PROJECT 1: THE TEACHING OF ECOLOGY IN SCHOOLS: A LITERATURE REVIEW

PROJECT 2: CONSTRUCTING ECO-CONCEPTS: STUDENTS' EXPERIENCES OF A CONSTRUCTIVIST APPROACH TO LEARNING ECOLOGY

PROJECT 3: FINDING A NICHE: THE POTENTIAL OF A COLLEGE OF EDUCATION TO BECOME AN IN-SERVICE TEACHER EDUCATION INSTITUTION

Research reports submitted in partial fulfilment of the requirements for the degree of

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DEDICATION

I DEDICATE THESE RESEARCH REPORTS TO THE MEMORY OF MY

FATHER, OPANIN KWABENA WIREDU, WHO IN HIS LIFE TIME ALWAYS

ENCOURAGED ME TO STUDY FOR A MASTER'S DEGREE

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ABSTRACTS

Project 1: This is a literature review on the teaching of ecology in South African schools. The importance of ecology education in the school curriculum is well reported. It is also reported that in spite of the apparent importance of the subject, not much ecology is taught or learned in schools. This report examines what ecology is supposed to be about and the challenges that confront its teaching. The approaches to teaching the subject are also discussed. It would seem that if teachers focus on teaching ecological concepts using constructivist teaching/learning strategies, students might be helped to learn ecology meaningfully.

Project 2: 'Constructing eco-concepts' is a case study that reports the effects of a module whose design was informed by social constructivist ideