of education with nineteen different departments providing education to different race groups and in different provinces, and under a policy of Bantu Education for the Black majority.

The new dispensation however seeks to provide an education process based on democratic principles and a commitment to equity:

The introduction of Curriculum 2005(DOE, 1997) is an attempt by the Government to provide a basis for this equity and to provide life – long learning for the citizens of the country. Curriculum 2005 suggests a move away from teacher – centered education based on a content-based curriculum and a transmission model of education to the development of conceptual knowledge, skills, values and attitudes that would be developed from learner centered education. This would involve a process where learners construct their own knowledge with the teacher as a facilitator. Educators are therefore faced with an education system that demands their total commitment and dedication.

1.2 IMPLICATIONS FOR THE INTRODUCTION OF OUTCOMES BASED EDUCATION

Outcomes Based Education has implications for curriculum development, content, methodology, assessment and the entire education enterprise.

1.2.1 Implications for Curriculum Development: this involves a move away from separate and distinct subjects to integration, the attainment of outcomes through learning programmes, an open curriculum and a greater choice of content across the curriculum.

1.2.2 Implications for Content: involves the development of integrated tasks, more diverse content, content linked to real world experiences – content selected to educate both minds and hands and the development of skills.

1.2.3 Implications for Methodology: these include activity based teaching and learning, independent as well as group and collaborative work, integrated as well as differentiated tasks, dynamics for heterogeneous learning and assessment practices.

1.2.4 Implications for Assessment: the need to know about different forms of assessment, increased transparency in assessment, formative principles, learner participation and the need to develop different assessment strategies for different situations etc. (DOE 1994).

These implications require a fresh outlook on teaching and learning and teachers need to be educated anew to be effective teachers.

1.3 PHILOSOPHICAL AND LEARNING THEORIES UNDERPINNING CURRICULUM 2005 AND OUTCOMES BASED EDUCATION

Schwab (cited by Doll. 1993:161) suggests that the field of curriculum is moribund. It is unable, by its present methods and principles to continue its work and contribute significantly to the advancement of education. It requires new principles, new methods and a new view appropriate to the problem. Doll (1989) identifies three facets of post-modern thought; foundational assumptions which have radical implications for the curriculum. These are (a) the nature of open systems, (b) the structure of complexity and (c) transformatory change. Doll referred to education under modern philosophy as closed, simple and accumulative. Schön (1983:296) is quoted by Doll as seeing the transformation in education taking place as a reflexive relationship between teacher and student. The teacher does not ask the student to accept the teachers authority, rather, the teacher asks the student to suspend disbelief in that authority, to join with the

teacher in inquiry. The teacher tries to understand what the student is experiencing and to make that understanding accessible to both the student and the teacher. The teacher agrees to help the student understand the meaning of the advice given and the rationale for it, and to reflect with the student on the tacit understanding each have (Doll 1989:248).

This is the challenge post-modernism put on us in South Africa today. We need to transform our education and look for effective and alternative forms of teaching and learning in the face of an ever-changing world, a situation in which the child is no more a silent recipient of information from outside.

Constructivism as a learning theory views learning as a process whereby knowledge can only exist when it is constructed within the mind of a cognizing being (Bishop & Carpenter 1993). Cobb & Steffe (1983) cited by Etchberger & Shaw (1992) said that understanding of any event, situation or problem occurs only when relationships are made to existing understanding in a learner's mind. Ausubel cited by Bishop & Carpenter (1993) said that the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly. Constructivists take the teacher as a facilitator; the learner as active in constructing meaning, the learner's mind containing strongly held preconceptions and knowledge constructed by each individual (Bishop & Carpenter, 1993). Social constructivists view learning as a process whereby individuals construct knowledge through social interactions with others. This is opposed to the transfer view of learning, which considers the teacher as a transmitter of knowledge, the learner as an absorber of knowledge with an empty bucket mind and knowledge independent of the knower. Constructivism rejects

this Lockian *tabula rasa* view of learning (Bishop & Carpenter, 1993). Yager (1991) suggests a constructivist's grid of teaching and learning involving the individual student, pairs of students, small group reviews, whole class or local community and the science community. This grid employs a teaching strategy consisting of, invitation, and exploration, proposing explanations and solutions and taking action. Learning is achieved through self-analysis, two person agreement, small group consensus, whole class agreement and consensus, new problems and actions.

1.4 NATIONAL EDUCATION AND OUTCOMES BASED EDUCATION

The current educational policy adopted by the Government places on us certain demands. These demands or expected outcomes include the production of people who can cooperate, find solutions together, and participate in shared decision-making in a democracy. Such people must be socially responsive and responsible and who would enhance the democratic ideal. In this regard we are all needed to solve problems in society; to work well together in task – oriented situations and bring resolutions to all kinds of problems facing the country. If we are to succeed as a democratic country then we have to learn to work together. These are ideals, which are needed to be achieved together with the cognitive development of the young of the country. The situation is even more urgent, when we come to think of the fact that we have to compete with the industrialized countries for our very existence and development as we move into the 21st century. There are increasing demands on mathematics, science, technology and computers in our school curriculum to prepare our young people to become literate and functional in the new millenium. To these ends we see that not only do we need people with the necessary cognitive development but also with the

appropriate affective behaviours.

There is no place better than the school situation where these ideals can be achieved. There is no doubt that schools bring together individuals with diverse backgrounds. These individuals must learn to live and work together, to bring about good decision making and participation in the democratic ideal.

These principles are those that are espoused by Constructivism and Outcomes Based Education. Verduin Jr (1996) cites Jarolimek & Packer (1993) as arguing that societies organised under the democratic ideal place special demands on their school systems. Children in these societies need to be educated to be the kind of citizens who can and will share in popular sovereignty (Verduin 1996:391). It is for these reasons that we must try co-operative teaching and learning through groupwork in our schools. After all, as the saying goes “two minds are better than one”.

1.5 GOALS OF THE RESEARCH

Curriculum 2005 urges the use of groupwork in classrooms. This is perhaps based on the assumption that learning is optimized in a social setting such as a school. Constructivists hold the view that children will have some conception – a cognitive schema on the classroom topic they are faced with. Learning in classrooms involves the extension, elaboration or modification of the schemas children hold (Bennett & Dunne 1994:1-3). Bennett & Dunne cite Vygotsky (1978) as saying that a child’s potential for learning is revealed and indeed is often realized in interactions with more knowledgeable others – their peers, siblings, the teacher, parents, grandparents and so on.

Where learning is achieved co-operatively, success is the aim – what a child can do today in co-operation, tomorrow he/she will be able to do on his/her own. The medium for this success is talk, which can be achieved in co-operation with others. Talk promotes pupils' understandings and evaluation of their progress (Bennett & Dunne 1994:3-4).

Teachers therefore have to take cognisance of this fact and incorporate this into their planning and teaching of lessons. Teachers have to know about the dynamics involved in group or co-operative teaching and learning to be able to practice these.

The introduction of Curriculum 2005 and Outcomes Based Education seems to have taken even teachers by surprise. This is so because, teachers have not been educated to use effectively alternative methods of teaching and more importantly, may not have any knowledge about the dynamics involved in groupwork. The problems seem large and complex. Facilities in especially disadvantaged schools are antiquated and in some, very poor or absent. There are more pupils to a teacher in most rural schools than in some urban schools and it may not be easy to practice groupwork in these schools.

This research project will therefore be a pilot attempt to look at the dynamics involved in group and co-operative – work in teaching and learning. It will try to identify problems and how to overcome these and the opportunities for improving and reinforcing positive group dynamics. It is also important to note that most research work on groupwork has been done in the western countries especially, the United States of America and Britain under conditions specific to

these areas (Bennett & Dunne 1994:28-34). Examples given and research results are therefore influenced by conditions of those countries. South Africa conditions would therefore be different and unique. This research project will therefore also add information to what may exist in the country on groupwork.

CHAPTER 2

2. LITERATURE REVIEW –ON GROUPWORK AS A TEACHING STRATEGY

2.1 Introduction and Definition

Most teachers are seemingly familiar with groupwork without really knowing about the dynamics of groups and how important groupwork is in teaching and learning. Groupwork differs from the traditional passive and expository methods, which most teachers in this country are used to and which rely largely on the efforts of the teacher. Groupwork achieves outcomes from the collective contribution of the teacher and class members. Swafford (1995) cites Vygotsky (1978) as asserting that social interaction is essential for the development of cognition, learning, and knowledge; that students must interact with a person who is more expert than themselves (be it an adult or a peer) in order to go beyond their current level of development. Social constructivists also assert that dialogue among students helps them explore, clarify and internalize concepts that are difficult to learn (Johnson & Johnson 1985, Swafford 1995, Yager 1991).

Swafford (1995) cites (Cohen 1994) for giving the U.S.A. and certain western countries as examples of places where research has shown groupwork to be successful in enhancing the development of higher order thinking, increasing learning and promoting pro-social behaviour. Matiru *et al.* (1995) cite Brown (1988) as describing group teaching as getting students to talk and think and, Borich (1988) emphasized the key characteristics of inquiry, discovering and problem solving – which initiate a process of generalization and discrimination, which requires students to rearrange and elaborate their understanding of a

topic. Matiru *et al* (1995) cite Curzon (1990) as talking of “collective exploration and public evaluation of ideas”.

These are the qualities Outcomes Based Education in South Africa is seeking to develop in learners and hence, the use of groupwork as the basis of teaching and implementing Curriculum 2005.

2.2 BENEFITS OF GROUPWORK

The benefits of groupwork to learners may include, higher achievement, deeper understanding, promotion of positive attitudes, a sense of belonging and the development of skills for the future (Hill & Hill, 1990). Groupwork may bring about enjoyment in learning and help to develop positive attributes of personality.

2.2.1 Higher Achievement

Hill & Hill (1990) cite research by Johnson *et al* (1981) to support the contention that social interactions lead to the development of more advanced cognitive development and the promotion of higher academic achievements as against individualistic or competitive learning experiences. These researches suggest that if schools are to provide for optimum intellectual development of their students, relationships amongst children and the kinds of co-operative activities children engage in will need to be taken seriously.

2.2.2 Deeper Understanding:

Students thinking skills and deeper levels of understanding are developed when there are different points of view, and the discussion of ideas and problems and their solutions.

2.2.3 Enjoyable Learning:

Our personal experiences show us that we learn more and achieve more when we learn in a relaxed way. This simple principle must be remembered by teachers to be used in their teaching.

2.2.4 Leadership Skills

Johnson & Johnson (1997) suggest that groupwork encourage the use of leaders. This enables pupils to understand other people's perspectives and develop better interaction skills than those from competitive or individualistic settings.

2.2.5 Positive Attitudes

Hill & Hill (1990) cite Johnson & Johnson (1981) as saying that when the environment is structured to allow children to work together co-operatively, they become more positive about school, their subject areas and their teachers. These characteristics are then transferred to their daily life activities.

2.2.6 Self-Esteem

Hill & Hill (1990) cite research by Norem-Hebeison & Johnson (1981) that co-operative learning experiences promote healthier processes for evaluating one's self-worth, self-acceptance and positive self-evaluation.

2.2.7 Inclusive Learning

Care and respect for others, is actively promoted by learning together, including others in co-operative learning groups and the setting up of a collaborative classroom environment. Learning together promotes positive peer relationships; it opens up channels of communication and the perspectives of others are more easily understood (Hill & Hill 1990). Children in every classroom come from different backgrounds with a range of abilities and some are exceptional in many ways. To succeed in learning it may be necessary for learners to put their efforts together.

2.2.8 A sense of belonging

Learning together in groups may give children a sense of belonging. This is because some children may be shy, others may be slow learners, some may lack the necessary motivation to learn, others may not simply be suited to learn effectively in the traditional learning environment etc. Collaborative learning in groups has enormous potential for all such children. It satisfies their needs for recognition and belonging through their involvement in group activities.

2.2.9 Skills for the future

Skills obtained by the individual through groupwork are essential not only for learning in schools but for future success in a person's integration at work and in the community in future. Groupwork and collaborative learning in the form of tutorials can be traced back to Socrates who led his students in critical inquiry to insight through discussion (Matiru *et al.* 1995). Teaching the skills of collaborative learning, group management and organisation will become more important than simply instruction and imparting knowledge and teachers must realise this.

2.3 PROCEDURE FOR STRUCTURING GROUPS

2.3.1 Factors to consider

It is important for teachers or co-ordinators to go through a process of effective groups' formation to ensure success. Group size is however dependent on the task at hand, time available, the level of interpersonal and group skills, the number of learners in a class etc. According to Johnson & Johnson (1997) evidence suggests that to be effective, the optimal group size of learning groups might be from four to six members. This is to ensure diversity and a variety of resources so that everyone's resources will be utilized and that everybody will participate and receive rewards for his/her contributions.

2.3.2 Group Objectives

It is important for the teacher/facilitator to specify the objectives for the learning groups.

2.3.3 Group Size

Group formation is not merely being physically near other persons, discussing materials with other members, helping others or sharing materials with, other members etc. but forming 'effective' groups with collaboration or co-operation in mind, although all such factors are also important factors to consider.

It is therefore important to select group size appropriate to the tasks and objectives at hand. The smaller the group the more effective it is for co-ordination and participation by all. Not all group members participate if the group is too large and members perception of each others contributions decrease.

2.3.4 Assigning Participants to Groups

Johnson & Johnson (1997) cite Johnson (1980a) as suggesting that randomly assigning participants to groups usually ensure sufficient heterogeneity among members. Such groups usually contain a fair mix of high-, medium- and low-performing participants.

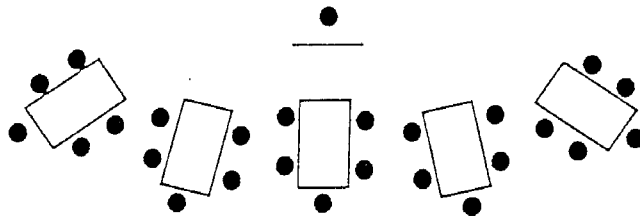
2.3.5 Room Arrangement

Factors which may be considered in arranging a room for groupwork may include (i) the symbolic message of what is expected and (ii) how such arrangement would facilitate (or interfere) with learning. According to Johnson & Johnson (1997) in order to arrange a room to facilitate learning the coordinator needs to know how to:

1. Define patterns of work and social interaction through spatial arrangement, graphics, colour, and physical boundaries.
2. Utilize physical arrangements to maximise learning.
3. Visually focus group members' attention on the co-ordinator, each other, or instructional materials, depending on the specific task.
4. Control levels of noise in the room.
5. Design patterns of circulation that will enable group members to have access to the social and material resources needed for learning. (page 477)

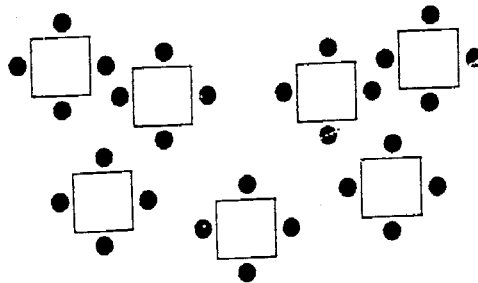
Cowie & Rudduck (1991) suggest that it is helpful if the room can be arranged in ways that match the nature of the learning task. If the task should change during the course of the session, so should the seating arrangements. Cowie & Rudduck (1991) make the following suggestions on room arrangement to suit particular group activities.

Seating Arrangement A

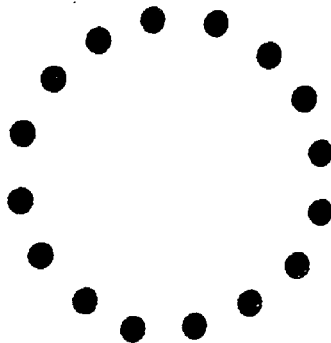


This is suitable for a task which require both a common focus (e.g. on the tutor/teacher, on a video, on an OHP) and some small group activity.

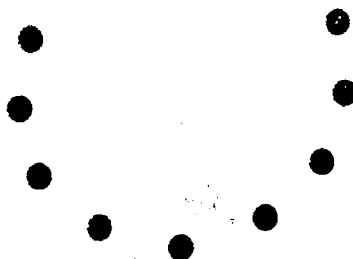
Seating Arrangement B



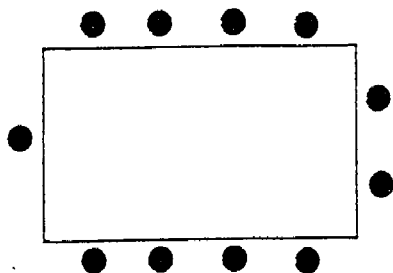
This assumes that groups will work on a task all the time with some opening explanation from the tutor/teacher (or even with any instructions printed and distributed to each table).

Seating Arrangement C

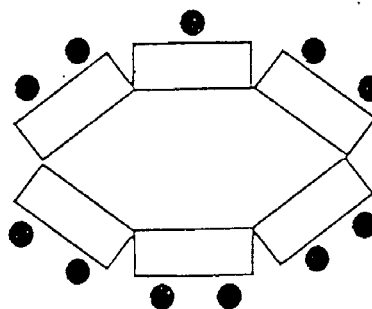
This is suitable for a discussion where no materials will be handled and where equal participation is expected (however, many people find the circle of chairs very threatening).

Seating Arrangement D

This is less stark than seating C in that it allows face-to-face contact among all members of the group. If the tutor/teacher is to chair the discussion, then he or she is best located at either end of the arc.

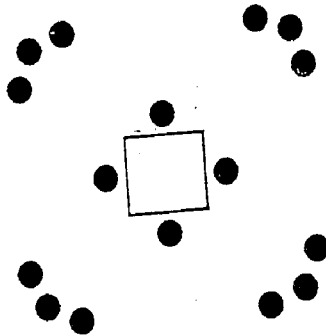
Seating Arrangement E

OR



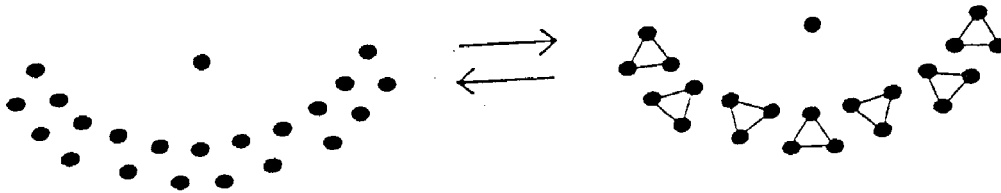
This is appropriate for a group discussion where there is a chairperson and where materials are likely to be used during the course of the session.

Seating Arrangement F



This is appropriate for activities where some event is undertaken by a few people and observed by the majority as a basis for debriefing.

Seating Arrangement G



This is appropriate for a lecture which is somewhat informal and where there will be some “buzz group” activity (i.e. quick bursts of discussion among small groups of three people).

2.3.6 Distribution of materials:

It is important to consider age and experience of group members in distributing materials to such groups. Materials should be distributed to ensure that all members participate and master the assignment.

2.3.7 Assigning Roles

Role assignment would depend on the age and experience of groups and group members. While adult groups can assign roles to themselves, the coordinator should assign roles to younger age groups to facilitate cooperative interdependence.

Adams & Hamm (1996) identify the following general roles, which may be assigned depending on the objectives of the group.

- (a) **Facilitator:** organizes the groups work.
- (b) **Checker:** checks with group members to make sure that everyone understands their task and agrees with group response and can explain it.
- (c) **Leader:** reads the problem or directions to the group.
- (c) **Recorder:** writes the groups response or data collection on a group response sheet or log.
- (e) **Encourager:** offers support and encouragement to group members.

The encourager according to Johnson & Johnson (1997) keeps others feeling good about working together.

Hill & Hill (1990) also suggest the following;

- (a) **Challenger:** stirs up thinking, takes a different point of view e.g. "Is there another way to look at this?" etc.
- (b) **Timekeeper:** watches time, tells when time is nearly up.
- (c) **Observer:** watches the group and gives feedback on co-operative skills. The observer is usually invisible to the group and rarely intervenes in the group discussions.
- (d) **Questioner:** forms open-ended questions for the group e.g.: Could this be true? How would you know if it was or wasn't?
- (e) **Predictor:** asks the group to predict all the possible outcomes especially in project work etc.

2.3.8 The need for Intervention

It is at times necessary for the co-ordinator to give assistance when asked and to step in where groups are having problems in collaborating successfully. When it is obvious that group members lack certain group and interpersonal skills that they need in order to co-operate with each other, the co-ordinator will want to intervene in order to help the members learn these social skills.

2.3.9 Assessing and Evaluating How Well the Group Functioned

It is not only important for the co-ordinator to present closure to the lesson but also to assess the quality of student learning. The co-ordinator should evaluate how well the group functioned together and to provide and encourage feedback. The co-ordinator should discuss how the group could improve (Adams & Hamm 1996).

2.4 FACTORS THAT MUST BE PRESENT FOR CO-OPERATIVE LEARNING TO WORK BEST

According to Johnson & Johnson (1997) and Adams & Hamm (1996) co-operative learning works best when the following are all present:

2.4.1 POSITIVE INTERDEPENDENCE

Positive interdependence develops when students/group members recognise that they can reach their personal goals only when everyone in the group reaches their goals; students should maximise the learning of all members by sharing their resources, providing mutual support and encouragement, and celebrating their joint successes.

2.4.2 FACE TO FACE INTERACTION:

This involves student discussion, reasoned decision making and action on suggestions that help each group member to achieve individual and group goals.

2.4.3 INDIVIDUAL ACCOUNTABILITY:

This is making sure that individuals take personal responsibility for doing his/her fair share of the work; this may involve giving personal tests, developing personal portfolios and providing feedback to one another on performance of tasks and responsibilities.

2.4.4 INTERPERSONAL SKILLS:

Each group member should use his/her personal skill(s) to help the group. Students are more likely to help each other and resolve conflicts together if they respect each other's interpersonal skills as teamwork develops.

2.4.5 GROUP PROCESSING:

This involves the group going through self-evaluation to find out how well they worked together, their weaknesses and strengths and how to improve for the future. Co-ordinators can take part to give positive feedback to groups.

All the factors mentioned above help learners to work co-operatively with each other.

2.5 GROUP TEACHING METHODS

Various methods for teaching small-groups are suggested by various authors, Adams & Hamm(1996), Matiru *et al* (1995), Verduin (1996), Johnson & Johnson (1997) etc, but the common ones seem to be tutorials, seminars and problem solving classes. These are perhaps too general for classification purposes. According to Matiru *et al* (1995), five separate types have been identified to describe the full range of techniques *viz*;

- 2.5.1 BUZZ SESSIONS: this refers to short discussions by very small groups within a lesson. The buzz group is also referred to as brainstorming.
- 2.5.2 GROUP DISCUSSIONS; which consist of various forms of in depth discussions, such as tutorials or seminars.
- 2.5.3 PROBLEM SOLVING ACTIVITIES: these cover a range of games, simulations and participative exercises such as case studies, role plays, and business games.
- 2.5.4 MEDIATED FEEDBACK SESSIONS, in which specific skills are practiced, analyzed and discussed, such as microteaching and interactive skills training.

2.5.5 GROUP PROJECTS: Whereby a small group undertakes a co-operative task of a practical nature, such as a laboratory or field project Matiru *et al.* (1995) give an overview of the most commonly used small group methods as follows:

METHOD	DESCRIPTION
Brainstorming	A technique for generating many ideas uncritically with comment and evaluation only considered
Buzz Groups	A short period during a lesson in which several small groups intensively discuss a given issue, often followed by plenary feedback.
Case Study	An in-depth analysis of real or simulated problems for students to identify principles or suggest solutions.
Controlled Discussions	A discussion in which students may raise questions or comment but the tutor controls the general directions.
Fishbowl	A discussion group in an inner circle surrounded by a silent 'observation' group. Often followed by plenary session or role reversal.
Free Group Discussions	A group discussion in which topics and direction are largely controlled by members not tutor.
Problem-centered Group	A group with a specific open ended task which is discussed, with findings reported at plenary session or summarised on a poster.
Projects	A practical group exercise or scholarly activity involving investigation of a problem
Pyramid (Also called Snowball)	An 'ideal' generating technique whereby groups of two briefly discuss a problem, then form groups of four for further discussion prior to reporting back.
Questions	Tutor displays questions (on BB or OHP), gives time to think and then elicits answers for discussion and elaboration by group. Can be used as quiz with teams.
Role Play	A technique in which participants act out different roles in particular situations and later discuss their feelings and aspects of the problem
Seminar	Group discussion of a paper presented by a student
Simulation and Games	An exercise involving essential characteristics of a specific real situation where participants re-enact specific roles.
Step-by-step Discussions	A discussion organized around a carefully prepared sequence of issues and questions to draw out the required information from students.
Syndicate	Several sub-groups forming part of a larger group each working on a problem for a set time and reporting later to the whole group.
Tutorial	A meeting with a small group, often based on a pre-set topic or previous lecture.
Workshop	A 'hands-on' participating experience involving several methods and directed at developing skills or attitudes.

2.6 MANAGING GROUP DIFFERENCES

The fact that pupils would work in groups is an indication that there would always be differences among members of a group. Differences of opinion, conflicting views and failing to reach consensus within groups however small are inevitable. Malcolm (1997) identifies factors, which would inhibit the smooth working together of groups. He established the fact that in the rural communities of South Africa, there are large and overcrowded classrooms. The facilities in these schools may be limited or totally absent and, that teachers have to teach and express themselves in English which might be a second or third language for most learners. At group level, problems he identified included the fact that not everybody may be involved in group activities or even believe in groupwork. Learners may not be interested in the task, the question or context facing them and may not recognize or understand the context in which the question is set. Learners may not understand what they are supposed to do due probably to lack of the required background knowledge. Learners may be slow learners or cannot think up imaginative ideas. They may be simply tired or bored. Learners in our local schools may not also either believe in science or even in themselves. Learners have problems with expressing themselves freely in English, which is a second language to them and may not be confident in speaking in groups. He also identified the possibility that learners may find it difficult to come up with a product. They may not be committed to the task at hand and they may procrastinate, delay, and have difficulty discussing on the task. Groups may be working but the quality may not be high. Some group members too, may want to dominate the group (Malcolm 1997:31-47)

Swafford J (1995) identified students who assumed roles as non-participants, under-participants and overparticipants during groupwork. Johnson & Johnson (1997) identify problem behaviours such as:

- (a) Lack of team maturity; that groups ordinarily require some time to develop and stabilize their patterns of working;
- (b) The teams history and background of members;
- (c) Mixed motives of team members and
- (d) Obstructive individual behaviour which may interfere with team effectiveness. Team members may be passive, active, and too independent or would like to take charge to do everything.

The fact that groups may have these many problems does not mean that the 'groups idea' must be dismissed outright or that such problems are insurmountable. Doll (1989) says that groups like open systems, need fluxes, perturbations, anomalies, errors: These are the triggers which set-off re-organisation. He cites Piaget (1977:13) as saying that 'It is worthwhile to note that however the nonbalance arises, it produces the driving force of development. Teachers and educationists should know these and be adept in handling these group problems; to find answers and alternatives for each one of them.

The variety of methods mentioned above, need selecting during preparation and should be closely related to goals, strategies, content and setting. Groupwork should not be used just for the sake of change. It must be remembered that groupwork will not crowd out individual opportunity and initiative.

Groupwork will enhance existing strategies without replacing them (Johnson & Johnson 1997). Groupwork should be viewed as an alternate and complementary approach to learning which when implemented in the appropriate situation, can benefit learners in a variety of ways. It is important to note that an over emphasis on co-operative learning could encourage a lack of independence and personal responsibility for learning as well as the loss of individual creativity (Wilmot & Euvrard 1998).

2.7 IMPLICATIONS FOR TEACHERS

It is clear from the above that the use of groupwork as a basis for the new Outcomes Based Education and learner centered education is by no means an easy one. Teachers are faced with the challenge of adaptation and change, and re-education in those teaching strategies which have been taken for granted.

As Wilmot & Euvrard (1998) suggest, teachers need an understanding of the principles on which co-operative learning is based. They need a sound grasp of their subject/discipline as well as how and where it may be used in teaching; pedagogical knowledge/a knowledge and understanding of different approaches to learning; knowledge of their learners and knowing how to assess co operative learning.

Even though the concept is student centeredness the teachers role is not passive, but an active one, in teaching selected skills, in assisting in organizing, in securing materials when necessary, in guiding team activity, in identifying road blocks, in evaluating all aspects of the educational process, and in providing an atmosphere that is conducive to group and cooperative learning.

The teacher is of course the facilitator, the evaluator, the intervenor, and the person who keeps the process going (Verduin 1996). For groupwork to be successful the teacher must be a democratic teacher who allows:

shared control & decision making with the class,
encouragement of group initiatives,
delegation of responsibility to the class,
working towards the establishment of mutual goals and
active participation in class activities. (Hill & Hill 1990).

Hill & Hill (1990) also cite Lewin's (1944) classic study, which found that an autocratic group functioned only when the leader was present. The laissez-faire group was chaotic but the democratic group functioned well even without the leader. These are the challenges facing the teacher under Outcomes Based Education.

CHAPTER 3

3. METHODOLOGY

The purpose of this chapter is to indicate the research strategy used and how the research project was carried out.

3.1 BACKGROUND EDUCATIONAL PARADIGM & THEORY

The underpinning educational paradigm that was used in this research project is Social Constructivism in the Post-modern milieu. The research took place in the social setting of a college, the Griffiths Mxenge College of Education, Zwelitsha.

The research depended on the participation of the lecturers and students and involved shared responsibilities and discussions aimed at receiving and sharing the results and improvements (and or additions) to the methods of teaching that the project was to achieve. As Gergen (1985) says, social constructivist inquiry is principally concerned with explicating the processes by which people come to describe, explain or otherwise account for the world (including themselves) in which they live. Driver & Bell (1986) add that in learning situations we are actively hypothesising, checking and possibly changing our ideas as we interact with phenomena and with other people. Post-modernism & Social Constructivism is gradually replacing the positivist-empiricist concept of knowledge which restricted educational research to the “scientific method”.

3.2 RESEARCH STRATEGY

The research strategy that I used is Action Research and represented a first cycle Action Research. This is because the research project was:

Situational - it took place in the social setting of Griffiths Mxenge College, where the problem was encountered and an attempt made to solve the problem in the context of the college;

Participatory - that some lecturers and students took active part in implementing the research;

Collaborative - it involved group activity and the collaboration of the members of the groups and co-operation from colleagues; and

Self-evaluative – that as the project progressed modifications were made based on the evaluation of the various stages with the aim of improving and adding to the methods of teaching biology and other subjects at the college (Cohen & Manion, 1994). I also hoped that students would be equipped for their future roles as teachers in the community.

I considered this research project as a first Cycle Action Research because of the time factor involved and based on the dynamic nature of the project itself. My methods underwent continuous modifications aimed at improvement and it was hoped that improvements to teaching would go on continually.

Brandt and Dresselhaus (1997) cite McNiff *et al* (1996: 7 – 11) as describing Action Research as a form of practitioner research which leads to knowledge from and about good professional practice. It is research with people rather than research on people. Action research operates in cycles.

It proceeds by “doing” and “making mistakes” in a self-reflective spiral of planning, acting, observing, reflecting, planning etc. Cycles transform into new cycles, and so the whole inquiry may be seen as a cycle of cycles or a spiral of spirals, which has the potential to continue indefinitely (Brandt & Dresselhaus 1997).

It was also my hope that this research project would be a tool for turning teachers and students into life – long learners in finding ways to improve our teaching.

Through participation in the different research activities the students would have been motivated by the potential of success through collaboration. They would have had the chance of using their own initiative in finding solutions to learning problem situations. Through groupwork they would have experienced the challenges involved and would have tried to find answers to such challenges.

3.3 PARTICIPANTS IN THE RESEARCH.

Since my research was situational, participants were from the Griffiths Mxenge College of Education, Zwelitsha where I lecture.

3.3.1. The Rector

When I approached the Acting Rector of the college Mr. K Ngaso to ask permission to undertake the project, he was enthusiastic. This was because he saw the research, as part of his dream to turn the college into a resource centre for teacher education and the benefit he thought the college would derive from such research. When Mr Deliwe was later appointed into the rectorship of the college, he said education was moving

away from teacher centered to learner centered education and a lot would have to be done to make this successful. He supported the idea.

3.3.2 Lecturer Participation

My initial intentions was to involve only the two other biology lecturers of the college but as it turned out these lecturers were not always available when they were needed. One in particular was involved in administrative duties and spent much time in that direction. We were however able to discuss issues on groupwork. The additional lecturer was a lecturer in Afrikaans who witnessed two lectures and offered suggestions and comments. The lecturers had been lecturing at the college for over five years each and were familiar with teaching methods as practised over the years.

3.3.3 Student Participation

Third year biology students of the college were selected to participate and also serve as respondents in the research project (Cohen & Manion 1994). This is because they had gone through two years of subject didactics training and were familiar with the theoretical background to groupwork although they had not practised its use. I also thought that since they were soon to leave the college and enter into teaching the ensuing year, they would immediately benefit from the experience and perhaps practise groupwork strategy in their teaching.

These students had been used to the lecture method of teaching.

Demonstration lessons and microteaching sessions had been for the most part a repetition of the lecture method. Exercises involving groupwork were therefore a challenge to them.

Five of the students, out of a class of 30, were chosen at random to be interviewed.

3.4 GROUP FORMATION

The class was divided into seven groups of four or five members per group. This group formation was initially based on how students were seated at lectures. This meant that members of a group could therefore have been friends or close associates. (Students usually sit with friends at lectures). This, according to Bennett & Dunne (1994), is known as friendship groups. I decided to retain the same group structure for a second time to see whether there would be improvements in the dynamics of the groups.

For the third and consecutive lectures I re-arranged the groups using the order in which their names appeared on the previous groups list. Names, which appeared first in the different groups, were put together, number twos' together, etc. The intention of re-arranging the groups was to mix the class as much as possible and to give them the chance of practising the collaborative idea. According to Hill & Hill (1990), boys choose to work with boys, girls work with other girls, the very articulate sit with other talkers and the quiet, withdrawn children sit alone. The class however had to learn to be cohesive. Cohesiveness is essential for effective collaboration. The students had to learn to be co-operative, to accept others and to learn from others (Hill & Hill 1990).

3.5 DATA COLLECTION

Methods of data collection involved lecturing through groupwork, observation, questionnaires and interviews. The main advantage of using multiple methods is that it allows for triangulation. Cohen & Manion (1994) say that when different methods of data collection yield substantially the same results, the more the researcher will be confident about the findings. Cohen & Manion (1994) cite Boring (1953) as saying that when a construct gets two alternative operational definitions it is beginning to be validated. When the defining operations, because of proven correlations, are many, then it becomes reified.

Although I had planned the project work on ecological studies in such a way that students would do all the work, I went to the field with them. The objective was for me to observe the groups in action and also to intervene whenever possible and to help in the identification of biological specimen etc.

The groups were made to go through techniques, which were intended to support co-operative work. These techniques are discussed below.

3.5.1 GROUPWORK TECHNIQUES AND LECTURES USED TO PROMOTE INTERACTION AMONG GROUPS.

Techniques used in the project included buzz groups, snowball groups and crossover groups. This is because these techniques embody the characteristics of groupwork. These techniques bring small groups together to pool ideas in a framework, which positively encourages people to interact and to be creative or take risks with ideas. However buzz groups, snowball groups and crossover groups may not be, taken as substitutes for the sustained interaction and depth of understanding the co-operative groupwork supports (Cowie & Rudduck 1988).

Buzz Groups: the student groups were asked to spend a few minutes to exchange views about things they do not understand, and how to go about the work they were given. They were then to write down all possible points that occurred to them on the problem at hand (Matiru et al 1995, Johnson & Johnson 1997, Cowie & Rudduck 1988).

Snowball Groups: in this technique, one group was to form a partnership with another group and compare ideas. The quartet then joined another quartet to form an eight. They were to try to arrive at some consensus. This was to be reported back, from each of the eights, and an overall position arrived at through further exploration. Snowballing was to prepare the group members to participate confidently in the final plenary discussion (Cowie & Rudduck 1988). The diagram below may represent the sequence of stages.

Example Task: - To find if there is shared understanding on the project work on aquatic ecology.

Stage 1: 0 + 0	brainstorm, record your ideas in a list.
Stage 2: 00 + 00	share views and select those that all agree would contribute to an understanding of the project.
Stage 3: 0000 + 0000	share lists, identify those that are common to both lists and list them in order of importance. Appoint a spokesperson.
Stage 4: 00000000 + 00000000 + 00000000	plenary session: review reports and discuss areas of agreement or disagreement.

(Diagram adapted from Jaques, 1984, p. 92 cited by Cowie & Rudduck 1988, p. 17).

These stages were meant to keep all students actively involved and to some extent avoid the danger of repetition.

Crossover groups: in this each member of a group was labelled as A, B, C, or D, etc. Therefore there were seven As, seven Bs, seven Cs, seven Ds etc. The A B C groups were to meet to establish their identity and control over the agenda. Groups then were to reform as quartets, A B C D in a group. Then after discussing their findings they were to go back to their base of As, Bs, Cs and Ds. The home-based teams were to review their findings from their interactions with other groups. a plenary session was to be held to consolidate all finds. (Cowie & Rudduck 1988). The diagram below illustrates the stages involved in the crossover groups.

Stage 1

AA	BB	CC	DD	EE	FF	GG
AA	BB	CC	DD	EE	FF	GG

Stage 2

AB	AB	AB	DE	DE	DE	DF
CD	CD	CD	FG	FG	FG	FG

Stage 3

AA	BB	CC	DD	EE	FF	GG
AA	BB	CC	DD	EE	FF	GG

The diagrams below illustrate the lines of communication, which came into play through intra – group interactions.



Lines of communication in groups of four to five students (Bennett & Dunne 1992).

The diagrams also indicate that the larger the group the more complex the lines of communication. While small groups may be effective, increasing the lines of communication may also increase learning potential (Bennett & Dunne 1994).

3.5.2 LECTURES USED FOR THE RESEARCH PROJECT

Lectures that were used for the research project were selected from the college syllabus. This idea was to help in the completion of the students' year programme and for meeting the requirements of the course. These lectures were made up of:

- (a) Project work on an aquatic ecosystem.

This project was over two weeks with actual instructional contact time of about three hours per week. These were times for practical work on the college timetable.

- (b) Experimental work on physiology in the laboratory and,

- (c) **Classification exercises on branching diagrams and construction of a key for classification.**

The instructional contact time for the physiological and classification exercises were three hours each. The physiological exercises took place at the biology laboratory. Students worked in their groups and therefore had contact with each other.

3.5.2.1 EXPECTED CO-OPERATIVE GROUP OUTCOMES FROM THE EXERCISES GIVEN.

The outcomes expected from the exercises groups went through were among others, for group members to develop

- the skill and confidence in communicating.**
- the skill and confidence in social interaction and collaboration,**
- the skill of sharing ideas,**
- the ability to offer and accept criticism**
- how to pool their skills, ideas and experience**
- how to accept compromise**
- how to tolerate each other based on respect for self and others.**
- a sense of responsibility for their own and for the groups work**
- the skill of identifying and using the resources of the group to advance their own learning and understanding**
- the skill of interpreting data and analysing data,**
- the skill of relating opinions to situations and roles, etc.**

(Cowie & Rudduck 1988).

3.5.2.2 PROJECT WORK ON AQUATIC ECOSYSTEM.

Project location: Buffalo river (a fresh water habitat outside the college).

Project duration: two weeks

- Instructions:**
- (i) Work in your groups
 - (ii) Draw a sketch to show the terrain and any special features you may identify,
 - (iii) Identify plant and animal species in and on the banks of the river.
 - (iv) Measure the speed of movement of the stream,
 - (v) Determine the depth of penetration of light using a sechi disk, take readings of temperature and pH of the water.
 - (vi) Describe inter-relations of organisms you identify in the habitat?
 - (vii) What are the indications of human interference and or pollution of the habitat?
 - (viii) Write a report of your studies and submit this for assessment.

Your report should indicate

- (a) general area of interest
- (b) possible title
- (c) aim of study
- (d) expected outcomes
- (e) working strategy; hypothesis
- (f) data collection
- (g) resources & limitations
 - equipment and materials required
 - amount of time spent on the project.
 - skills required
 - problems
- (n) analyses and results.

Note: Items mentioned under writing a report would constitute assessment criteria for the project work.

Project Outcomes:

- students will identify inter-relations in an aquatic ecosystem.
- students can take physical measurements in an aquatic-ecosystem.
- students will learn how to write up projects.

Focus Outcomes:

- use process skills
- understanding concepts and principles
- responsible decision making
- apply scientific knowledge.

Equipment/apparatus:

thermometer

sechi disc

pH indicator

stream flow meter

ropes

storage bottles

planktonic net

FAA solution

formaldehyde solution

vegetation net

herbarium

dissecting instruments

glass beakers (500ml)

3.5.2.3 EXERCISE ON FOOD TESTS

Theme: Life & Living

Knowledge assumed to be in place: food tests.

Problem: You are provided with four test tubes A, B, C & D containing four different solutions respectively. Perform physiological tests to identify the solutions using the reagents supplied. Write out a hypothesis for the work and give an account of the procedure you used including a data table for recording your observations and conclusions.

Your work will be collected after the practical period.

Students submitted their work after 1 hour.

- Outcomes:**
- **Students can design their own experiment to identify food substances.**
 - **Students can observe colour changes involved in the identification of food substances through the use of specific chemicals/reagents for food tests.**

Focus Specific Outcomes:

- **Use process skills**
- **Understanding concepts**
- **Responsible decision making**
- **Apply scientific knowledge**

Assessment Criteria:

- Ability to write correctly a statement of hypothesis
- Ability to plan experimental works in sequential manner
- Ability to record observations accurately in a data table
- Ability to report correctly on experiment
- Ability to form a conclusion from the experiment

Equipment/Apparatus, chemicals and materials:

- Glass beakers (250ml), measuring cylinders (25ml), test-tubes, food samples, 1% starch solution, 10% glucose solution, 10% albumen, Biuret reagent, iodine solution, Benedicts solution, bunsen burner, tripod, gauze, test tube holder.

3.5.2.4 EXERCISE ON CLASSIFICATION

Theme: Life and Living

Topic: Construction of a branching diagram for the separation of leaves.

Problem: You have been given a set of leaves – grass, orange, pawpaw, rose, pea and cassia.

Construct: (i) a branching diagram and
 (ii) a key to separate/identify the leaves using observable

characteristics. Use correct biological terminology in your work.

Expected Outcomes:

- **students will construct a branching diagram and a key for the separation of organisms**
- **learn to use biological terminology to describe observable characteristics of organisms**
- **learn to present work systematically.**

Focus Outcomes:

- **use process skills**
- **understand concepts**
- **responsible decision making**
- **apply scientific knowledge**

Assessment Criteria:

- **construction of branching diagram**
- **construction of key for separation**
- **use of observable characteristics**
- **systematic presentation of work**
- **names/identification of leaf type.**

3.5.3 QUESTIONNAIRES TO STUDENTS

I administered questionnaires to students soon after exercises involving groupwork. The questionnaires contained both open-ended and closed-ended questions. The closed-ended questions contained only dichotomous items with only 'yes' or 'no' (Cohen & Manion 1994).

This method of questioning was chosen to ensure some uniformity in the responses students would give. The students' responses also allow easy coding. The open-ended questions were to find out more about what students knew about groupwork and to allow them free expression and comment, and perhaps for them to throw light on the problems or usefulness of groupwork. According to Cohen & Manion (1996), open-ended questions may elicit at times unexpected or unanticipated answers, which may suggest hitherto, unthought of relationships or hypothesis.

I did not write any introductory letter or notes to the students. I however explained to them the reasons behind my request. They agreed to help.

I trial tested the questions and later modified them after discussions with my supervisors.

3.5.4 STUDENT INTERVIEWS

Interviews are important in revealing important insights into a situation and can help one identify other relevant sources of evidence. It is however true that because interviews represent verbal reports they may be subject to bias, poor or inaccurate recall and poor articulation (Cohen & Manion 1994).

My interviews with the students particularly showed these features, as their expressions were not very good. I noticed they could not clearly say what they wanted to say and their explanations might have been wrongly given. The interviews were to find out from them their impressions about groupwork and suggestions they could make towards improvement.

Five students were interviewed and the interviews taped. Transcripts were later made.

Semi-structured interview method was used because I considered this flexible and an adaptable way of finding things out. This allowed for change in questioning and the addition of new questions when necessary. (Cohen & Manion 1994). I did not face any difficulties in gaining the confidence of the interviewees, as they were my own students. Some were nervous initially but this was soon overcome.

3.5.5 LECTURER PARTICIPATION

I invited two lecturers to observe my lectures. One lecturer was available for two lectures but the other one was able to observe only one lecture. I gave each lecturer prepared observation forms to use. I had discussed with them what the whole thing was about. I interviewed these lecturers to find out more about what they knew about groupwork and to make suggestions for the improvement of such methods. I used mostly open-ended questions to allow them free expression of views.

The advantages of open-ended questions are given above. Since the lecturers were more mature than the students I also expected them to be more critical.

The use of interviews was to allow me to check the accuracy of my impressions on groupwork.

CHAPTER 4

ANALYSIS OF DATA

The interviews, questionnaires and observation forms were analyzed to determine how effective and useful were the group exercises respondents went through and to find out their criticisms and suggestions on the strategies used.

4.1 INTERVIEWS WITH STUDENTS

The interviews were transcribed and issues raised by the interviewees compared to the characteristics of ineffective and effective groups as suggested by Johnson and Johnson (1997). Since the interviews with the students followed a semi-structured approach, the responses which emerged were less organized than would have been the case with a tightly structured interview approach (Cohen & Manion 1994). The report, which follows is therefore an attempt to organize the salient points which appeared from the responses to the various questions.

1. **Question:** Did you have any knowledge of groupwork before it was introduced in your class?

 Response: All five interviewees replied in the affirmative but they were not involved in the actual activity involving groupwork.

2. **Question:** Did you share ideas together in the group?

 Response: The interviewees said they shared ideas from the discussions they had initially however, since they did not understand how to operate in groups, it was not always that this was done.

3. **Question:** Did you plan how to go about your work in the group?

 Response: Interviewees said they initially did not. Their understanding was to do everything together and not divide work. However they later saw that it was necessary to plan their work if it was to be smooth.

4. **Question:** Did you distribute responsibilities in the group?
- Response:** This was limited to the group leader and the secretary although they all took part in the group's activities.
5. **Question:** Did you work together through all stages of the work?
- Response:** This was not possible all the time. This is because some of the group members did not always take part. There were occasions when one person did all the work.
6. **Question:** Did you experience any problems in your group?
- Response:** Problems included non-participation by some. Others would turn up late at group meetings or would not appear at all. Some argued far too much. Some people did all the work. There were a few quarrels.
7. **Question:** What was the role of the group leader?
- Response:** The group leader organized the group and often wrote the report. Some group leaders dominated the group.
8. **Question:** Did you write a joint report for your projects?
- Response:** Although some groups did this, in other groups, the dominant member of the group wrote the report.
9. **Question:** Did you discuss your report together?
- Response:** While some groups did this – not all the groups discussed the report. The one who wrote the report submitted it to the lecturer.
10. **Question:** What do you consider as advantages from your group?
- Response:** Answers given included shared ideas, learned to co-operate and work with other people, the chance to express ones self and opinions. Some felt their members helped them to understand issues.
11. **Question:** What suggestions do you have for the improvement of groupwork?
- Response:** Suggestions given were mostly points mentioned. These included the fact that groups must be democratic and share ideas: groups must work together.

4.2 STUDENT RESPONSES ON THE DYNAMICS OF GROUPWORK USING QUESTIONNAIRES. [CLOSED QUESTIONS]

- 1. Question: Did you plan your work together?**
Response: Yes: 17 No: 1
- 2. Question: Did you select a leader for your group?**
Response: Yes: 13 No: 5
- 3. Question: Did you appoint a Secretary (scribe?)**
Response: Yes: 16 No: 2
- 4. Question: Did you take on different responsibilities in your group?**
Response: Yes: 13 No: 5
- 5. Question: Did you work together through all stages of the work?**
Response: Yes: 8 No: 10
- 6. Question: Was there a non-participant?**
Response: Yes: 7 No: 11
- 7. Question: Did one of you try to dominate the group?**
Response: Yes: 2 No: 16
- 8. Question: Did you write a joint report?**
Response: Yes: 17 No: 1
- 9. Question: Did you discuss your report as a group?**
Response: Yes: 17 No: 1
- 10. Question: Did you read through the report together before submission?**
Response: Yes: 14 No: 4

Students' responses to the closed questions of the questionnaire may be represented in a table as follows:

QUESTION	RESPONSES		%		COMMENT
	YES	NO	YES	NO	
1	17	1	94	6	Effective
2	13	5	72	28	Effective
3	16	2	89	11	Effective
4	13	5	72	28	Effective
5	8	10	44	56	Groups divided +ve / -ve
6	7	11	39	61	Strong Group Awareness of responsibilities
7	2	16	11	89	"
8	17	1	94	6	"
9	17	1	94	6	"
10	14	4	78	22	"

4.3 STUDENTS RESPONSES ON THE DYNAMICS OF GROUPWORK: OPEN QUESTIONS OF THE QUESTIONNAIRE

11. **Question:** Is groupwork advantageous to only clever people?

Response: Majority of students felt that groupwork can be disadvantageous to 'clever' people when they have slow learners in the group. Such people tended to be bored and frustrated. Others also felt that if groups are not structured properly and work not evenly distributed it could be disadvantageous to all –both 'slow' and 'quick' learners.

12. **Question:** A group leader must be responsible for writing the group report.

Response: Almost all the respondents said there must be an even distribution, of responsibilities in the group and that the secretary or scribe should do the actual writing of the group report. A group leader is only an organizer and not responsible for everything.

13. **Question:** Would you describe your group as democratic?

Response: Respondents said their groups were democratic. They shared ideas together; they were free to discuss issues and they arrived at decisions together. Responsibilities were shared.

14. **Question:** Did you use your mother tongue during the discussions?

Response: Respondents said it was easy to have their discussions in their mother tongue. This helped them to understand issues and for free expression.

15. **Question:** Would you agree with the statement that groupwork promotes higher achievement than individualistic and competitive learning?
- Response:** Respondents said that groupwork was beneficial to them in that the group corrected their individual mistakes. They learned more from members, they supported together weaker members.
16. **Question:** Did you enjoy working in a group?
- Response:** Some respondents said they were happy in their groups. The relaxed atmosphere contributed to their learning. There was free communication and smooth interaction among members. They came to know each other well. It was a joy to know that you belonged to a group. Others respondents found their groups too noisy; members were less co-operative and argumentative and there were some disagreements among members.
17. **Question:** Is groupwork time consuming?
- Response:** Respondents felt whether groupwork was time consuming or not depended on the group. If the group was well-organized responsibilities evenly shared and all members of the group actively involved, groupwork would not occupy too much time.
- Some said groupwork was time consuming through quarrels among members; less participation and non-co-operation from certain members of the group. Laziness and slowness of members could waste a lot of time. Time could also be wasted if members could not agree on time schedules.
18. **Question:** Do you think groups must be made up of friends only in class?
- Response:** Some respondent said friends work better because they know themselves and understand each other better. Others felt friends could talk about unnecessary things – things which do not contribute to the progress of the group. It was necessary for groups to be properly formed – an even mixture of people; people with new and different ideas. Groups should therefore be changed from time to time.
- One respondent asked ‘what happens if you do not have a friend in class? Does it mean you cannot belong to any group?’
19. **Question:** Do you think leadership must be rotated in the group?
- Response:** Rotation of leadership is important to give everyone the chance to be exposed to the responsibilities of a leader. Rotation should help in developing the skills of various positions in a group. This would help each person to develop his capabilities; to develop experience of how to manage people; to make a person responsible and to develop confidence.

20. **Question:** Indicate below any advantage or disadvantage you may have on groupwork, which is not covered.
- Response:** Respondents said that lack of materials or information may hinder groupwork; Other comments were that groupwork develops critical thinking, that groups helps to motivate people and that being in a group helps one to know how to settle conflicts between people.

4.4 OBSERVATION OF STAFF MEMBER: CLOSED QUESTIONS

1. **Question:** Are all members of the groups working actively?
- Response:** Yes
2. **Question:** Is there an indication that one member wants to dominate others?
- Response:** No.
3. **Question:** Is there an indication of active discussions going on in groups?
- Response:** Yes.
4. **Question:** Do groups appear to have leaders?
- Response:** Yes
5. **Question:** Do groups have scribes?
- Response:** Yes
6. **Question:** Are group members using their mother tongue in their discussions?
- Response:** Yes.
7. **Question:** Do students appear to be enjoying their work?
- Response:** Yes.
8. **Question:** Do you notice any non-participant or daydreamers?
- Response:** Yes.
9. **Question:** Are all members of groups taking down notes?
- Response:** No (Only some)
10. **Question:** Did groups initiate own activity?

- Response:** This was not clearly noticed but the students were busy collecting apparatus and performing experiments.
11. **Question:** Did the class have a plenary discussion to start the lesson?
- Response:** This was not clearly evident.
12. **Question:** What was the group size?
- Response:** 4 – 5 members.
13. **Question:** Did groups negotiate roles for their members?
- Response:** No.
14. **Question:** Did the teacher allow free discussions?
- Response:** Yes.
15. **Question:** Was there inter-group discussions?
- Response:** Yes – definitely.
16. **Question:** Was class disorganized?
- Response:** No.
17. **Question:** Was there teacher participation in the groups' work? (to explain issues?)
- Response:** Yes.
18. **Question:** Do you consider the class a success?
- Response:** Yes.
19. **Question:** Any other comments.
- Comment:** I thought the lesson was huge success in terms of self exploring co-operation between all involved, and independent study. The lecturer was fully involved in explaining concepts, offering advice and moving around all the time.
- Group discussions were going on all the time and these discussions did not intrude upon other groups discussions i.e. the group discussions went orderly and did not disturb other groups.

4.5 INTERPRETATION AND INFERENCES

According to Hitchcock & Hughes (1994) analysis of data involves discovering and deriving patterns in the data, looking for general orientations in the data and in short, trying to sort out what the data are about, why and what kinds of things might be said about them.

What follows is an interpretation of the interviews, questionnaires and observations; involving a reconstruction of the inherent significance structures to look for overall coherence and meaning of the data collected. (Cohen & Manion 1994).

4.5.1 INTERVIEWS

4.5.1.1 INEFFECTIVE GROUP DYNAMICS IDENTIFIED

Responses from the interviewees indicated a number of dynamics that did not contribute to effective groupwork. The interviewees reported that some members of groups did not participate fully. Some members were often late to group discussions and others did not simply turn up for discussions or other forms of groupwork. Non-participants also showed little or no interest in their groups activities. Discussions turned into arguments and there were instances when arguments turned into quarrels. These were examples of personality clashes. There were groups which were dominated by individuals who wanted to do everything, who were the loudest and who wrote and submitted reports on their own. It was also evident that in one mixed group of men and women, no woman was allowed to be a leader or a secretary.

In other groups no roles were assigned to members; there were no discussions of reports and individuals submitted reports. One interesting dynamic was the fact that students did not want to report non-participants to me, but rather shielded them. This is because according to them, they wanted to 'be fair' to all.

4.5.1.2 EFFECTIVE GROUP DYNAMICS IDENTIFIED

The effective group dynamics which were mentioned by interviewees are the fact that there were discussions and exchange of ideas on knowledge and how to go about investigations. Some groups wrote and presented joint reports after discussions. Other groups planned their work and assigned roles to their members. These roles were mainly that of group leaders and secretaries. Some interviewees were happy with their groups. This is because there was co-operation among their members and some helped others with explanations and so on. Some learned to tolerate and listen to their members. In cases where there were disagreements, they were able to resolve issues amicably. This confirmed the mature nature of the students. Groupwork also helped some to learn to assess themselves and their peers.

4.5.1.3 RESPONSES TO CLOSED QUESTIONS

Student responses indicated that factors needed for co-operative learning to work best were to some extent present in almost all groups. There were however other dynamics which had negative effects on teamwork. Some groups said that planned their work, selected leaders, appointed secretaries and took on different responsibilities. They also said they worked together through all stages of their work. They discussed issues together, wrote a joint report and read through such report together before submission.

Group dynamics as mentioned above indicated positive interdependence, face to face interactions, individual accountability and group processing of information. These factors identify an effective group. The extent to which these dynamics affected the groups was not clearly evident. The questions did not allow comments from the students.

Dynamics, which did not contribute to effective groupwork, include the failure of some groups to plan their work. Such groups did not appoint leaders, secretaries and did not distribute responsibility among themselves. Some members of groups were simply not co-operative. Some individuals were dominant, wrote the group report alone and submitted such reports. There was no joint processing and no joint participation.

4.6 RESULTS OF STUDENT REPOSES TO OPEN QUESTIONS OF THE QUESTIONNAIRE

4.6.1 DYNAMICS OF INEFFECTIVE GROUPS IDENTIFIED.

Responses on the questionnaires confirmed those that were given in the interviews, with a few additions. Respondents indicated that undisciplined members hindered their work. Some of the people engaged in unnecessary debate and argument, leading to disagreements and a waste of time. Some groups indicated that some of their members were lazy and slow in their work. The non-participants dodged group discussions and did not even apologize for their absence.

Respondents said that groups should not always be made up of friends. This is because friends tended to talk about unnecessary things and chatted most of the time thus causing delays. They said lack of suitable apparatus also retarded group progress.

4.6.2 DYNAMICS OF EFFECTIVE GROUPS IDENTIFIED

Respondents said that groups made up of an 'even mixture' of individuals e.g. 'slow' and 'quick' thinkers, 'achievers' and 'non-achievers', performed better. This is because the quick thinkers and achievers tended to help weaker colleagues and helped in discussions and researched on issues. Groups learned to plan their work and assigned roles. They discussed their work together and presented joint reports. Some of the groups enjoyed "democratic relations" and worked in a relaxed atmosphere. When disagreements developed they were able to settle such conflicts peacefully; they learned to tolerate each other. Group members who made mistakes in their learning or reports were also corrected.

Respondents suggested that there must be role rotation among group members to help members develop different group skills and learn to be responsible.

Respondents also said that through groupwork they were able to know each other better.

4.6.3 RESULT OF LECTURER OBSERVATION ON GROUP ACTIVITY

From his observation, the lecturer said that he noticed members of groups working actively, and having discussions. Discussions were among members of the same group and between groups. He noticed there were individuals acting like group leaders because such people seemed to be leading discussions. There were other people taking down notes and who appeared to be scribes of the groups. There was also indication of non-participation from some students. Group size was 4 – 5 and there was indication of an organized class.

The lecturer allowed the groups to have free discussions. The lecturer moved from group to group to offer explanations and advice. Although there was no indication as to whether the class had a plenary session or not, the observer thought the class “was a huge success in terms of student self exploring activity, co-operation between all involved and the attention students paid to their work”.

4.7 DISCUSSION

There is some validity in the methods used in the collection of data. This is because responses to questions put during interviews and on questionnaires and comments from observations by the lecturer seem to give the same results. (Cohen & Manion 1996).

Effective group dynamics, which were identified, included, two-way communication between lecturer and students and between student and student and, participation by all. Decision making processes involved all. The teacher encouraged discussions. Group behaviour was stressed, and there was an indication of problem-solving ability (Johnson & Johnson 1997).

In-effective group dynamics as described by Johnson & Johnson (1997) were also identified. In some groups, members accepted goals imposed on them by individuals who appointed themselves as leaders. Interviewee number five was happy to be a group leader most of the time (Appendix 8.7). As a group leader he said he had to monitor the progress of the group. He 'collected the group together' told other members what to do. He made decisions for the group and in fact it seems he even intimidated the others (Appendix 4.6 – 4.7, 8.6 – 8.7). This is an example of individuals who dominate others in a group. In such a situation communication is one-way, only ideas are expressed and individual feelings suppressed (Johnson & Johnson 1997). In other groups, distribution of responsibilities was limited to the appointment of a leader and a secretary (Appendix 5.11). Other ineffective group dynamic was non-participation by some members – some had no inputs to give (Appendix 5.13) others did no honour group appointments (Appendix 6.3).

An interesting dynamic, which emerged, was the fact that students shielded these non-participants because they did not want to be unfair to them (Appendix 6.9). Students understanding of groupwork were limited to a literal meaning of the concept – they wanted ‘to do the same thing together and at the same time’. Distribution of work was in one case limited to each member of the group ‘reading different parts of a book’ or collecting plants together (Appendixes 5.10, 6.4, 7.6). There were instances when students quarreled about issues (Appendix 6.12). Johnson & Johnson (1997) said that ‘healthy’ controversy and conflict are seen as a positive key to members’ involvement, and continuance of the group in good working condition. The quarrel described under appendix 6.12 is an indication of incompatibility of the members. Such quarrels originated because there were ‘people who always think that what they think is always right, they do not want to be corrected’. It is interesting to note that students were able to settle such quarrels and to even advise the ‘offender’ (Appendixes 6.3, 8.20). There were some students who preferred to work alone because groupwork was a waste of time, because not every member of the group is responsible and at times it takes too long for the group to complete a topic (Appendix 6.19).

The semi-structured nature of the interviews allowed me the flexibility to follow a particular line of interviewing without losing sight of the objectives of the exercise. The responses revealed information, which was not on the interview schedule; e.g., it was revealed that group members tended to shield non-participants. Such non-participant was assessed on the same basis as those who did the work (Appendix 6.8–6.10). The interviews also indicated lecturer participation and intervention when necessary (Appendix –6.26).

Self and peer assessment by individuals and members of the groups also occurred (Appendix 8.5). The development of social skills as an advantage of groupwork was also mentioned (Appendix - 8.17-8.18).

It must be mentioned that I depended on the logical progression of the interview. The duration of the interviews ranged from 15 minutes to about 1 hour depending on the contributions of the interviewees. Some interviewees were initially nervous but I succeeded in establishing rapport with them. It was difficult for me to keep quiet and to wait if an interviewee did not immediately reply after a question. I tended to prompt and at times helped in completing sentences etc.

Student responses were based on the fact that they had had theoretical as well as practical experience of groupwork – both during field work and lecture room activities. Lecturer observation was based on lecture room activity.

The fact that there were disagreements that led to quarrels indicate the complexities involved in the formation of groups. Every individual is unique in a certain way and it is not easy to obtain full co-operation from all on all issues. In this regard, it may be necessary for the teacher to intervene to settle issues and further educate on the merits and merits of groups etc. Perhaps there is validity in the assertion that it is better to allow free choice or friendship groups to controlled formation by the teacher (Rosen & Rosen 1983, cited by Bennett & Dunne 1994). Johnson & Johnson (1997) on the other hand consider controversy and conflict as a key to members' involvement, the quality and originality of

decisions, and the continuance of the group in good working condition. This is in a situation where controversy and conflict do not get out of hand.

It may also be necessary for teachers to plan activities in which everybody will be fully involved. If the cognitive demand is too hard, or above the abilities of students, and students do not have enough background and experience and knowledge to discuss or answer questions, it is likely that the co-operative element will disappear (Bennett & Dunne 1994).

Students' responses on mixed-group formation indicate views, which have been debated overtime. Teachers of the college as well as some people from the community of Zwelitsha and environs, have wondered whether it would not be a waste of time especially for achievers if such people are put in the same group with slow or non achievers. Cohen (1986) as cited by Bennett & Dunne (1994) states that there is no evidence that ability grouping, particularly for those in low ability groups, is effective. Low ability groups have been found to be an enormous drain on their time at the expense of other children. These types of groups showed little skill in encouraging and allowing the group to work together. They find difficulty with interpreting tasks and communicating any understanding purposefully. A low attainment group is a case of the blind leading the blind (Bennett & Dunne 1994). While there may be validity in the fact that low achievers may waste the time of high achievers, the more these achievers lead, 'teach' and explain issues to their colleagues, the more they come to understand and become knowledgeable. Kagen (1988) cited by Bennett & Dune (1994), in his answer to critics of the idea of mixing achievers and non-achievers in the same group, say that "when we look at our students, we forget our own experience and how much teaching itself is a great teacher". High

achievers have been known to show leadership skills, conflict resolution skills and role-taking abilities.

These qualities meet the expected outcomes of Curriculum 2005. High achievers in a mixed group apart from their leadership qualities also help to raise the standard of the group's work considerably. They are skilful in encouraging, questioning and organizing. Teachers must however be careful that the leadership of high achievers in groups does not lead to complete domination of other members.

Domination in mixed groups was due to gender bias. It is common custom among the Xhosa for the man to be the 'complete' head and leader of the family. Interviewee Number Five showed this characteristic most (App.8). He was the leader, the secretary and organizer of the group. He wrote the report on his own and presented it to the class during class discussions. Bennett & Dunne (1994) indicate that much research shows that the gender effect is pronounced in classroom groups, whether or not the grouping is co-operative. Cowie & Rudduck (1988) say that girls may not feel confident enough to contribute, in a teacher's word, 'for fear of the ridicule and hostility of the boys'. This condition is so true to the situation at the college, student men feel superior to women and somehow the women seem to allow this. On the other hand my own experience with my students however has shown me that boys and girls can work effectively together. Johnson & Johnson (1997), Bennett & Dunne (1994) and Cowie & Rudduck (1988) support this assertion. A major consideration on the part of teachers, when forming groups is whether to form single or mixed sex groups. Teachers are encouraged to set mixed groups to eliminate sexual bias; and to treat all students equally. An interesting dynamic, which came out of the

interviews, was that of group support. Johnson & Johnson (1997) consider as characteristics of effective groups, the stressing of dynamics such as high levels of inclusion, affection, acceptance, support and trust. These were identified with the groups. There were occasions however during which group members wrongly supported and shielded non-participants. They did not report colleagues who did not co-operate with the group. The reason was based on the fact that the groups were 'strongly cohesive' and members wanted to treat all fairly. This was dishonesty and perhaps based on local sayings such as "what affects one affects all" and "pass one pass all" etc. The group members had their own methods of correcting deviants. The groups were assessed on the same levels – participants and non-participants equally.

The discussions on group dynamics as indicated above, show the enormity of the problem that would face educators. Galton *et al* (1980) are cited by Bennett & Dunne (1994) as saying that for learners to gain from groupwork, they would need to develop a number of social as well as cognitive skills. They would have to have a degree of tolerance and mutual understanding, the ability to articulate a point of view, to engage in discussion, reasoning probing and questioning. Johnson & Johnson (1985) cited by Bennett & Dunne (1994) add that one of the important internal dynamics of co-operative learning groups may be the opportunity for students with differing achievement histories to interact with one another. Teachers must take notice of these and incorporate them in the training of their class-groups in social skills.

Johnson & Johnson (1997) give the components of an effective group as comprising:

- **high inter-personal effectiveness**
- **understanding, relevance and commitment to goals**
- **communication of ideas and feelings**
- **active participation and distribution of leadership.**
- **flexible use of decision-making procedures**
- **encouragement and constructive management of conflicts**
- **equality of power and influence**
- **high group cohesion and**
- **high problem solving strategies.**

Johnson & Johnson (1997) refer to these dynamics as positive interdependence.

Some aspects of positive interdependence and negative interdependence were highlighted in the research project. What is necessary is our ability to take the negative or inhibitory aspects of groupwork as challenges and to turn them round and, to use such factors to promote co-operative work. Positive factors must be reinforced. There are immense opportunities for the teacher to show how adept he/she is in selecting appropriate teaching techniques to meet every classroom situation.

CHAPTER 5

CONCLUSION

This study focused on the use of groupwork for the teaching of biology. It highlighted the fact that the approach is based on the paradigm of constructivism and post-modernism as underpinning Outcomes Based Education.

It tried to establish the negative and positive dynamics that come into play when groupwork is used as a teaching strategy.

5.1 FINDINGS FROM THE RESEARCH PROJECT

The following findings seemed to emerge from the study.

- that there are dynamics which may be associated with ineffective groups and**
- dynamics associated with effective groups**

Knowledge on group would provide the teacher with opportunities and inhibitors in his/her work. Opportunities because, they would provide the teacher with challenges which he/she would have to overcome; the teachers ability to adapt and vary his methods to ensure the success of his/her lesson. Inhibitors because they would make the teacher aware of the complex nature of groups and the difficulties associated with managing groups; difficulties which would become obstacles to smooth teaching if nothing is done about it.

5.2 LIMITATIONS OF THE RESEARCH PROJECT

The research project was a trial run of the concept – groupwork; a first cycle action research project, which has established the basis for further research on the topic. I hope that it will make teachers aware of the nature of groupwork and

factors, which would have to be taken into consideration in employing groupwork as a teaching strategy.

The research project was limited by a number of factors. These included:

- the short time during which the project was completed,
- the work demands and pressures facing lecturers,
- lack of sufficient background knowledge of respondents,
- the fact that students were familiar with me; this had either positive or negative connotations, their responses may be considered narrow and based on only superficial meaning of groupwork,
- the poor expression of students; even though students may have understood the concept but could not express themselves well;
- commitment on the part of colleagues and students etc. and my own inexperience in research activities.

Factors such as time tabling and lecture period duration, availability of materials and resources such as reference books, lecturer and student attitude and readiness for accepting a change from the transmission mode of teaching and learning to student – centeredness etc., were not mentioned by the respondents.

Perhaps these factors may be basis for further research on the topic.

Surely groupwork as a teaching strategy cannot be a panacea for solving the problems associated with teaching and learning. It is the Constructivist views that the appropriate methods should be used to suit particular topics for teaching (not forgetting that the learner should be at the center of such teaching and learning). Yager (1991) suggests strategies involving the individual student, pairs of students, small groups, whole class (local community) and science community.

What follows is an attempt to offer suggestions for solving problems that were identified with groupwork during the research project.

5.3 SUGGESTED SOLUTIONS TO PROBLEMS IDENTIFIED BY THE RESEARCH.

Problems, which the research project identified, were mostly associated with how to get students involved, and how to ensure the success of groupwork.

The first issue concerns how to plan groupwork and arrange students into groups. Some lecturers at the college and perhaps teachers in some schools, in their attempt to use groupwork in teaching re-arrange desks in lecture/classrooms into fours or fives etc, but continue with the transmission mode of teaching. As the literature suggests, the answer lies in the teacher being aware of the different group strategies at his/her disposal. He or she should study these strategies, plan his/her work well and select the appropriate one(s) to suit the lesson. Malcolm (1997) suggests that it may be necessary for the teacher to design and develop activities to help learners develop skills necessary for working in-groups. Teachers would have to involve learners in developing groupwork and roles to make them partners in the whole process. This would help to develop learner confidence. Teachers would have to chose different activities as alternate to ones that may not be interesting – to make learners interested in groupwork and, they may have to recast tasks, to help learners understand the context in which questions are set. Teachers would have to make material and reference resources available to help learners get the required background knowledge. It may be necessary to provide alternatives to speaking e.g. drawing, collecting items, demonstration, model building to help learners develop the confidence in communicating their ideas.

It is advised that it may be necessary to allow learners to have their discussions in local language and then report in the official language of the institution. It may even be necessary to offer rest periods from time to time to avoid learners being bored or tired especially if class sessions continue over long periods. It may be necessary for the teacher to assign roles associated with particular requirements, to set time limits, to rotate roles among learners etc. to ensure that learners come up with a product and that each person is responsible for a particular job etc.

Cowie & Rudduck (1988) make suggestions on how teachers may solve group problems. They say among others that for teachers to encourage more independent contributions from pupils it may be necessary for teachers to ensure that learners have sufficient face to face contact with each other, as well as with the teacher. Learners may also be encouraged to question each other. To minimize the influence of a dominator or disruptive individual, the teacher must encourage everybody to contribute, roles may be rotated among group members. It may be necessary for the teacher to gradually encourage mixed-group collaboration to overcome deeply rooted gender-based bias in a community where this is prevalent. To determine whether a learner is silent or withdrawn through diffidence or choice, the teacher should ensure as far as possible, that peer-group constraints (i.e. ridicule) are reduced or eliminated. In such cases the teacher may split the class up into smaller groups to give more opportunity for quiet learners to gain access to the discussion or even try role-playing in pairs. In situations where learners find work 'difficult', the teacher should make sure the group has a choice of issues for discussion. To prevent learners from destroying the possibility of learning in groups, Bennett & Dunne (1994) agree with Cowie & Rudduck (1988) that teachers should try to structure tasks so that there are very

clear, definable goals. Care should be taken in establishing the composition of groups. It may even be necessary for the teacher to sit with a disruptive group.

Verdium (1996), suggests a flow chart for overall perspective on co-operative knowledge production suitable for the different phases and levels of the education ladder as follows:

1. **ORGANIZATIONAL PROCESS**

(Initial “greeting to know one another”, establishing focus, forming teams, providing leadership, assessing team process and leadership, planning research projects, and planning the environment).



2. **INFORMATION PROCESSING**

(Identifying information sources, prioritizing and screening sources, establishing task specificity, managing and co-ordinating tasks, training in information processing, and assessing of relevant data).



3. **IMPLEMENTATION - PHASE I**

(Defining an approach, securing materials, and beginning and completing projects).



4. **EVALUATION - PHASE I**

(Process evaluation and production evaluation).



5. **REFINEMENT AND IMPLEMENTATION – PHASE II**

(Process refinement and implementation and product refinement and implementation).



6. EVALUATION – PHASE II

(Summative process evaluation and summative product evaluation).

The suggestions above clearly indicate the complex nature of groupwork. It is therefore necessary for the teacher to re-educate him/herself to learn more about methods of teaching to ensure successful and effective teaching. This re-education can take place in the form of In-Service Training and hence the necessity for teachers to attend such courses. Teachers must develop team teaching techniques and have continuous discussions with colleagues' etc. Paradigms and theories keep changing and the teacher must be aware of these.

Teacher educators should let student teachers practice more of the strategies involving groupwork to help these future teachers know about alternatives to teaching methods that involve learners.

What is the most important is the need for teachers to have an attitude change to be able awaken from 'lethargy' and get involved in attempts to improve the education of the youth in the country. The question each teacher must ask him/herself is how best should teaching be done? How best may learning be achieved?

6. CRITICAL REFLECTIONS

The research project represented a journey – a journey to the unknown, which revealed to me more than what meet the eye. I realised that I was still learning. The topic – groupwork – seemed common place and simple and it was one of the reasons, which I considered in choosing it as a research project. But soon after planning my work, I realised the enormity of the problem. I was determined though, to complete the project, cheered to effort by the fact that I should continue to serve as a model to my children, family, friends and colleagues. The whole project required long nights and several visits to the library.

The literature review on the project taught me about a large number of books, articles, journals etc. the topic – groupwork. I was able to read only a few. The few that I read however taught me a lot about groupwork; types of groups, group dynamics, formation of groups, group teaching methods and so on. Information contained in the books I use in teaching biology didactics at my college, I realized, are so limited and without much detail that I have decided to change them and introduce more educational journals to the college library. Literature review also taught me more about making references and how to use such references to convey a message and in support of arguments. Some of the information on groupwork in the literature was however not related to the topic and objectives of the project and, I had to put them aside. Research in the library taught me how to select appropriate information from reference material.

Keeping a project diary: this was a project on its own and I have to admit that I was not able to keep the diary the way it was meant to be done.

At times I kept information so long in my head that I forgot exactly what to write. I found the project diary however a valuable tool. This is because I recorded my experiences, observations, my reflections, my reactions, my plans on how to proceed with my work etc., in it. I also recorded in the diary the results of my encounters with my students and my colleagues. For example, I noticed and recorded in the diary how one particular student seemed interested in the work but almost always gave a wrong or un-related answer to questions.

I also recorded some of the frustrations I met while undertaking the research project; the pressures from work and the home. The project taught me the importance of keeping a diary. I could always make reference from it.

Participation by others: While it was easy to get the students to take part in the research, that was not the case with my colleagues. I noticed that some colleagues gave promises but never kept them. This could be perhaps, due to my approach or they were not interested or due to reasons I was not aware of. Some were almost flippant in the manner in which questionnaires were handled. They did not read these to understand them. Two colleagues however gave positive criticisms on my presentations and lectures. The college authorities were fully co-operative and allowed me 'free range' in my research efforts. I had a number of discussions with my students. Students were willing to answer questionnaires and to be interviewed. This was an aspect of the work I enjoyed most because I became closer to my students. We were able to talk freely and exchange views. Some even gave suggestions on improvements. This I presume is the social constructivist ideal.

Questionnaires and Interviews: It was not easy to construct questions for the questionnaire and interview sessions. Some of the questions did not elicit the appropriate responses. They were clearly the work of a novice. I wished I had another chance to improve them. I take consolation in the fact that the research was a pilot study – a first cycle action research - and that shortcomings of the project may become the basis of future and further research by any who may want to do so.

Lecturing techniques: techniques that I used in my lecturers did not always go the way they were intended to. Some started well, but later everybody moved somewhere and it was difficult to control the students all the time. For instance, buzz and snowball groups worked well but crossing over presented problems. It was also not possible for me to ‘police’ my students to see if these techniques were being used in my absence. I also noticed that one would have to know ones students well to be able to group them fairly well. This would stop quarrels, misunderstanding and non-participation among groups.

Discussions with supervisors: this was an invaluable aspect of the project. Suggestions given, corrections made on my writing etc. went a long way in putting me on the right tract. It was almost difficult for me to clearly connect my findings with the literature and data. I was lead to know how to write up a research report. I am indebted to them.

The whole project has been an eye opener to me. At the beginning of the MEd course, my course mates and I were made to write our expected outcomes of the course.

I wrote as part of my expectations:

- **to gain more knowledge about approaches in learning and teaching science,**
- **sharing knowledge with colleagues,**
- **imparting knowledge and experience to other teachers and**
- **being better prepared to lecture.**

I see that this research experience has brought me closer to the realization of these expectations and if other people should find the project useful, then I would be grateful.

7. REFERENCES

- (1) Adams D., & Hamm M. (1996). Co-operative learning: - Critical thinking and Collaboration across the curriculum. (2nd ed.). Springfield: Charles C Thomas.
- (2) Bennett N., and Dunne, J. (1994). Managing Classroom groups. Cheltenham: Stanley Thornes.
- (3) Brandt C. and Dresselhaus F. (1997). Action research as a spiral of transformation in teacher education. Teacher Education towards 2000 pp. 265-278.
- (4) Bishop S., and Carpenter J., (1993). Constructivism: an introduction and critique: Spectrum. 25(2), 147-158.
- (5) Cohen, L. and Manion, L. (1994). Research methods in education (4th ed.) London: Routledge.
- (6) Cowie H., and Rudduck J., (1988). Co-operative groupwork: an overview. University of Sheffield: BP Educational Service.
- (7) Cowie H., and Rudduck J., (1991). Co-operative groupwork training guide. University of Sheffield: BP Educational Service.
- (8) Doll Jr. W. E., (1989). Foundations for a post-modern curriculum. J Curriculum Studies. Vol. 21(3), 243 – 253.
- (9) Doll, Jr. W.E. (1993). A post-modern perspective on curriculum. Teachers College, Columbia University, New York: Teachers College Press.
- (10) Driver R., & Bell B., (1986). Students' thinking and the learning of science: a constructivist view. School Science Review.
- (11) Etchberger M.L. and Shaw K.L. (1992). Teacher change as a progression of transitional images: a chronology of a developing constructivist teacher. School Science and Mathematics. 92(8), 411-417.
- (12) Gergen K. J. (1985). The social constructionist movement in modern psychology. American Psychologist. P.p. 266-274.
- (13) Hill S., & Hill T., (1990). The Collaborative classroom. Portsmouth : Heinemann
- (14) Hitchcock G., & Hughes D., (1994). Research and the Teacher. A qualitative introduction to school-based research.
- (15) Johnson D.W., & Johnson F. P. (1997). Joining together group theory & group Skills. 6th ed). New York: Allyn & Bacon.
- (16) Malcom C. (1997). Making groups work. Discussion document, RADMASTE Centre, WITS University, Johannesburg.

- (17) Matiru M., Mwangi A., and Schlette R. (Eds) (1995). Teach your best: A handbook for university Lecturers. Bonn: German Foundation for International Development.
- (18) South Africa (Republic). Department of Education (1997). Curriculum 2005. Pretoria.
- (19) Swafford J., (1995). I wish all my groups were like this one. Facilitating peer interaction during groupwork. Journal of Reading 38:8.
- (20) Verdium, Jr J.R. (1996): Helping students develop investigative, problem solving and thinking skills in a cooperative setting. A handbook for Teachers, Administrators & Curriculum Workers . Springfield: Charles C. Thomas.
- (21) Wilmot D., and Euvrand G. (1998). Cooperative learning. Rhodes University: Education Department.
- (22) Yager R. E., (1991). The Constructivist learning model. Towards real reform in science education. The Science Teacher. 58 (52-57).

APPENDIX I

THE INTERVIEW SCHEDULE

1. What did you know about groupwork before it was introduced to you?
2. Did you share ideas together in the group?
3. Did you plan how to go about your work in the group?
4. Did you distribute responsibilities in the group? (Did you appoint a leader, a secretary etc?)
5. Did you work together through all stages of the work?
6. Did you experience any problems in your group?
7. What was the role of the group leader?
8. What part did you play in your group?
9. Did you write a joint report – for your projects?
10. Did you discuss your report together?
11. Did you ask each other question?
12. Did any one person do most of the talking?
13. What do you consider as advantages from your group?
14. What suggestions did you have for the improvement of groupwork?

GROUPWORK OBSERVATION SCHEDULE

Select either option Yes or No to the following questions on the groupwork you are observing by circling your option.

<u>ITEM</u>	<u>OPTIONS</u>	
1. Are all members of the groups working actively?	Yes	No
2. Is there an indication that one member wants to dominate others?	Yes	No
3. Is there an indication of active discussions going on in groups?	Yes	No
4. Do groups appear to have leaders?	Yes	No
5. Do groups have scribes?	Yes	No
6. Are groups members using their mother tongue?	Yes	No
7. Do students appear to be enjoying their work?	Yes	No
8. Do you notice any non-participant or daydreamers.	Yes	No
9. Are all members of groups taking down notes?	Yes	No.

Kindly answer the following questions with either YES or NO or give comments on any issue you may feel important.

10. Did groups initiate own activity?.....
.....
11. Did the class have a plenary discussion to start lesson?
12. What was the group size?.....
13. Did the teacher allow free discussions?.....

14. Was there inter-group discussions/activity.....
15. Was class disorganized?.....
16. Was there teacher intervention in the groups work?.....
17. Do you consider the class a success.....
18. Any other comments.....
.....

APPENDIX 3

QUESTIONNAIRE ON GROUPWORK - STUDENTS

You may accept or reject the questions which follow on groupwork by putting a circle around either option.

Example:

Are all of you wearing the same dress:	Yes	No
Selected option.	Yes	<input type="checkbox"/> No

<u>ITEM</u>	<u>OPTIONS</u>	
1. Did you plan your work together?	Yes	No
2. Did you select a leader for your group?	Yes	No
3. Did you appoint a secretary (Scribe)?	Yes	No
4. Did you take on different responsibilities in your group?	Yes	No
5. Did you work together through all stages of the work?	Yes	No
6. Was there a non-participant?	Yes	No
7. Did one of you try to dominate the rest of you?	Yes	No
8. Did you write a joint report?	Yes	No
9. Did you discuss your report together?	Yes	No
10. Did you read through the report together before submission?	Yes	No

Give a reason for your answer in the following.

11. Groupwork is disadvantageous to only clever people.	Yes	No
Reason?		

.....

12. **A group leader must be responsible for writing the group report.**

Yes No

Reason?

.....
.....

13. **Would you describe your group as democratic?**

Yes No

Reason?

.....
.....

14. **Did you use your mother tongue during your discussions?**

Yes No

Reason?

.....
.....

15. **Would you agree with the statement that group work promotes higher achievement than individualistic and competitive learning. Reason?**

Yes No.

.....
.....

16. **Did you enjoy working in a group?**

Yes No

Reason?

.....
.....

17. **Is groupwork time consuming?**

Yes No

Reason?

.....

18. Do you think groups must be made up of friends only in a class? Yes No
Reason?

.....
.....

19. Do you think leadership must be rotated in the group? Yes No
Reason?

.....
.....
.....

20. Indicate below any advantage or disadvantage you may have on group work which is not covered above.

.....
.....
.....
.....
.....

APPENDIX 4

FIRST INTERVIEW

TRANSCRIPT	NOTES
<p>4.1 Q. Good morning. I. Good morning Sir.</p>	<p>Salutation and attempt at establishing a relaxed Atmosphere (+ve)</p>
<p>4.2 Q. I want to ask you a few questions about group work. I would therefore suggest that you relax, take this exercise as a conversation and be open about your ideas as much as possible. I. Thank you Sir.</p>	<p>Chuckle</p>
<p>4.3 Q. No tell me, what did you know about group work before I introduced to you. I. Group work is very important in the sense that when the people are mixed and sharing ideas, some of them must gain knowledge from the others so that this why group work is very important.</p>	<p>Wrong answer but indication of shared knowledge and information . Group Interdependence (+ve)</p>
<p>4.4 Q. Oh, so you shared ideas in your group? I. Yes, we shared ideas. We help each other.</p>	<p>Group interdependence (+ve)</p>
<p>4.5 Q. Did you work together through all stages of the work? I. Yes, in the class when we discussed with the other people you gained much information from others because some of us read the std 10 book the others read the biology advanced and the information from the people differ in the sense that some are know not better than the others but some are getting some knowledge in the advanced or in the library.</p>	<p>Working together, sharing information through discussions (+ve)</p>

4.6 Q. Did you experience any problems in your group?

I. In the first group I come with a problem because one member of the group is dominant. What I am saying like the others he not accept all the time and because of that we fail in the project of the Buffalo river. He did not write all the points down so it is a problem in the group but is is not a problem in my new group.

Danger of individual dominance- controversy and conflict – as a positive key to members involvement.

4.7 Q. What was the role of the group leader?

I. The group leader did everything himself but the group members are together to writing a report so he said he was completed this report on his own.

Individual dominance-over participant (-ve) as a source of conflict and controversy members willing to be involved – +ve sign.

4.8 Q. Did you write a joint report for your projects?

I. Yes we write it. In the group work every person must have a job to do; like if you dealing with digestion, the others must dealing with another part of digestion say characteristics of alimentary canal – so that when you meet again for reporting or writing down the report people must talk whatever you read – O.K. So that you share ideas but all the people must read the topic so that you write a joint report.

Distribution of work-members participation (+ve)

debate, discussions - consensus - members involvement (+ve)

4.9 Q. Did you discuss your report together?

I. No at times and Yes at times. In the first group the group leader write the report, in the second group we discussed it.

dominance, over participation (-ve)
Group participation.

4.10 Q. What do you consider as advantages from group work.

I. Group work is useful because if you read individually, some things you don't get right but but are not right. You also understand people. Some people are short tempered, others are short

knowledge and understanding of people – tolerance and Respect for individual opinion (+ve attitude).

TRANSCRIPT

NOTES

tempered, other are not. You share ideas so that you read the people to know them.

4.11 Q. What suggestions do you have for group work?

I. In group work everybody must take part, people must not be lazy. People must not fight and so on.

4.12 Q. Well thank you for your time and co-operation.

I. Thank you, Sir.

SECOND INTERVIEW

APPENDIX 5

TRANSCRIPT

NOTES

5.1	Q. Siphho, Good morning!	Salutation and establishment of rapport – intentions established.
	I. Good morning, Sir!	
5.2	Q. Siphho, I called you here to ask you a few questions on group work for my research and would like you to relax and discuss issues freely with me.	
	I. Alright Sir.	
5.3	Q. Before I introduced group work to your class did you have any ideas about the topic?	Prior knowledge about group work
	I. Yes, I just have a little but of idea about it.	
5.4	Q. How? Where did you get the information from.	
	I. From my previous experience.	
5.5	Q. In class?	
	I. Yes.	
5.6	Q. Did you learn about group work at education lectures?	
	I. No, not as that much.	
5.7	Q. I see, You have never used it as a strategy for learning and teaching?	
	I. No Sir.	
5.8	Q. Did you share ideas together in the group?	Sharing of ideas and knowledge (+ve)
	I. We shared a lot of ideas and I gained some more input on what they say, so I can say on the outset that group work has brought success to me.	
5.9	Q. Did you plan how to go about your work in the	No initial planning, but

TRANSCRIPT	NOTES
<p>group?</p>	
<p>I. We did not plan as such but we have group leader. We all worked on the problem.</p>	
<p>5.10 Q. You mean you did not plan how to go through the work at all?</p>	
<p>I. We planned it Sir, We ask different people to do different things like say, we read different parts of a book or we collect different plants, in a group everybody must have a job to do.</p>	<p>planning involving distribution of work in the group – group participation (+ve).</p>
<p>5.11 Q. Did you appoint a leader in the group – did you distribute work?</p>	
<p>I. Yes as I said before, in the group we distribute the work and we gave people work to do. We gave people work to do. We appoint a group leader, we appoint a secretary.</p>	<p>Shared responsibility (+ve).</p>
<p>5.12 Q. Did you work together through all stages of the work?</p>	
<p>I. We met to discuss our work. Some do one part and the other another, then we meet to discuss and brainstorm then the leader write the report.</p>	<p>Group discussion and debate. Misplaced responsibility.</p>
<p>5.13 Q. Did you experience any problems in your group?</p>	
<p>I. Somewhere, some how, I do have some problems Sir. It is like some of the other students they have no input. It is like they just are passing in the group. So the work was done with particular people.</p>	<p>Non-participation - passive uninvolved (-ve)</p>
<p>5.14 Q. What did you do to solve such problems.</p>	
<p>I. We speak to members to do their work. It must Not be some body's job.</p>	<p>Positive attitudes, group Responsibility. (+ve).</p>

TRANSCRIPT	NOTES
<p>5.15 Q. Did you have free discussions? Were there no disagreements and so on?</p> <p>I. It is like sometimes we usually have discussions which is not easy – have a solution so that we can argue about certain topics.</p>	<p>discussions debate – positive involvement.</p>
<p>5.16 Q. What was the role of the group leader?</p> <p>I. As a group leader I guide the group – the group leader must not be autocratic, he must be democratic so that he can allow other people involved in the group so as to bring input</p>	<p>democratic approach shared responsibility and participation.</p>
<p>5.17 Q. Did you write a joint report for your projects?</p> <p>I. We met to discuss and the group leader wrote the report.</p>	<p>mis-directed Responsibility.</p>
<p>5.18 Q. What do you consider as advantages from your group?</p> <p>I.</p>	
<p>5.19 Q. In what way do you think your experience is going to help you?</p> <p>I. Its gonna be useful to me Sir; because I am one of the students which are not outspoken that much inside the class but as the group work goes by we use to know each other then I can become like</p>	<p>participation by shy, soft spoken introverts, knowledge, tolerance of other people – (+ve)</p>
<p>5.20 Q. You can express yourself and speak freely?</p> <p>I. Yes.</p>	<p>Opportunity to express oneself (+ve)</p>

TRANSCRIPT

NOTES

5.21 Q. Would you like to use group work in your teaching?

I. Group work is learner centered and it will help me teach my students.

Positive - future orientation.

5.22 Q. Thank you so much for your time.

I. Thank you Sir, I enjoyed the conversation.

THIRD INTERVIEW

APPENDIX 6

TRANSCRIPT

NOTES

6.1. Q. Good day

I. Good day Sir.

6.2 Q. I have called you here to ask you a few questions on group work. This is for my research so I want you to relax and feel free to answer the questions or express yourself as you can.

I. Alright Sir.

6.3 Q. Kindly speak up so that I can record our conversation.

I. Alright, Sir.

6.4 Q. O.K. Before I introduced group work in your class did you know anything about group work as a teaching strategy?

I. I only know that group work, in group work its where you work in groups; we discussed the ideas on a problem then we try to come to the solution.

6.5 Q. I see, did you practice group work before we did this in class?

I. Yes we tried it first year.

6.6 Q. I see. Did you find group work useful?

I. It is useful sir when all the members are participating, Contributing.

6.7 Q. Are you telling me by your answer that at times some people did not participate?

Salutations and establishment of rapport

Interviewee still nervous an speaking softly.

Some background indicated – of discussions, debate and common consensus (+ve)

group participation (+ve)

TRANSCRIPT	NOTES
I. Yes.	
6.8 Q. What did they do? What are the problems you met.	
I. May be someone is ignorant by nature, we don't know then we are supposed to come into a group to may be prepare something to be done; then that person is not there, then he doesn't even report that he wouldn't be available.	Non-participant Non-cooperative. (-ve)
6.9 Q. I see and what do you do to such people?	
I. Because we don't want to be unfair to them we sometimes, like after the group maybe, we have to submit the work, then we have to write our names-of the group members; then we do write that person because we don't want to be wrong her.	group shielding non-participant -encouragement of non-participation(-ve)
6.10 Q. Oh, I see. (Chuckle) – the fact that you don't want the person to lose marks or that sort of thing – do you think there is a way of correcting this? What do you suggest must be done to correct such things?	Individuality Ignored (-ve)
I. I think sir, that it is wrong that we write his name down-because he wouldn't know that what he did is wrong – we shouldn't write the name down.	acceptance of wrong approach to making Non-participant to participate (-ve)
6.11 Q. My point is what do you think can be done, can we speak to such a person to change his ways?	
I. We should speak to him.	Advise to non-partici- pant to take part (+ve).
6.12 Q. Apart from that were there any other problems?	
I. We use to quarrel Sir. Hmm – I can say may be some one, there are people who always think that what they think is always right; they don't want to be corrected. We do get such problems.	Quarreling - unhelpful behaviour (-ve) -individual stubborn- ness (-ve)

TRANSCRIPT

NOTES

6.13 Q. I see. How did you solve such problems?

I. Sometimes we force that person to let us write even our own information; sometimes in other groups they even, that person even overcomes them and they write what that person wants to write.

Use of force (-ve)
individual dominance
of group (-ve)

6.14 Q. Do you find group work as we went through any useful?

I. Yes, it is useful Sir, because in a group work people come with their ideas then, something may be its new, you did know it before then we come to understand it by listening to others.

shared ideas,
understanding of
problem issues (+ve)

6.15 Q. I see – Did you always plan your work in your groups. when you are given a task?

I. Yes.

Group plan of
Work (+ve)

6.16 Q. How did you plan the work?

I. We set the times when every one will be available then, we do rough work firstly, then we write it formal.

Group agreement on
time schedules (+ve)

6.17 Q. Oh, before you write your report or even start work, did you share responsibilities? e.g. a leader, a secretary etc?

I. No, we don't choose firstly the leader – we choose some One who write, the scribe.

role play – equal
expectations,
scribe necessary
(+ve)

6.18 Q. I see.

I. Yes, then after we finish the work or task, then we choose may be, if it is going to be presented in class, it is only then that we choose that person who is going to present it in class, after we have prepared our work.

role play (+ve)

TRANSCRIPT

NOTES

6.19 Q. I see, OK enh – Do you think it is a good idea to introduce group work in your class at all?

I. It is a good idea Sir, but I think sometimes it is wasting time because you give the people the topic, the students the topic, they have to discuss at a first, then they have to you have to regroup the people then – they come with the solutions; then sometimes it is wrong and you have to correct them. I think it is time consuming.

group work as a waste of time (-ve) – too much time involved discussions, consensus, common Solution (+ve)

6.20 Q. Yes, it is time consuming – but do you finally get something out of the process? The discussions and the debate? Do you finally come out with something useful?

I. Yes.

6.21 Q. Like?

I. Some topics you come to some agreement but not on all topics.

debate, discussions as positive interdependence and involvement by all. (+ve)

6.22 Q. Alright.

I. May be some topics the class doesn't understand; the whole class did not understand the topic, then we have still to discuss it. Whereas we don't understand it. Then it is then that the people start chatting. They don't even trying to solve the problem they are given.

topic possibly above ability of group (-ve) Chatting- misdirection loss of interest in work (-ve).

6.23 Q. I see

I. Because they do not understand, they start chatting.

6.24 Q. You lose track of what you are doing?

I. Yes.

6.25 Q. What do you think must be done?

I. I think the topic must not be too difficult.

Topic to be at level of learners to be productive – (+ve).

TRANSCRIPT

NOTES

6.26 Q. O.K. What do you think is the role of the teacher during group work?

I. I think the teacher should come to each group and try to lead or guide them where they need to be guided.

teachers role as facilitator, guide intervention when necessary (+ve)

6.27 Q. I see O.K. Would you like to practice group work in the future?

I. Yes – but the teacher should also see that everyone is participating in the group.

teacher to control – maintain class discipline. (+ve)

6.28 Q. O.K.

I. Then may be, I can't put it sir, but that every person should point out his feelings, his contributions to the group.

discipline likely to cause problems and non-participation (-ve)

6.29 Q. I see. Anyway thank you for your ideas. As I said, I called you to find out your views on group work. When I have gone through my summaries, I will let the class know and to see how we can improve this in the future.

members to be free to express themselves given opinions and Contribute to group effort (-+ve)

Feed back indicated.

Thank you so much for your time.

I. Thank you, Sir.

FOURTH INTERVIEW

APPENDIX 7

TRANSCRIPT	NOTES
7.1 Q. Good afternoon Maame	
I. Good afternoon Sir.	
7.2 Q. Maame I called you here to ask you questions on group work for my work. I therefore want you to relax, feel free and express your views freely. You must be open about what you think.	Salutation and establishment of rapport with Interviewee.
I. O.K. Sir.	
7.3 Q. Before we learned about group work did you have any knowledge about group work?	
I. Yes we done it before.	Prior knowledge about group work
7.4 Q. Oh, where and how?	
I. In English lectures.	
7.5 Q. Oh, I see. How did you do it?	
I. We learned about it well Sir.	
7.6 Q. Did you plan how to go about your work in the group?	
I. When we did group work we were working together, sharing our ideas and at lectures when we discussed our conclusions, we did it together.	working together, sharing of ideas, discussions and consensus at conclusions (+ve).
7.7 Q. Tell me did you find any problems with our own experience of group work?	
I. The problems I came across are the problems of others who were not serious about group work who were relying on others.	non-participants (-ve).

TRANSCRIPT

NOTES

7.8	Q.	What do you mean they were not serious and relying on others?	
	I.	When we set the time for the group to do, they did not come up so they were just doing their own thing.	Obstructive individual behaviour (-ve)
7.9	Q.	What did you do to such people – What did you do to correct that problem?	
	I.	That problem when it arises, we have chance to correct it by going to their rooms and call them to come to the group work.	problem solving adequacy of members (+ve)
7.10	Q.	Did you come across people who liked to dominate the group most of the time?	
	I.	Yes we did.	Individual dominating group
7.11	Q.	And what did you do to such people?	
	I.	We happened to tell them that they were not going to listen to them all the time, that we must share ideas and each persons ideas must be respected.	stressing interpersonal and group Behaviour(+ve)
7.12	Q.	I see, Do you think it is useful to work in a group? sometimes.	expression of dissent
	I.	It is useful to work in a group sometimes.	
7.13	Q.	Sometimes? What exactly do you mean?	
	I.	It is useful to work in a group when you are working with people who are serious about group work. Sometimes there people who do not want to work in the group – those who want to work individually.	problem individuals-passive involvement
7.14	Q.	Now you are talking about individual and group work. Which do you prefer?	
	I.	I like group work because in group work it is when you have some mistakes about things of the subject, it is whereby you are corrected and it is when you are	interpersonal and group behaviours stressed through

TRANSCRIPT	NOTES
<p>corrected and it is when you are going to get more information about the subject unlike the individual.</p> <p>7.15 Q. Do you think it was a good idea to practice group work class.</p>	<p>support, inclusion positive interdependence (+ve)</p>
<p>I. Yes it is good.</p>	
<p>7.16 Q. Why?</p>	
<p>I. Because here at the college we have a lot of work and we don't know everything. So it is whereby when we are in groups each and everyone should go and research about something so that when meet together we are going to share in the information.</p>	<p>group support (+ve)</p>
<p>7.17 Q. And if you qualify as a teacher will you want to use group work in your teaching?</p>	
<p>I. Yes I would like to promote it because group help the the student much. The student take part in the lesson; the student have initiative, the student live with other people, the student take part in his own learning – I think it is a good method.</p>	<p>group work as a basis for learner involvement in lesson (+ve)</p>
<p>7.18 Q. What suggestions do you have for the improvement of group work?</p>	
<p>I. I am going to say that group work is a very good method to use. It's because it is whereby the pupils are going to find the information on their own and share ideas in class with others.</p>	<p>group work a means of developing student initiative (+ve)</p>
<p>7.19 Q. O.K. Thank you so much and enjoy your lunch.</p>	
<p>I. O.K.</p>	
<p>7.20. Q. Kindly call me Luvo.</p>	

TRANSCRIPT

NOTES

8.1 Q. Good afternoon Luvo.

I called you here so that I can ask you a few questions about group work. It is just an interview for my research.

Salutations
And establish-
ment of
Rapport.(+ve)

I. O.K.

8.2 Q. Therefore I would like you to relax, to be free to answer the questions and give your views. I am writing a paper on group work.

I. You are welcome Sir (Chuckle).

8.3 Q. Yeah, before I introduced group work to you, did you have any idea at all about group work?

I. Yes, I had an idea about group work but the thing is I was not familiar with it. O.K. I was just eh – I just heard about it but I was not practically involved.

Theoretical
prior
knowledge about
group work(+ve)

I mean by the way we have been now.

8.4 Q. You mean you are practically involved now?

I. Yes, I am – I can say I am practically involved.

Experience of
groupwork
activity/process
(+ve)

8.5 Q. I see; now what did you experience with group work?

I. Group work for me –
Group work makes it easy for me to understand. I mean before I am becoming introduced to it and eh – group work made it - eh it gave me a lot of opportunities for doing things practically; I do things practically.

group support
as help towards
understanding of
issues (+ve)

TRANSCRIPT	NOTES
<p>In group we discuss in groups. The discussions made it easy for me to assess myself. That is, where I am when I look at the ability of others, I can judge and assess myself. It gives me a lot of opportunities to improve my standard and leadership qualities. I can say I become exposed to such opportunities which were not - which was not familiar with them.</p>	<p>group discussions, self assessment, + peer assessment.</p>
<p>8.6 Q. I see, What part did you play in your group?</p> <p>I. Most of the time I have become a group leader.</p>	<p>Group role (+ve)</p>
<p>8.7 Q. O.K. go – on - what was your work as a leader in the group?</p> <p>I. Right, as a group leader in my group I had to monitor the progress of the group. It was me who was supposed to be collecting the group together; O.K., to tell people what to do for instance if we are given a project to work on, as a group leader I've to collect them and give them individual pieces of work to do; for instance if I say one must collect apparatus and do this and that, eh I do that, and then as a group leader I partly facilitate the progress. I've to be active more than other members; O.K. and show them and give them the chance to voice whatever he think he may say and then I collect all group efforts now I gather it on a single sheet of for presentation purposes. There as a group leader I have to present it to the class as a whole.</p>	<p>Leadership role. Indication of decisions made by individual, taking charge; individual dominating. Other members of group, individual desire of having personal interest satisfied, possible indication of intimidation of others. (-ve)</p>
<p>8.8 Q. I see, Isn't it – eh, it appears as if then that as a group leader you did everything?</p> <p>I. Hmm - E -----</p>	
<p>8.9 Q. Do you agree with me or not?</p> <p>I. I disagree with the effect that I did all the job no – I disagree with you.</p>	
<p>8.10 Q. What did the other group members do?</p> <p>I. Yeah – there is a lot of it is a group effort, everybody makes His contribution as much as one can.</p>	<p>Other group members comply to leaders</p>

TRANSCRIPT	NOTES
8.11 Q. I see.	instruction under intimidation (-ve)
I. Yeah, it is a question of everybody contributing to a group work.	Group roles – not evenly distributed (-ve)
8.12 Q. I see – but as a group leader you were still the Secretary?	Over participant.
I. Yeah, most of the time as a group leader I do the secretarial job.	
8.13 Q. You do the secretarial job too!	
8.14 Q. You did not try to be a dictator or that sort of thing?	Personality of group leader overshadowing other members (-ve)
I. Yeah, you don't need to be a dictator when you are a group leader I mean a task has been imposed on you, so everyone must be dedicated by the task not the group leader.	
8.15 Q. I see, did you come across problems in the group?	Difficult in understanding and applying principles of group activity. (-ve) Under-participation by members (-ve)
I. Yeah, I think it was due to the fact that we were not exposed to group work – for the first time I was in a group there were some problems- minor problems of having one member in – active and or not contributing at all - But that has been amended – we all enjoy group work.	
8.16 Q. O.K., How did you 'amend' that problem?	Group support, inclusivity, understanding, advise, positive group behaviour (+ve)
I. Yeah, we tried to amend that by motivating that particular member.	
8.17 Q. Alright go on –	
I. More than motivating an inactive member in a group, we make an	

TRANSCRIPT

NOTES

	<p>effort, we as group members to also explain how much easy it is when we study through the group. When we don't understand we ask it from among the group. Then we come to know the one who can explain can assist; as such just tell him you don't become confined when you are in a group you become exposed I mean the group can do a lot of things.</p>	Peer and self assessment
8.18	<p>Q. Oh yeah?</p> <p>I. I mean even socially it can help you socially you know. It just assist you, develop you, gives you characteristics or skills that you are not aware of you know.</p>	Group members-learning from each Other (+ve)
8.19	<p>Q. Yeah – Were you all tolerant to each other? No quarrels etc?</p> <p>I. You know most of the time, we become patient to each other, as we enjoy the group working.</p>	Positive group behaviour (+ve)
8.20	<p>Q. I see.</p> <p>I. As you know, somewhere, at times there happens a clash of views, its where you find that we happen to quarrel but very soon we correct that we come to understand and call each other to order, then we understand that though it has been a clash of views it is a failure to understand may be to a particular point and then—</p>	Initial group misunderstandings, but ability to
8.21	<p>Q. Alright – So far with the experience you have had with group work – what suggestions can you make for improvement of group work?</p> <p>I. Well as I said, I support group work. I suggest that group work eh – should be used – say let me say because I support it that whatever one teaches, he must use group work time and time again.</p>	did not understand question – nothing suggested in particular.
8.22	<p>Q. O.K.</p> <p>I. It is easy for learners to understand because it keeps learners actively involved so I'll advise that group work should be used- it is so communicating.</p>	That learners are actively involved in the lesson (+ve) -inter personal communication (+ve)

TRANSCRIPT

NOTES

8.23 Q. You mean you will use group work when you become a teacher in the future?

I. Yeah, I'll use group work because I want each and every student to be involved in my lesson, to develop good skills.

Intention to use group work as teaching strategy in the future. (+ve)

8.24 Q. I think I will bring this interview to an end and thank you most sincerely for your time and co-operation.

I. I thank you so much Mr. Kwayisi.

8.25 Q. Good Day Luvo.

**TOWARDS AN EFFECTIVE IMPLEMENTATION OF ASSESSMENT OF
BIOLOGY PRACTICAL WORK UNDER 'CURRICULUM 2005'**

A RESEARCH PROJECT

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR
THE DEGREE OF

MASTER OF EDUCATION

OF

RHODES UNIVERSITY

BY

FREDERICK NTOW KWAYISI

**SUPERVISORS: DR. JAAP KUIPER
MRS. GILL BOLTT**

JANUARY 1999.

CONTENTS

PAGE

I.	Declaration of originality	
II.	Dedication	
III.	Acknowledgements	
IV	Abstract.	
1.	Introduction	1
1.1	Background and context	3
1.2	The legacy of the psychometric/behaviourist period of assessment	4
1.3	International trends and the need for a paradigm shift in assessment	5
1.4	Learning theories underpinning outcomes based assessment	9
1.5	Functions of assessment	12
1.6	Goals of the research project	13
2.	Assessment methods that may be used in assessing biology practical work.	15
2.1	Norm – referenced assessment	15
2.2	Summative assessment	16
2.3	Formative assessment	16
2.4	Diagnostic assessment	17
2.5	Criterion – referenced assessment	17
2.6	Performance assessment	19
2.7	Continuous assessment	20
2.8	Self assessment	21
2.9	Peer-assessment	21
2.10	Evaluative assessment	21
3.	Assessing biology practical outcomes	22
3.1	Specific Outcomes for natural sciences	23

3.2	Expected outcomes for biology practical work	24
3.3	Use of expected outcomes in practical assessment	26
3.3.1	Factors to be considered in biology practical assessment	28
3.4	Assessment frameworks and formats	29
3.5	Biology practical work used in the project and how they were assessed	33
3.5.1	Assessment approach	33
3.5.2	Exercise one: classification/diversity of organisms	35
3.5.2.1	Assessment format on branching diagrams and construction of a key for separating laboratory glassware	36
3.5.2.2	Leaf identification using a branching diagram and a key for separation	38
3.5.2.3	Assessment format on branching diagrams and construction of a key for separation of leaves	38
3.6	Exercise two: Experiments on food tests	41
3.6.1	Assessment format on food tests	42
3.7	Exercise three: Fieldwork on aquatic biology	43
3.7.1	Assessment format on aquatic ecology studies	44
4.	Results arising from the exercises	45
4.1	Problems encountered	45
4.1.1	Exercises on classification	46
4.1.2	Exercise on food tests	47
4.1.3	Exercise on fieldwork on aquatic biology	48
4.2	Factors that may affect the assessment of students practical work	51
5.	Conclusion	53
5.1	Findings of the research project	53
5.2	Suggestions for the implementation of an assessment culture in biology practical work	54
6.	Critical reflections on the research project	57
7.	References	61
Appendix	1	64
	2	65
	3	66

DECLARATION OF ORIGINALITY

I hereby declare that the whole work in this research project is mine except where I have given direct quotation or given references.

DEDICATION

This work is dedicated to the 1998 biology class of the Griffiths Mxenge College of Education, Zwelitsha.

ACKNOWLEDGEMENTS

I wish to thank the 1998 biology student teachers of the Griffiths Mxenge College of Education, Zwelitsha, for their help and co-operation during this project.

My thanks also go to Mrs. Gill Boltt and Dr. Jaap Kuiper for their guidance and support without which this project would not have been a success and for granting me the opportunity of being their student.

I am grateful to Dr. Kofi Gavor of the Settlers Hospital, Grahamstown for allowing me the use of his hospitality during my studies.

Finally my sincere thanks go to Mrs. Christiana Kwayisi, my wife, who typed my projects and for the emotional support I received from her and the 'girls'.

ABSTRACT

Transformation taking place in education in the Republic of South Africa has implications for assessment. It involves a move away from the transmission mode of teaching and learning, to a learner-centered education with the attainment of outcomes. It is a move away from the summative mode of assessment to a formative mode, where assessment leads to the development of the learner and monitor and support teaching and learning. Questions arise as to what to assess, how, when to assess and by whom?

This research project is an initial attempt to look at how this assessment policy may be implemented effectively in schools and colleges, using the teaching and learning of practical biology as a tool. It looks at examples of assessment methods that may be used to assess learners work, their functions and problems that may arise in the teachers attempt to transform his/her practices. Suggestions are made on factors to consider in implementing assessment practice and how problems, which may arise in assessment, may be overcome.

1. INTRODUCTION

The role of practical work in science education has been a moot point for some time now. This is because practical work has been considered to follow a 'cook-book' approach; that practical work had been and is still, following a 'hands on' but not a 'minds on' approach (Doran, Boorman, Chan & Hejaily 1992). Students have been led to accept whatever comes from the 'black-box' without question (Latour 1987 cited by Nott 1998), that the priority among purposes teachers assign to practical work may have shifted over the years and this assumption has never been seriously challenged (Hodson 1996). On the other hand, practical work is considered a necessary compliment to understanding of whatever is being studied or investigated, that it enhances procedural knowledge – learning more about experiments and correlational studies, and acquiring more understanding of observation, experiment and theory. Practical work enhances investigate expertise (Hodson 1996). Practical work is said to provide worthwhile educational experience for all pupils and in particular, to enable them to acquire sufficient understanding and knowledge (Newsham 1998). Despite the debate on the role and usefulness of practical work however, practical work is now part of a well-established tradition of science teaching (Hodson 1996). Practical work is relied upon to provide learners with the necessary skills required to run the wheels of commerce and industry in the developed and emerging economies of the world. Practical work is seen to develop high order cognitive skills, and the ability of individuals to be critical and creative in their analysis of situations and the application of knowledge.

These are qualities expected from the education of learners in the country. If these expectations are to be met then there must be clear objectives set together with criteria against which learners' progress in practical knowledge and skills can be assessed. This is because assessment has been known to be a powerful tool for change in the education and development of individuals. It has been a barometer for measuring the progress or retrogression of the economies of nations. Education is held accountable in the developed countries to see to the effective education in practical skills and knowledge. These skills and knowledge are those needed to equip the individual to face challenges and adapt to situations that would face him or her. A way of seeing to this demand is the development of a systematic and regular assessment of individual learning and the development of an effective assessment policy. Assessment is seen, as a means of providing the necessary diagnosis and feedback needed for improvements in education strategies to the benefit of the individual and the country as a whole. Assessment has a direct influence on teaching and learning and this power it is noted, can be harnessed and directed to achieve positive impact (Department of Education 1996).

Challenges such as mentioned above, are the ones the new democratic government is facing. These challenges include how to implement effective assessment practices in schools and colleges, including the assessment of practical work.

1.1 **BACKGROUND AND CONTEXT**

Apartheid had perpetuated a policy of segregation in education along racial lines. Bantu education – the education for blacks, suffered most. Science education was mostly theoretical and rote learning was encouraged. There were no laboratories and where there was a semblance of a laboratory, equipment, chemicals and apparatus were either absent or antiquated. There was little or no assessment of practical. The education of teachers had been poor and teachers had little or no knowledge about assessment strategies. Curriculum for colleges for instance, did not encourage science students to do more than one practical subject as a major (DET 1990). Students were considered not to have the capacity to offer two science subjects. It was not uncommon for students to study as their majors, Biology and Afrikaans or Physical Science and Xhosa as a combination. In the Colleges of Education under the then DET, including the Griffiths Mxenge College of Education where I lecture, assessment of practical work at the end of the college course, was in the form of a “moderation”. In this, the files of students were looked into and about two to five students selected to perform ‘experiments’. The whole class was considered ‘passed’ or ‘failed’ based on the performance of the selected few. This type of assessment did not follow any format or criteria. It was simply impressionistic. Views of assessment under apartheid lead to practice in education that devalued, dismissed and separated people. In schools and universities, the practice of assessment sought to compare and reward individual prowess and put individuals in contrast with each other (Volmink 1994).

This view of assessment, which is still prevalent in schools and universities, is narrow and mechanistic and gets its origin in the science of psychometrics. Psychometrics in turn originated in that field of psychology that concerned itself with intelligent testing, aptitude testing and standardized achievement tests (Volmink 1994). Strongly behavioural in origin, this science holds that intelligence is fixed and innate in the way that other inherited characteristics such as skin colour are. Individuals were assigned to groups or schools which were appropriate to their intelligence. Assessment of the individual was thus limited (Gipps 1994:5). This model which was and is still practiced in most countries worldwide suited very well the policies of apartheid – the principle of separate and inferior education practices.

1.2 THE LEGACY OF THE PSYCHOMETRIC/BEHAVIOURIST PERIOD OF ASSESSMENT

The legacies of this paradigm are tests and examinations that rank student performances, rather than describe their level of learning in a meaningful way. This model gave rise to the assumptions of universality – that a test score has the same meaning for all individuals and that a score on a standardized test represents the individual's ability, which was universally accepted and understood. It also gave rise to the assumption of unidimensionality; that is all attributes and skills measured have uni-rather than multi-dimensionality. These tests were considered reliable and scientific (Gipps 1994:6-7). This paradigm also emphasized summative assessment at the expense of formative assessment. Thus the educational process was ignored in favour of the product.

Facts were given dominance at the expense of concepts and skills, since facts lend themselves to this type of assessment (van Harmelen 1996). Key assessment strategies under this paradigm included structured questions of the how many, where, when and what type and multiple choice questions. These were mostly, of the recall type. Assessment was thus discriminatory instead of illuminatory and identified deficiency rather than revealing the value of individuals (Gaddis and Volmink, 1993 cited by Volmink 1994). Assessment did not support teaching and learning, it did not help in the overall development of the individual.

van Harmelen (1996) says that the whole idea of norm referenced testing started to be challenged around the 1950s on the basis of the skewed view of science it espoused. This challenge became gradually accepted internationally around the 1970s on the basis that this 'scientific' model was inadequate to capture the phenomena of interest and significance in educational programmes.

1.3 **INTERNATIONAL TRENDS AND THE NEED FOR A PARADIGM SHIFT IN ASSESSMENT**

A number of countries for example the U.S.A. and Britain, had been concerned at the relative failure of their respective work forces to meet the challenges changing economic realities were imposing on them. Scholars, workers, professionals and the common citizenry lacked the skills required. These justified the need for change in education and assessment practices being used. According to Volmink (1994), in the United States, the government directed millions of dollars into educational programmes.

This rendered educational departments accountable to provide an evaluation report. Because of this, professionals, educational and research associations began to take evaluation issues seriously and in 1981, developed standards of Evaluations of Educational programmes. Contemporary evaluators could then choose from an assortment of approaches and were no longer captive to the objective-oriented Tyler approach. Tyler had developed a formal evaluation plan into the effectiveness of the progressive (Deweyan) high school curricula. It was not until the 1970s did it become accepted that Tyler's 'scientific' model was inadequate to handle all issues concerning assessment. The shift in philosophy of assessment practices did not appeal to the narrow comparative construct but one that was grounded in the belief that every person was valuable and should be valued (Volmink 1994).

In South Africa the curriculum had and still has emphasized the rote learning of an enormous and uncontested body of knowledge. It had neglected the development of critical and creative thinking and problem-solving skills, and the ability to select, adapt and apply skills and knowledge in unfamiliar situations. People were given training sufficient to serve them in one job for life (DoE 1996c). These qualities including practical skills, the ability to use initiative, organization and the plan and management of self and situations and divergent thinking, are the qualities needed by individuals to face the next millenium.

These are the challenges that faced the new democratic government when it took over the administration of the country in 1994.

Gipps (1994) defines assessment as

a wide range of methods for evaluating pupil performance and attainment including formal testing and examinations, practical and oral assessment, classroom based assessment carried out by teachers and portfolio (Gipps 1994:vii).

van Harmelen (1997) cites Gipps (1994) as saying, that assessment is undergoing a paradigm shift from the narrow modernist paradigm based on the psychometrics model to a broader post modern model of educational assessment – from a testing and examination culture to an assessment culture. This is supported by the notion that the purpose of assessment has broadened as our views of knowledge and theories of learning have changed. Gipps (1994) continues to argue that assessment ought to do more than just provide information for selection and certification as it was under the narrow modernistic view. Assessment should support the teaching and learning process by providing feedback to pupils, teachers and parents. It should be diagnostic and allow for teachers to establish where learners are at in their understanding and then plan meaningful tasks to enable development and progress. Assessment should meet the goals of developing critical, creative and flexible thinkers who are able to and believe that they are capable of problem solving and divergent thinking. Rather than measuring what students do not know and are unable to do in relation to others, as in norm reference assessment, we need to move towards assessing through a variety of techniques. This is to find out what learners can do in relation to themselves (self and ipsative assessment) compared to set standards or criteria. We should aim at assessing learners ability to perform a variety of different tasks, which reveal their growth in knowledge and ability to do

something with their knowledge, as they progress and develop from a novice learner to one of mastery in a particular domain. Assessment should move from how much learners know to how well they know, and to what they can do (van Harmelen 1997).

The Department of Education (1996a) argues for the need for a dramatic paradigm shift in assessment practice across education and training in South Africa, as a logical and essential part of the transformation taking place in education. This is for assessment to reflect the changing perception worldwide of the nature of assessment and its main purpose. Gipps (1994) cites Kuhn (1970) who defined a paradigm shift as,

.....a set of interrelated concepts which provide the frame work in which we see and understand a particular problem or activity. The paradigm within which we work determines what we look for, the way in which we construe what we observe, and how we solve emerging problems. A paradigm shift or 'scientific revolution' occurs when an old paradigm is unable to deal with an outstanding problem (Kuhn 1970).

To this end, the government sees the old assessment paradigm still operating in our schools, colleges and universities, grossly inadequate to deal with the challenges presented by new policies aimed at transformation of education and training. For the majority who were deprived of the opportunities of an effective education and who were assessed haphazardly, and the privileged few, whose studies were assessed in a 'correct way', the norms and standards which were used are today not acceptable anywhere in the world. Such standards fly in the face of international trends in assessment (DOE 1996c).

To achieve redress, equity and personal empowerment for the citizens of the country, the government introduced the idea of lifelong learning and 'Curriculum 2005', and outcomes based education with a range of alternatives to formal full time courses in education and training.

1.4 LEARNING THEORIES UNDERPINNING OUTCOMES BASED ASSESSMENT

The introduction of an outcomes based education system has brought with it implications for the curriculum, content, methodology, assessment practices and indeed the entire education of the country. While education under apartheid was based on racial guidelines the 'new' education is unified and is envisaged to bring equity in all aspects of education.

Education under apartheid and as it is currently practiced in the country, operated and is still operating, in the transmission mode of teaching and learning. This suggests a *tabula rasa* image of filling empty vessels with knowledge and other approaches where the learner is a passive recipient or rote learner. Although this method was effective in some cases, it deprived large numbers of learners of adequate opportunities to realise their full potential. It is hoped that outcomes based assessment can assure access to such opportunities (DOE 1996a).

Constructivism which underpins curriculum 2005 and outcomes based education, contends that knowledge does not exist outside of a person (Confrey 1990, Piaget & Inhelder 1969, von Glaserfeld 1987 a,b, cited by Shaw 1992). Etchbeger and Shaw (1992) further cite Cobb & Steffe (1983) as saying that true knowledge can only exist when it is constructed within the mind of a cognizing being. Understanding of any event, situation, or problem occurs only when relationships are made to existing understanding in a learner's mind. Teachers must therefore be aware of what knowledge base each individual student has and must use this information in planning and implementing instruction. According to Cunningham (1992), objectivists such as Thorndike (1905) said, if something exists, it exists in some quantity and it can be measured and submitted to scientific analysis. Constructivism however holds that learning is a process of building up structures. Learners do not transfer knowledge from the outside world into their memories, rather they create interpretations of the world based upon their past experiences and their interactions in the world. The role of education, in a constructivists view, is to show students how to construct knowledge, to promote collaboration with others, to show the multiple perspectives that can be brought to bear on a particular problem, and to arrive at self-chosen positions to which they can commit themselves, while realising the basis of other views which they may disagree. Under objectivism, some one decides what it is the student should know, constructs a task analysis of that knowledge, analyzes the learners existing capabilities, designs a strategy to communicate the required information to the learner, then tests to see if the communication process has been successful (Cunningham 1992).

It is this mode – the objectivist mode of teaching and learning and assessment, which the country is moving away from. The position to be adopted and adapted to suit conditions in the Republic of South Africa, just as in the case of constructivism, is where the teacher selects tasks that are relevant to the child's lived experience. These provide access to tools that can be accomplished by the individual learner and by a collaborative group. The learners must see the relevance of the knowledge and skill to their lives, how such knowledge can help them to do things that are embedded in the concerns they have. In constructivism, an indication of successful learning is the successful completion of the task. According to Cunningham (1992) assessment should not be a separate activity carried out after instruction, using some pseudoscientific instrument purported to reveal the truth of the learner's accomplishment. Traditional tests he said, can be part of an arsenal of tools that can be provided to teachers to help them make judgements.

The social constructivist view of learning is given by Hodson & Hodson (1998) who cite Vygotsky (1978) as emphasising the role of the teacher in assessment. He says that each child has a zone of proximal development where with the assistance of a more mature partner – a teacher or advanced student, the child can accomplish more, solve more advanced problems than he/she could alone. The mature partner (teacher or more advanced student) provides extensive guidance and support for those aspects, which are just beyond the student's current unaided capability. Through this assistance, the student masters all the component parts and gradually become capable of full and autonomous participation (Hodson & Hodson 1998).

Hodson & Hodson (1998) continue to cite Vygotsky as saying that what the child can do today, with help, she/he will manage alone tomorrow. The science teacher under outcomes based education should take notice of the fact that effective form of learning is likely to be inquiry – oriented, personalised and collaborative and conducted in accordance with the norms and values of the community of scientists (Hodson & Hodson 1998).

1.5 **FUNCTIONS OF ASSESSMENT**

A critical issue in outcomes based education is the attainment of certain outcomes. Assessments under outcomes based education is therefore to determine whether or not these outcomes have been attained. An indication of attainment of outcomes is to determine such attainment against criteria established in conjunction with learners. Learners will therefore be aware of what is required of them. All learners who meet the criteria for achieving specific learning outcomes would then receive credit. Those learners who do not meet the criteria to attain the standards should be able to apply for re-assessment whenever they are ready to do so. In this way assessment is transparent and fair (DOE 1996c).

The diagnosis of the assessment should then provide feedback to inform teaching and learning – to critique the outcomes, methodology and materials used. In this way assessment impacts the processes of teaching and learning in setting standards which guide activities. Assessment thus moves away from simply being norm to criterion referenced.

Diagnosis of assessment would also help the teacher to plan her/his teaching well and to determine which remedial or counseling activities to be undertaken.

According to the Department of Education (1996a) the explicit statement of outcomes serves to guide the teaching and learning process. Assessment can thus play the important role of continuously monitoring learners progress toward achieving outcomes, and in providing information to teachers about problems which learners might be experiencing at given moments in the learning process. Assessment in this sense is thus continuous and formative, and could be teacher, peer or self driven. Assessment becomes summative when it is required to assess learning at certain levels to determine whether or not specific outcomes have been achieved, and whether credits and or a qualification can be awarded. Certification *per se*, and selection or comparing one learner to another should not be the prime purpose of summative assessment in outcomes based education.

1.6 **THE GOALS OF THE RESEARCH PROJECT**

Some of the problems facing teachers about outcomes based education is that the majority of teachers know almost nothing about this shift in approach to teaching and learning. There are teachers who are underqualified or who may have no qualifications in education let alone to have the necessary training in evaluation and assessment. For almost all teachers, assessment practice had been and still is, summative. Some are lost in the sea of information facing them about outcomes based education and simply do not know what to do about it.

According to Prawat (1992), the new constructivist approaches are inconsistent with what these teachers believe and they are slow to rethink their views on a number of issues. The importance of teachers as either effective agents for change or major obstacles to the successful implementation of the outcomes based education envisaged cannot be over-emphasized. Teachers must therefore be informed and educated about these changes and or improvements in assessment practices to ensure effective implementation of outcomes based education. '

The intentions of this research project is therefore to describe briefly, various assessment methods and formats that may be used to assess biology (and or natural Science) practical work. It is hoped that these would be a basis for further development of methods for assessing biology practical work.

2. **ASSESSMENT METHODS THAT MAY BE USED IN ASSESSING BIOLOGY PRACTICAL WORK.**

The shift in emphasis of assessment methods as postulated by outcomes based education advocates for the use of a multiple system of assessment practices, aimed principally, at development and progress of the learner. Assessment may be norm, summative, criterion, and performance or self-referencing, it may be diagnostic, evaluative, informal or formal and continuous.

2.1 **NORM-REFERENCED ASSESSMENT**

Norm-referenced assessment is the type of assessment, which is widely used in schools and is familiar to educators. Performance of an individual is measured against, and relative to, the norms of levels of performance of others in a normative group (e.g. school, age group, class) (Wrigley *et al* 1986). Learning of a particular content or skill is important only to the extent that differential learning allows the tester to rank individuals in order, from those who have learned many skills to those who have learned a few. Norm referencing is designed to do only one thing; to separate the performance of individuals so that there is a distribution of scores. The tester then discriminates among the performances of a number of individuals and interprets how one person's performance compares to that of other individuals with similar characteristics (Ysseldyke 1988). Thus as Wrigley *et al* (1986) say, norm-referenced assessment is a screening device, separating the sheep from the goats, for finding out who is good, bad or indifferent, by comparing them with others.

This is the type of assessment that the country wants to move away from if it is the only one to be used.

2.2 **SUMMATIVE ASSESSMENT**

Summative assessment is closely related to norm-referenced assessment because it is concerned with final summing up of assessment. Its concern is to differentiate between learners, so that selection can be made. This type of assessment often comes at the end of a term, a year, a course or a school career. It is entrenched in the public examination system. The judgement it makes is for the benefit of people other than the learner. Great importance is attached to it by parents, employers and in the public in general (Wringley *et al.* 1986).

The difference between norm and summative assessment lies in the timing of the assessment process than in the intentions of the assessor.

Summative assessment may contribute to the development of a learner if the intention is for recording the overall achievement of the learner in a systematic way; to inform and support teaching and learning (Hughes and White, 1992)

2.3 **FORMATIVE ASSESSMENT**

In formative assessment, assessment is integral with learning and teaching and takes place throughout teaching. According to Wringley *et al* (1986), formative assessment gives the teacher and learner feedback information about whether the learning outcomes are being reached.

It provides information on areas of weakness, and also on strengths and potential. Hughes and White (1992) said that formative assessment uses the positive achievements of the learner to discuss and plan appropriate next steps in the learning process. For the learner, it is a form of attention and encouragement, and an important ingredient of motivation. To the teacher it gives a constant feedback on whether teaching and learning outcomes are being achieved. This leads to improvement (Wrigley *et al.* 1986).

2.4 **DIAGNOSTIC ASSESSMENT**

Diagnostic assessment concerns itself with the scrutiny and classification of learning difficulties so that appropriate remedial help and guidance can be provided. (Hughes and White 1992). Diagnostic assessment thus has formative assessment potentialities.

2.5 **CRITERION-REFERENCED ASSESSMENT**

According to the Department of Education (1996 b) criterion-referencing defines a number of learning outcomes at various levels and then sets about recording a learners progress in relation to criteria by which it has been agreed learners can demonstrate competence at the various levels. This is a more appropriate way to judge a learner's fitness to enter a course i.e. placement or readiness of the learner, or move to the next state i.e. promoting the learner or awarding credit to the learner, or for the learner to satisfy entry requirement and or obtain qualification.

Criterion – referencing, answers the question ‘Can X and Y do Z?’ rather, than ‘Did X score higher than Y on Z?’ (Gipps 1994). The awarding of a credit indicates a learner’s ability to meet the criteria set for the attainment of a particular unit, standard or to demonstrate competence in comparison with another candidate. This according to the Department of Education (1996c) is the basis for the portable accumulative credits which give access to lifelong learning.

Gipps (1994) says that there is an argument that norm-referenced assessment and criterion-referenced assessment are closely linked and those norms may be used to set criteria and that a norm-reference interpretation can be put on a criterion-referenced measure. Gipps (1994) cites Phillips (1991) for given an example of a norm-reference/criterion-referenced interaction in the German grading system the *Notenskata*. In this the grading framework is criterion-referenced for example, 1 = very good, well above the required standard, 2 = good, fully meets the required standard etc. Government publishes the knowledge and skill, which should be mastered and taught at each stage, the standards are pre-determined and therefore can be described as criterion-referenced. What constitutes ‘good performance’ in a particular class is only assessed through a norm-referenced process. Gipps (1994) quotes Glaser (1963) for defining criterion referenced testing in terms of its difference from norm-referenced testing thus:

What I shall call criterion-referenced measures depend upon absolute standard of quality, while what I term norm-referenced measures depend upon a relative standard (*Ibid*, p529)

and

Measures which assess student achievement in terms of criterion standard thus provide information as to the degree of competence attained by a particular student which is independent of reference to the performance of others (*Ibid* p520).

It is important to note that every examiner produces memoranda, and every teacher uses criteria each day when marking work and evaluating student input.

2.6 **PERFORMANCE ASSESSMENT**

Gipps (1994) quotes Stiggins and Bridgeford (1982) as defining performance assessment as,

a systematic attempt to measure a learner's ability to use previously acquired knowledge in solving novel problems or completing specific tasks. In performance assessment, real life or simulated assessment exercises are used to elicit original responses which are directly observed and rated by a qualified judge (Stiggins and Bridgeford 1982).

Performance-based assessments aim to model real learning activities we wish learners to engage with skills, problem-solving activities, so that assessment does not distort instruction. The intention of performance based assessment is to capture in the task, the same demands for critical thinking and knowledge integration as required by criterion performance (Gipps 1994). Performance assessment support good teaching because it requires teachers not to move away from concepts, higher order skills, in depth projects that learners are expected to know. It is a move away from the traditional standardized multiple choice testing. Haetel (1992) is cited by Gipps (1994) as saying, performance assessment can be used for large scale testing such as term level assessments which, require learners to demonstrate their capabilities by creating some product or engaging in some activity.

Well-structured 'matric' or end of year examination requiring the demonstration of higher order skills would be an example of performance based testing.

2.7 **CONTINUOUS ASSESSMENT**

Continuous assessment answers one question about the choice of mode of assessment by assessors. The choice of mode of assessment determines when the assessment takes place; at the end of a term or throughout the course? The mode depends on who is the assessor but the prime purpose would be towards benefiting the learner (Wrigley *et al.* 1986). In this regard the teachers assess the learner continuously throughout the year. It is important to note that it is impossible for the teacher to assess all pupils all the time. For this reason the teacher adopts a plan to ask questions, record observation, collate marks, diagnoses learners work to be able to form an 'opinion' about the learner etc. Informally much of the teachers interaction with learners – a word of praise or sarcasm, a smile or a rebuke, convey a valuation of the learner's work. Recorded observations of the learner as he/she goes through the course may be a more valid way of assessing such learner. Continuous assessment therefore uses the 'process' to come out with a 'product'. It is thus necessary for the teacher to use a variety of assessing modes to produce a fair assessment of the learner (Wrigley *et al.* 1986). These forms of assessment may include profiles, journals and portfolios, self and peer assessment.

2.8 SELF-ASSESSMENT

The Department of Education (1996b) advocates the use of the learners' handbooks, journals or self-assessment sheets to encourage this practice. In this, ways of guiding learners in the assessment of their own work on an on-going basis, reminding them of the criteria for assessment, are sought to help learners improve the quality of their work. Learners try to identify strengths and weaknesses and negotiate bargains in terms of rate of progress expected if the agreed goals are to be met. Gipps (1994) refers to ipsative assessment in which the learner evaluates her/his performance against his/her previous performance.

2.9 PEER-ASSESSMENT

Peer-assessment is when a colleague, a course or classmate gives valuable guidance to his/her mate. This form of assessment is valuable in groupwork activities and in practical work. The success of mixed ability teaching in raising the standard of the lower achievers whilst maintaining good results for higher achievers is partly dependent on this approach. Peer-assessment also helps learners to develop the skills they need to assess their own work (DOE 1996c).

2.10 EVALUATIVE ASSESSMENT

Assessment can be evaluative when it is used to compare and aggregate information about learners' achievements so that it be used to assist in curriculum development and the evaluation of teaching and learning (Hughes & White 1992).

3. ASSESSING BIOLOGY PRACTICAL OUTCOMES

The assessment of practical work is based on the premise that learners do practical exercises. In this regard, it is essential that teachers plan suitable practical activities, which will permit each individual to be assessed appropriately in the laboratory or field throughout the course. The concept is to move away from the 'cook-book' activities i.e., conforming to what is 'accepted' or 'right', currently practiced in our schools. Learners are told the purpose of an experiment, given a set of instructions to follow, and presented with a format for collecting and organizing their results. They then write a report and present it to their teacher. This constitutes definitely a 'hands-on' method, involving manipulation and not a 'minds-on' approach (Doran *et al.* 1992). The shift in emphasis – outcomes expected from practical work, would include both 'hands-on' and 'minds-on' outcomes.

According to the National Qualifications framework, NQF (1996), Outcomes are the end products of a learning process. In outcomes based education, teachers work backwards from agreed and desired outcomes within a particular context. These state clearly what the learner should be able to demonstrate an understanding of and ability to apply. Programmes of learning are then designed to help the learners achieve these outcomes. The NQF document (1996) refers to Specific Outcomes and Essential Outcomes. Essential outcomes are cross-curricular, broad generic outcomes that inform all teaching and learning. The specific outcomes are contextually demonstrated knowledge skills and values, reflecting essential outcomes.

Each of the learning areas of curriculum 2005 has specific outcomes, which are clearly listed. The following specific outcomes are quoted from the Natural Sciences learning area of curriculum 2005.

3.1 SPECIFIC OUTCOMES FOR NATURAL SCIENCES

- Use process skills to investigate phenomena relating to the natural sciences.
- Demonstrate the acquisition of knowledge and an understanding of concepts and principles in the natural sciences.
- Apply scientific knowledge and skills to problems in innovative ways.
- Demonstrate an understanding of how scientific knowledge and skills contribute to the management, development and utilization of natural and other resources.
- Use scientific knowledge and skills to support responsible decision-making.
- Demonstrate knowledge and understanding of the relationship between science and culture.
- Demonstrate an understanding of the changing and contested nature of the natural sciences.
- Demonstrate knowledge and understanding of ethical issues, bias and inequities related to the natural sciences.
- Demonstrate an understanding of the interaction between natural sciences, technology and socio-economic development” (Curriculum 2005 1996).

The specific outcomes set a national standard for education in the natural sciences. The outcomes specific to the natural sciences are assessed based on criteria, which provide information about what learners should be able to do in order to achieve each of the specific outcomes. The natural sciences have been organized around four themes, namely, the planet, earth and beyond, life and living, energy and change and matter and materials. These four broad themes show the integrated nature of the natural sciences. Education in the natural sciences implies the need for practical activities and skills. Knowledge cannot be divorced from the practical skills involved in acquiring and using this knowledge (Curriculum 2005, 1996).

3.2 EXPECTED OUTCOMES FOR BIOLOGY PRACTICAL WORK.

Expected outcomes on biology practical work (of the natural sciences) may be grouped around the pre-laboratory/laboratory/post-laboratory, expectations. Assessment criteria on these may be determined generally as comprising:

a. **PLANNING AND DESIGN OF PRACTICALWORK**

Phenomena identified.

Question or problem to be investigated formulated.

A plan of action is formulated.

Hypothesis is formulated.

Results predicted.

Observation and measurement procedures designed.

b. **EXECUTION OF PRACTICAL WORK**

Measurements and observations are made.

Apparatus, equipment are manipulated.

Data are collected.

Results are recorded.

Calculations are made.

Explanations or decisions about experimental techniques are made.

Works according to own design.

c. ANALYSIS AND INTERPRETATION

Data are analyzed and interpreted.

Results are transformed into standard form

Relationships are determined.

Accuracy of data discussed.

Limitations/assumptions discussed.

Generalizations are formulated.

Relationships are explained.

New questions/problems formulated.

d. APPLICATIONS

Predictions based on results of investigations are made.

Hypothesis for follow up are formulated

Experimental techniques are applied to new problems or variables

Findings are communicated. (van den Berg & Giddings 19?)

Carrick (1987) says that biology assessment outcomes are split into two groups in the national criteria of the United Kingdom. These are:

- (a) Knowledge and understandings and
- (b) Skills and processes.

To satisfy the requirements for practical assessment, learners should be able to:

- make and record accurate observations
- plan and conduct simple experiments to test given hypotheses
- formulate hypotheses and design and conduct simple experiments and test them
- make constructive criticisms of the design of experiments
- analyze, interpret and draw inference from a variety of forms of information including the results of experiments (Carrick 1987).

3.3 USE OF EXPECTED OUTCOMES – IN PRACTICAL ASSESSMENT

Expected outcomes as listed above, may be used in various ways to produce the attainment of specific skills in practical work by learners. Newsham (1988) suggests the use of outcomes assess the attainment of manipulation skills by learners for example, apparatus, simple dissections, setting up a microscope and so on. He suggests exercises that would assess the students' ability to measure mass, volume, time temperature, pH etc. To indicate successful attainment of outcomes concerning observation skills, students should be able to draw biological material obtained from dissection; draw biological material from observing using a microscope, students ability to group biological material before and after specific treatment etc. Other skill areas that may be associated with product skills are

students' ability to enter results in a prepared table construction of a results table and the entry of results and the construction of a graph (Newsham 1988).

Skills associated with experimental design, such as identifying the problem, hypothesis formulation, selection of apparatus, experimental results, interpretation and evaluation of results were difficult to attain in the research. This is as a result of the poor background of students with little or no experience in practical work. Before these skills are assessed it may be necessary for the teacher to spend time to discuss basis on which a hypothesis for instance is formulated. Various strategies are also suggested that would move practical teaching practice away from the 'cook-book recipe' method we are used to. These suggestions include 'Predict-explore-Explain' or POE, to which a fourth component may be added, "thinking about 'data' and the nature of data. In this before students start an experiment, they are made to PREDICT what they think they would say, observe, and individually, asked to write short explanations or reasons for their predictions. They then share their predictions and reasons with others. The students then carry out the experiment and record their OBSERVATIONS. They review their predictions to come out with a more confident explanation. They are then asked to EXPLAIN what had happened that could support the data. The additional factor is for them to make a list of the aspects of the experiment they would decide as DATA and to underline those that were critical to their explanations. Other practical work strategies that may lead to the attainment of high order skills may include scrambled instructions and 'linking' (Downing 1998).

3.3.1 FACTORS TO BE CONSIDERED IN BIOLOGY PRACTICAL ASSESSMENT

It is necessary for the teacher to consider when, how and what to assess. Wrigley *et al* (1986) say that unless we are clear about why we are assessing, we are unlikely to make the right decisions about when, and what, and how, and by whom.

For assessment to be of benefit it must inform teaching and learning. One method of deriving benefit from assessment is the construction of a progress map. The teacher draws on his knowledge and that of his colleagues, of typical paths of students' progress and from an analysis of students' performances on assigned tasks. The evidence used to estimate students' levels of attainment on a progress map could be based on a variety of assessment methods. These include on going observation of student behaviour and work in the classroom; projects, student presentations to the class, classroom quizzes and tests; products of student work etc. (Matiru *et al* 1995).

Assessment of outcomes can then take place after the teacher has successfully answered the question as to whether assessment has been achieved or not? Assessment criteria are then established in conjunction with learners to allow transparency. It may be necessary for the teacher to monitor continuously that particular student. Newsham (1988) suggests a progress map for following the development of particular skills in the entire school year.

Since assessment methods and purposes differ, it may be necessary for the teacher to determine together with learners, whether the attainment of outcomes would be normative summative, performance or criterion based etc. Matiru *et al* (1995) gives suggestions on which type of assessment method to use thus:

- | | | |
|-------------|---|--|
| Project | - | ability to find and select relevant information, to analyze collected data, and to write a report. |
| Portfolio | - | ability to write on a range of purposes |
| Observation | - | ability in instrumental manipulation etc. |

It is important to note that assessment, which addresses only some outcomes, would provide a limited picture of the learners' achievement and would provide incomplete feedback to teaching and learning.

3.4 ASSESSMENT FRAMEWORKS AND FORMATS

For assessment of the attainment of skills associated with biology practical work to be valid, there must be evidence of a full range of outcomes. Such assessment must be fair and reliable to all students. The formulation of assessment formats to suit all kinds of skills and outcomes therefore become very useful for the teacher and learner. Assessment formats can be designed to cater for a day, a week, a term, a

year or the entire school/college life of the student. Easy reference can therefore be made by referring to a record of a student's performance on such assessment format.

Various suggestions have been made on assessment frame works and formats. According to Carrick (1978) the Midland Examination Group (MEG) for example has categorized the performance of each practical skill as high, intermediate or low using criteria provided. Each of these categories is further sub-divided into three, given allocation of a grade:

	H	-	9		
H	I	-	8		
	L	-	7		
	H	-	6	<u>Key</u>	
I	I	-	5	H	- High
	L	-	4	I	- Intermediate
	H	-	3	L	- Low
L	I	-	2		
	L	-	1		

The Welsh Joint Education Committee (WJEC) on the other hand has a three point Scale and provides criteria for each level of competence. The London and East Anglia Group (LEAG) for the general Certificate of Secondary Education (GCSE) requires eight skills areas to be assessed.

Doran *et al.* (1992) suggests a scoring form for a science laboratory test with criteria based on experimental design and experimental report. Their suggestion appears below:

School/Student ID. No. _____		Reader ID No. _____	
Date _____		Time _____	
Subject Area	B C P	Task	1 2 3 4 5 6
PART A: EXPERIMENT DESIGN			
1.	Statement	NR	0 1 2 3 4 5 NA
	. Dependent variable _____		
	. Independent variable _____		
	. Expected effect _____		
	. Directionality of effort _____		
	. Experimentally feasible _____		
2.	Procedure for investigation	NR	0 1 2 3 4 5 NA
	. Sequenced strategy or plan _____		
	. Detailed procedure _____		
	. Safety procedure _____		
	. Diagram of set-up _____		
	. List of materials _____		
3.	Plan for recording and organizing observations/data	NR	0 1 2 3 4 5 NA
	. Appropriate dependent variables _____		
	. Appropriate independent variables _____		
	. Units included _____		
	. Concern for repeated trials _____		
	. Organization _____		
PART B: EXPERIMENT REPORT			
4.	Quality of observations/data	NR	0 1 2 3 4 5 NA
	. Qualitative description _____		
	. Accuracy of measurements/ observations _____		
	. Completeness of data table _____		
	. Correct use of units _____		
	. Consistency of data _____		
5.	Graph	NR	0 1 2 3 4 5 NA
	. Has an appropriate title _____		
	. Axes labelled with correct variables/units _____		
	. The scale of the graph is appropriate _____		
	. Completeness of data table _____		
	. Correct use of units _____		
	. Consistency of data _____		
6.	Calculations	NR	0 1 2 3 4 5 NA
	. Used all data available _____		
	. Correct use of units _____		
	. Accuracy of calculations _____		
	. Knowledge of relationships _____		
	. Correct substitution into relationship _____		
7.	Forms a conclusion from the experiment _____	NR	0 1 2 3 4 5 NA
	. Correct use of variables _____		
	. Accurate relationship among variables _____		
	. Consistent with data _____		

.Sources of error	_____
.Consistent with scientific principle	_____
Doran <i>et al</i> (1992)	

Wrigley *et al* (1986) suggest a format for assessing project work as shown below:

Item	Raw score	Multiply By	Total marks out of
1. Summary	3 2 1 0	x 1	/3
2. Table of contents	3 2 1 0	x 1	/3
3. Outline of background to study	3 2 1 0	x 2	/6
4. Main line of argument (Hypothesis objectives)	3 2 1 0	x 5	/15
5. Evidence/research/ observations:			
Written	3 2 1 0	x 2	/6
Statistical tables graphs	3 2 1 0	x 1	/3
Diagrams, maps, photos	3 2 1 0	x 2	/6
Practical fieldwork	3 2 1 0	x 4	/12
Bibliography	3 2 1 0	x 1	/3
6. Conclusions	3 2 1 0	x 5	/15
7. Critical thinking: evidence of ability to reason, to evaluate results, etc.	3 2 1 0	x 5	/15
8. Presentation/Communica- tion skills:			
Report (final draft)	3 2 1 0	x3	/9
Oral examination	3 2 1 0	x1	/3

(Assessment of project work adapted from Wrigley *et al.* (1986).

Likewise various examinations boards and institutions have formats along which Learners' or candidates may be assessed.

The type of assessment technique and or format to be used in assessing learners work would depend on circumstances and the outcomes that need to be assessed.

The important questions that teachers need to ask themselves are why assess? What are the main purposes of the assessment? What should be assessed? What should be the scope of the assessment? Who is to be assessed, when, and by whom? How should the assessment be done?

Answers to these questions would help the teacher select and use appropriate assessment.

3.5 BIOLOGY PRACTICAL WORK USED IN THE PROJECT AND HOW THEY WERE ASSESSED.

Practical work used in the project was selected from the biology syllabus of the college. These were selected to serve to support the theory students were learning. Practical work in the syllabus involved basically plant and animal physiology work, classification of plants and animals, ecological fieldwork and anatomy. Various practical exercises can be identified which may be used for the development and attainment of specific outcomes. Three exercises were selected to represent the spectrum of practical work in the biology syllabus; one on diversity/classification of organisms, fieldwork in ecology and food tests.

3.5.1 ASSESSMENT APPROACH

For each practical exercise, I decided to first, formulate the expected outcomes. To do this I wrote down what students might do and what they might learn during the practical. From these, expected outcomes were written down and assessment criteria established.

These criteria were then discussed with the students and agreed upon. Students were then aware of what was expected of them. An assessment format was then prepared. In the three exercises, students were given the practical problem and were asked to formulate a hypothesis, and to plan and design the experiment. They used apparatus and materials available. In a few instances however, they were asked to innovate. They were encouraged to manipulate the apparatus and write down the appropriate procedure they went through in performing the exercises.

In the exercise on fieldwork students were asked to plan, organize and suggest ways of collecting data and using such data in their work.

The students worked in groups made up of four or five persons per group. Assessment of the exercises was in two stages – while the practical exercise was going on and after they had presented their work. In all I got involved in the work by visiting the groups, and giving suggestions, answering questions and assessing. We were able to discuss the over all assessment by looking at the weaknesses or strengths of abilities shown by students. Suggestions were also made on improvements on the formats used.

3.5.2 EXERCISE ONE: CLASSIFICATION/DIVERSITY OF ORGANISMS

- Theme:** Life and living
- Topic:** Construction of a branching diagram for the separation of Laboratory glass ware.
- Problem:** Collect a set of laboratory glassware – made up of a beaker, dropping bottle, measuring cylinder, volumetric flask, round Bottom flask, conical flask, petri-dish.
- (i) construct a branching diagram to separate these items using observable features.
- (ii) construct a key for the identification/separation of the glassware.
- Purpose:** Students will develop the ability to classify organisms.

(a) WHAT STUDENTS MIGHT DO AND LEARN.

- Students might collect different glassware based on their observable characteristics.
- Students might draw diagrams for separation of the glassware.
- Students might name the glassware.
- Students might organize the work in some way.
- Students might learn how to use answers to questions to separate apparatus.
- Students might learn to present work in a systematic way.
- Students might learn to observe critically.

(b) OUTCOMES THAT WOULD BE ADDRESSED:

1. Use process skills.
2. Understand concepts.
3. Responsible decision making
4. Apply scientific knowledge.

(b) ASSESSMENT CRITERIA**(i) Branching diagram**

- construction of branching diagram
- use of observable characteristics
- systematic presentation of work
- names of apparatus use
- appropriate heading/caption of work.

(ii) Construction of a key for separation

- construction of key from branching diagram
- use of observable characteristics
- systematic presentation of work
- names of apparatus used
- appropriate caption/heading.

3.5.2.1 ASSESSMENT FORMAT ON BRANCHING DIAGRAMS AND CONSTRUCTION OF A KEY FOR SEAPRATING LABORATORY GLASSWARE**A. ON OBSERVATION****SCORES****COMPETENCY LEVEL**

(i)	Branching diagram constructed accurately	9 8 7	III
(ii)	With one or two minor inaccuracies	6 5 4	II
(iii)	With a major inaccuracy/and one or two minor inaccuracies	3 2	I
(iv)	Several inaccuracies	1	
(v)	Skill not demonstrated	0	0

B. ON RECORDING SCORES COMPETENCY LEVEL

(i)	Key constructed accurately from branching diagram	9 8 7	III
(ii)	Key constructed with some disorder	6 5 4	II
(iii)	Key constructed with considerable disorder	3 2 1	I
(iv)	Skill not demonstrated	0	0

HEADING TO WORK CORRECTLY GIVEN = 2
TOTAL SCORE OUT OF (20)

COMMENTS:.....

MARKING SCHEME

A. On observation:

- pouring spout 1
- calibration for volume 1
- cover/ lid 1
- size 1
- volume 1
- neck 1
- height/length 1
- round bottom 1
- flat bottom 1
- sloping sides 1
- curved sides 1

[10 x 1 = 10]

A. On recording – key formation

- vertical columns headed
- horizontal columns
- correct terms used
- comparison made (a certain number given)
- results recorded in single table
- overall layout

(i)	from branching diagram	8 7	III
(ii)	Key constructed with some disorder	6 5 4	II
(iii)	Key constructed with considerable disorder	3 2 1	I
(iv)	Skill not demonstrated	0	0

HEADING TO WORK CORRECTLY GIVEN = 2
TOTAL SCORE OUT OF (20)

COMMENTS:.....

.....

ASSESSOR:

DATE:

MARKING SCHEME:

A. ON OBSERVATION:

Margin

Lamina

Leaf

Vein Structure

Stalk Structure

Colour of leaf

Simple

Compound : Type etc.

Any correct observation x 1 + 9.

B. ON RECORDING (KEY FORMATION)

- Vertical columns headed - 1
- Horizontal columns headed - 1
- Correct terms used for headings in vertical columns- 2
- At least 3 comparisons made- 2
- Results recorded in single table - 1
- Overall layout clear - $\frac{2}{9}$

MARKS OBTAINED	0	1-6	7-12	13-30
COMPETENCY LEVEL	0	I	II	III

I = **Below average**
II = **Average**
III = **Above average**

**Adapted from GCSE Biology Practical Assessment: Teachers Manual:
(Newsham 1988 p. 71-73).**

3.6 EXERCISE TWO : EXPERIMENTS ON FOOD TESTS

Theme: Life & Living

Topic: Experiments on food tests.

Problem: You are provided with four test tubes A,B,C & D containing four different solutions respectively. Perform physiological tests to identify the solutions using the reagents supplied. Write out a hypothesis for your work and give an account of the procedure you used including a data table for recording your observations and conclusions.

Your work will be collected after the practical period.

Students submitted their work after 1 hour.

Outcomes:

- Students can design their own experiment to identify food substances.
- Students can observe colour changes involved in the identification of food substances through the use of specific chemicals/reagents for food tests.

Focus Specific Outcomes:

- Use process skills
- Understanding concepts
- Responsible decision making
- Apply scientific knowledge

Assessment Criteria:

- Ability to write correctly a statement of hypothesis
- Ability to plan experimental work in sequential manner
- Ability to record observations accurately in a data table
- Ability to report correctly on experiment
- Ability to form a conclusion from the experiment.

Equipment/apparatus, chemicals and materials:

Glass beakers (250ml), measuring cylinders (25ml), test tubes, test tube holders, Bunsen burners, tripod, gauze;

Food samples: - 10% glucose solution, 10% albumin, 1% starch solution;

Buuret reagent, iodine solution, Benedicts solution.

3.6.1 ASSESSMENT FORMAT ON FOOD TESTS

	<u>CRITERIA</u>	<u>SCORES</u>
1.	Statement of hypothesis - experimentally feasible	0 1 2 3
2.	Procedure for investigation – - sequenced strategy or plan -detailed procedure -safety procedures -list of materials -use of correct chemicals	0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3 0 1 2 3
3.	Plan for recording observations and data - correct data table - accuracy of observations	0 1 2 3 0 1 2 3
4.	Forms conclusion from the experiment. - consistency with data - relevancy of conclusion (identity of solutions)	0 1 2 3 0 1 2 3
5.	Total out of	/30
6.	Comments: _____	

Scoring Procedure: 0	-	ability not demonstrated
1	-	poor
2	-	ability demonstrated
3	-	very good.

(Adapted after successful laboratory Assessment:
Doran *et al* 1992).

3.7 EXERCISE THREE: FIELD WORK ON AQUATIC BIOLOGY

Fieldwork on aquatic biology.

Problem: Project work on an aquatic habitat.

You are to study the Buffalo river (a fresh water habitat outside the college) over a two week period. You may have to identify plant and animal species in and on the banks of the river;

Draw a sketch to show the terrain and any special features you may identify;

Measure the speed of movement of the stream;

Determine the depth of penetration of light using a sechi disk, take readings of temperature and pH.

Describe inter-relations of organisms you identify in the habitat you study.

Write a report of your studies and submit this for assessment.

OUTCOMES:

- students will identify inter-relations in an aquatic ecosystem.
- students can take physical measurements in an aquatic-ecosystem.
- student will learn how to write up projects.

FOCUS OUTCOMES:

- use process skills
- understanding concepts and principles
- responsible decision making
- apply scientific knowledge.

ASSESSMENT CRITERIA:

- ability to identify biological phenomena
- ability to formulate investigative questions
- formulation of a plan of action.
- collection and recording of data.
- analysis/inferences from data.
- communication of findings.

EQUIPMENT/APPARATUS AND CHEMICALS:

Thermometer, secchi disc, stream flow meter ropes, storage bottles, plank tonic net, vegetation net, herbarium, dissecting instruments, glass beakers, pH indicator, FAA solution, Formaldehyde solution.

3.7.1 ASSESSMENT FORMAT ON AQUATIC ECOLOGY STUDIES

1.	Statement of hypothesis				
-	directionality and clarity	0	1	2	3
2.	Procedure for Investigation				
-	strategy or plan	0	1	2	3
-	list of apparatus/materials	0	1	2	3
3.	Plan for recording and organizing Observations/data.				
-	organization of tables	0	1	2	3
-	identification of organisms	0	1	2	3
-	readings taken (at least three times over two weeks)	0	1	2	3
-	identification of at least 5 different inter-relations	0	1	2	3
-	analysis of readings/recording	0	1	2	3
4.	Report on project				
-	critical thinking: evidence of ability to reason, to evaluate results, etc.	0	1	2	3
-	presentation/communication skills	0	1	2	3
	Total score out of				/30

5. **Comments:**

Scoring procedure:

0	-	ability not demonstrated.
1	-	poor
2	-	ability demonstrated
3	-	very good.

(Compiled from Wrigley 1986) Assessment from principles to action and Doran *et al.* (1992) Successful Laboratory Assessment)

4. RESULTS ARISING FROM THE EXERCISES

The skill areas that were assessed included, observation and recording skills, measuring skills, procedure skills, manipulative skills, formulation of an hypothesis and the designing and conducting of an experiment to test it and undertaking project work.

4.1 PROBLEMS ENCOUNTERED

It was noticed that not all the skills or outcomes of any one exercise could be assessed at the same time. This was due to the fact that the class was made up of thirty students. Even though the students worked in groups the development of particular skills by individuals needed individual attention. It was not possible at times to finish a single round to all the groups. The students may be considered adult students but they have had a background of either poor or no experience in practical work or, practical work was not encouraged in their schools. While it was easy for them to do certain things it was difficult for them to do others. Students had been used to the transmission mode of learning –where they were told and taught how to do everything. Giving them a problem to solve such, as the problem on the food tests was not entirely easy for them.

4.1.1 EXERCISES ON CLASSIFICATION

The specific skill to assess under this exercise was observation i.e. how well students were able to use observable characteristics to separate objects and organisms. The assessment was based on what students wrote down and the type of branching diagrams and keys for separation they were able to construct. This was therefore an assessment of a product (Wrigley *et al* 1986). The problem I encountered in this exercise was my inability to determine conclusively if individual students had achieved that particular outcome or not. The work produced was a group effort and certain individuals were likely to have assumed leadership *cum* secretarial duties on their own and would have written and submitted the report. This was possibility.

What assessment was done was based on the groupwork. Marks awarded therefore were the same for all. On that basis then it was assumed that students were able to use descriptive terms to separate the objects and the leaves. A few students were however trying to glean information from other groups. The assessment format used, removed to some extent any subjectivity that could have occurred when the assessment was being done.

4.1.2 EXERCISE ON FOOD TESTS

The assessment format, which was prepared for this exercise, I noticed later, reduced the assessment to a “paper and pencil” assessment. This is because while the exercise was going on, I moved from group to group, explaining issues, giving direction as to how certain things should be done etc.

I also noticed that students demonstrated manipulation abilities such as setting up the apparatus for the experiment, how to hold a test tube correctly etc. These were not catered for on the format. At though what students wrote in their reports might have been correct, there was no clear indication that individuals attained such specific skills. A format therefore ought to have been prepared for the spot assessment while the process was going on. On the basis of the prepared format the experimental reports of some students did not state the hypothesis correctly and some conclusions did not relate the hypothesis. This indicated that members of that particular group had not achieved the attainment of that particular skill. The degree to which the students’ observation was achieved was also not clear to assess. If students indicated the correct colour change they were assumed to have achieve the skill.

The use of the format did not allow me the opportunity of knowing which particular students needed help. My discussions on the work were with the whole class. The only individual attention I gave was when the exercise was going on giving explanations and directions.

However I was not able to attend to all the groups. Other problems included the non-availability of a sufficient number of apparatus and the lack of sufficient elbowroom.

The target skills for assessment were skills involved with experimental design, hypothesis formulation, selection of apparatus and chemicals, experimental plan, experimental procedure, recording results and interpretation and evaluation of results.

It would have been better if I had prepared assessment one assessment form for the actual performance of the experiment to indicate student participation etc. and one for experimental reporting.

I realised that it was not possible for me to assess all the skills at once. It was also not enough to assess those skills only once. Subsequent assessment of those same skills would give an indication of progress or retrogression.

4.1.3 EXERCISE ON FIELDWORK ON AQUATIC BIOLOGY

This exercise was a project work. According to Wrigley *et al.* (1986) the advantages of a project work such as fieldwork include the opportunity to develop thinking, communication, and information, retrieval, aesthetic appreciation and practical and psychomotor skills. He continues to say that project assessment is a form of performance assessment because it is based

on assessing the learners performance on the evidence of the end product (a project report). Project assessment may also include the assessment of skills such as inquiry skills (Wrigley 1986). The target skills (expected outcomes) that were assessed were, ability to identify biological phenomena, procedure for investigation, plan or strategy, apparatus selection, plan for the collection and organization of data, the relation of the data to conclusion(s) and how the project report was written – to show critical thinking, and communication skills. The factors I considered in preparing the assessment format for this project included how to distribute marks especially which part required more marks than the other and so on. In this regard I wrote out the expectations of each part of the report thereby came up with a total. The presence of evidence in the report, according to how clearly such evidence is presented, was an indication of the attainment of the skills. It was difficult to determine whether all the students in a particular group had attained that skill. It was also difficult to assess the communication skill of the report due to the poor language of the students. Because of this, I awarded maximum marks to groups with a slightly better reporting. Apparatus and equipment were not enough to go round. These were passed on from one group to another.

The total marks awarded had both summative and formative functions. This is because while the marks went towards an accumulation of marks for certification, such marks also showed the level of attainment of a particular

skill. I also noticed that although the students studied the same aquatic habitat, their conclusions were difficult. These were assessed according to how they related to the findings in the report.

Our discussions gave us a feedback on how to approach a similar project in the future. We discussed how to formulate a hypothesis, how best to collect data, and how such data is made use of in the project.

I also realised also that the assessment format did not assess all skills. This I considered difficult to do. It required the preparation of different formats for specific skills, and the performance of specific practical to bring out the required expected outcome. The assessment format gave an indication of the problems students went through. It was evident that some students were not able to identify some plants. They were not able to establish inter-relations in the habitat and the food chains they drew were based mainly on theory. Some food chains were impossible. These shortcomings were also part of our discussions and feedback sessions. Newsham (1988) provides examples of assessment formats which may be used to record competency or achievement levels of learners under aspects of practical work on skills such as, following instructions, measurement, manipulation and observation (appendix 1) experimental design (appendix 2) and a format for recording marks for each practical (appendix 3).

4.2 FACTORS THAT MAY AFFECT THE ASSESSMENT OF STUDENTS PRACTICAL WORK

There are several factors that may influence how a teacher assesses the work of his/her students. These factors may include the personality of the teacher, how close he/she is to his students, and his/her opinions about the student. How long a teacher has been with students is likely to affect assessment. Stereotyping may also occur, when the teacher is biased toward the sexes and or when she/he generalizes by assessing all students as 'average' or 'good' or so. Previous assessment is also likely to affect the students' work – i.e. when the teacher has formed an opinion about the student. Comments, which are derogatory or sarcastic, may also affect the moral of a student. Some teachers may be too lenient or too harsh on students. The general classroom atmosphere including physical factors such as heat and light, which may hamper students work, may affect assessment.

Factors, which affected the procedures I used during the project, include the expected outcomes, which were formulated. This is because the criteria which we set reduced the assessment to 'pencil and paper' assessment (Wrigley *et al*, 1986). This form of assessment procedure had the disadvantage of not recording the processes students went through – on the field, as well as in the laboratory. The assessment formats did not record how a student used plankton net, how a water bath was set up or not, how a chemical was poured into a test tube etc. The non-availability of sufficient and appropriate apparatus and materials (not all groups received the same and an equal distribution of apparatus), especially for fieldwork

on ecology affected the way students did their practical. This might have affected their recordings etc. and also their reporting. Although there were indications of students attaining certain outcomes and skills it was difficult to clearly know whether all students understood what they were doing or not. It was also not easy to know if the students understood instructions given and whether they could all plan and execute their experiments etc. It was also noticed that it was not all members of a group that performed the same specific chores. This was because this was impossible. It may also have been due to the fact that certain individual would have assumed control of the group and would have done all the work, including writing and presenting exercises were performed once it was not possible to assess those particular skills in all students.

These and other factors not mentioned are factors, which may affect how practical may be assessed and the validity of the assessment of achievement levels.

Most schools in the rural communities have no laboratories. Where there may be laboratories, facilities may be lacking. In these instances practical work if any, may be limited to simple field exercises and classroom practice. It may be difficult to assess skills, which may not have been taught. Some biology teachers may be the laboratory technician as well as the teacher who does all preparations for practical work. These may place enormous problems on the shoulders of teachers and these may discourage the performance of practical let alone the thorough assessment of work done.

5. CONCLUSION AND SUGGESTIONS

The project on assessing biology practical work was an initial attempt at implementing assessment under outcomes based education. It was aimed at looking at the factors that need to be considered in implementing such policy in schools.

5.1 FINDINGS OF THE RESEARCH PROJECT

Certain issues were raised from the project. These included the fact that assessment in schools was limited to pencil and paper assessments – at least that was the influence my experience brought into the work. Before assessment of any work is undertaken, it would be necessary to determine whether the time was ripe for such assessment or not. It was also necessary for teachers to ask how, what, when and for what purposes the assessment, was to be done. It was also realized no proper assessment could proceed without the setting up of appropriate outcomes. These outcomes would have to be targeted at the attainment of specific skills by students. It was noticed that a teacher would have to prepare an assessment plan including a format.

The project also raised a number of problems that may be associated with the implementation of assessment in practical. These included among others, the fact that an improperly prepared format may not measure what it is expected to measure. It was also noticed that it was not possible to measure a large number of skills at once. Problems encountered included the insufficient provision of the necessary equipment and or facilities that would help teachers teach lessons to be used for

assessments, effectively. A number of suggestions are given below which may help to promote an assessment culture in schools.

5.2 SUGGESTIONS FOR THE IMPLEMENTATION OF AN ASSESSMENT CULTURE IN BIOLOGY PRACTICAL WORK

Arnold & James (1991) describe how they were able to turn assessment into fun at the Icknield school science department in the U.K. They write that the teachers of that school realised the need to keep the assessment of practical skills near to the student, and to integrate it into everyday learning process. They started the whole process by developing several 'can do' statements as central to the teaching and learning of science. The teachers at Incknield always set workable criteria which objectivity were discussed among themselves and where necessary with their students. Their discussions were frank which also helped to establish the objectivity, workability and preciseness of assessment criteria. Teachers shared ideas about good and bad lessons and assessment strategies. This lead to the revision of criterion-referenced statements with revision of expected outcomes. In their practice when a student had attained an outcome such outcome statement was written on students work in class and after written work was inspected. Students therefore became aware of and identified themselves with the attainment of outcomes. Self and peer assessment were encouraged. Teachers endorsed such assessment after discussions with the students. Such discussions were a basis for continuous dialogue between students and teachers leading to a better understanding of the skill to be developed.

Records of assessment of students' work were fully filed for reference and for discussions and for common use by teachers. The teachers of Icknield were above all enthusiastic assessment To them assessment was fun. (Arnold & James 1991)

I have written on the story of Arnold and James at length because of what I consider as good ideas towards the implementation of assessment practice in our schools.

For assessment of practical work to be of developmental use to students and to inform teaching and learning, it may be necessary for teachers to plan assessment strategies that would be convenient to use. Resources used for practical exercises intended to lead to the development of specific skills must be carefully selected. It may be useful for teachers to develop a bank of resources. Teachers must review outcomes and practical exercises from time to time (Wrigley *et al.* 1986). For teachers to achieve outcomes based expectations, it may also be necessary for teachers to spend time to get students to have a feel for achievement, not as failures but as people who would use their non-performance as a basis for future growth. When students are made to learn more from their mistakes they develop positive attitudes to their studies; they would become involved in the learning process. Malcolm (1997) say that because the outcomes based education adopted by this country is 'learner centered', it is important that outcomes based assessment allows students with different skills to demonstrate the extent of their learning. Perhaps the most important thing for teachers to realise is that, being simple taught about changes in assessment will no longer suffice.

Teachers would have to be seen to practice appropriate assessment. Teacher education courses will have to be located within the new, transformation paradigm. Teachers would need to implement model teaching and learning methods and approaches to assessment, which are associated with and appropriate to change (Wilmot 1998).

6. CRITICAL REFLECTIONS

I believe that the whole process of research has led to an enhancement of my knowledge base and experience for assessment. This is because the research project involved gathering information and data concerning literature review on assessment, the methods used in assessing biology practical work, problems that arose from the research, suggesting solutions to such problem etc. My interest in the research project arose from the fact that I was (in fact I still am) looking for answers to questions concerning assessment. The M.Ed. course offered me the opportunity to satisfy that need. The project has added a lot to my personal experience.

PLACE AND PARTICIPANTS OF THE RESEARCH

The research took place in the social setting of my college, Griffiths Mxenge College of Zwelitsha. Before the project could start, I had to inform my rectors, and to ask for their permission to allow me time for it. Then I had to inform my colleagues and students about my intentions. These processes involved discussions and formal letter writing. This was also to ask for the participation of these persons, from the college community, in the research process. I then practiced as a social-constructivist, a practice that opened my eyes to the benefits of other people, helping and co-operating in my work.

LITERATURE REVIEW:

Literature review on the project work took me to the library, where I learned more about modern ways of referencing and how to use these references to look for information on the research. My knowledge in the use of the computer also improved. I was able to choose what I considered relevant information on assessment and in particular practical assessment. There was a particular article on continuous assessment, which I had used in my lectures. After close scrutiny of the literature I came to the conclusion that that article did not contain any information on how continuous assessment may be used to support teaching and learning. I learned how to use pieces of information from various sources to produce a 'new thought' on the subject I also came across and used new words, terms, phrases etc. I learned about how to list and refer to articles, books, journals etc., that there were different way in which such referencing may be done. While I did a lot of individual study and research, I also consulted and discussed issues with my lecturers and colleagues.

DATA GATHERING PROCESS:

This part of the research was quite challenging to me. I was working on two research projects and I did not want to use the same process as for the other one. However, since assessment *per se* cannot be divorced from methods, I was fortunate to have used the same lecturing material for the project on groupwork and assessment. These supported each other in a harmonious way. I had taught the students the theoretical background to assessment including assessment types etc.

I therefore discussed with them expected outcomes on the practical exercises. At one stage I asked the students to prepare their own formats for the assessment of one practical exercise, to my surprise they were able to do this. I considered the formats I prepared perfect but realised during the process that they did not measure activities during the practical exercises. This thought me that in future I would have to think every well about the outcomes expected for every practical. The formats I prepared, I realised later, assessed only the end product of the students work. The outcomes were many on the formats prepared but marking was easy because I was looking at the finished product. I realised that in future I would have to present practical exercises for specific but few outcomes at a time. I also noticed that time usage was very important. One has to manage one's time very well to finish ones work in the stipulated time. Of concern too was the fact that topics selected for the project were part of the syllabus for the students' course. The topics had to be taught and contribute to their final examination. The research project was not to be seen to interfere too much with the students course expectations.

Writing the research report presented me with initial difficulties but these were soon overcome. It demanded my full attention but this was not possible all the time. I realised that I often lost the sequence of thought processes when for one reason or the other I had to stop work to continue another time. The keeping of a dairy did not completely help to revive such lost memory. Domestic pressures also played a part in how effectively I conducted the research.

This is because I spent most time at my office reading, writing etc. to the effect that I did not pay much attention to the house. I am pleased to write that I had the full co-operation of my family in this exercise.

RESULTS OF THE RESEARCH EXPERIENCE

I noticed that because I showed enthusiasm about the project, my students were also willing to help. I believe they might have learned a lot from the experience. This I hope would help them in future. I learned more about the research process. I learned that perhaps I did not have to be over ambitious in taking on too much at the same time. I have come away from the research perhaps a little wiser. I have new and additional knowledge on the subject, how to use assessment to profit teaching and learning. I was exposed to contemporary ideas, questions and applications in a first hand way. I know that I have become part of the research community.

I am grateful that I was given the opportunity for that; and for the support and guidance of my lecturers.

7. REFERENCES:

1. Arnold W., & James J. (1991). Assessment It can be fun! School Science Review 72(261) 131-134.
2. Carrick, T. (1987). Reflections on practical assessment in GCSE 1: A survey of biology syllabus requirements. Journal of Biological Education (1987) 21(2).
3. Cunningham, D. J. (1992). Assessing constructions and constructing assessments: A dialogue. In T. M. Duffy & D. H. Jonassen (Eds.). Constructivism and the Technology of Instruction. A conversation. (pp. 35-43). Hills Dale, New Jersey: Lawrence Erlbaum and Associates.
4. Doran, R. L., and Boorman, J. and Chan, A. and Hejaily, N. (1992). Successful laboratory assessment. The Science Teacher. 59, 22-27.
5. Dowing H. (1998). 'Lecturer handout un-referenced'.
6. Echeberger, M. L., and Shaw, K. L. (1992). Teacher change as a progression of transitional images: a chronology of a developing constructivist teacher. School Science and Mathematics. 92(8), 411-417.
7. Gipps, C. V. (1994). Beyond testing: Towards a theory of educational assessment. London: The Falmer Press.
8. Hodson D., (1996). Practical work in school science: exploring some directions for change. International Journal of Science Education. 18(7), 755-760.
9. Hodson, D., and Hodson, J. (1998). From construction to social constructivism: a Vygotskian perspective on teaching and learning science. School Science Review. 79(289), 33 – 41.
10. Hughes, M., & White, T. (1992) Developing an assessment system for international schools which follow the U.K. National Curriculum. The Journal of Design & Technology Education. 2 (2) 150-162.
11. Malcolm C. (1997). Thoughts from South Africa: Lab talk, 41(5): 20-21.
12. Matiru M., Mwangi A., and Schlette R. (Eds) (1995). Teach Your Best: A handbook for university lecturers. Bonn: German Foundation for International Development.

13. Newsham, D. (1988) GCSE Biology Practical Assessment. Teacher's Guide. London: Hutchinson Education.
14. Nott, M., (1996). When the black box springs open: practical work in schools and the nature of science. International Journal of Science Education. 18(7) 807 – 818.
15. Prawat, R. S. (1992). Teachers' beliefs about teaching and learning. A constructivist perspective. University of Chicago.
16. South Africa (Republic). Department of Education (1990). Colleges of Education Course Structure. Pretoria
17. South Africa (Republic). Department of Education (1994). Curriculum 2005. Pretoria.
18. South Africa (Republic). Department of Education (1996a). Curriculum Framework for General and Further Education and Training. Pretoria.
19. South Africa (Republic). Department of Education (1996b) Discussion Document. Life Long learning through a National Qualifications Framework. Report of the Ministerial Committee for Development Work on the NQF. Pretoria.
20. South Africa (Republic). Department of Education (1996c). Recommendations for the implementation of assessment policy. Pretoria.
21. van den Berg, E. & Giddings, G. (19?) Science Teaching in the laboratory: A diagnosis of problems. Curtin University of Technology.
22. van Harmelen, U. (1996). (Assessment in Education) M.Ed. & B.Ed. lecture notes, Education Department, Rhodes University, Grahamstown.
23. van Harmelen, U. (1997). (An overview of assessment and the place and purpose of portfolios). M.Ed. in Environment Education notes; Education Department, Rhodes University, Grahamstown.
24. Volmink, J. D. (1994). Evaluation & Assessment Practice in the South African Context. Journal of Education Evaluation. Special Conference Edition.
25. Wilmot, D. (1998). Portfolio as a tool for course work assessment within the context of pre-service Geography teacher education: A South African perspective. The Geographical Association Annual Conference, University of 1998 Leeds, 15-17 April.

26. Wrigley, J., Lloyd-Jones, R. Bray, E., Johnson, G., and Currie, R. (Eds.) (1986). Assessment: From Principles to Action: Guides to Assessment in Education. London. Macmillan.
27. Ysseldyke, S. (1988). Assessment in Special and Remedial Education. Houghton Mifflin Co.

Appendix II

Candidate's Record of Assessment

Name _____

Teacher _____

Examining Group _____

Skill area	Skill*	Exercise No.	Date	Competency Level
<i>Following instructions</i>				
<i>Manipulation</i>				
<i>Measurement</i>				
<i>Observation</i>				
<i>Recording</i>				
<i>Interpretation</i>				
<i>Experimental design</i>				

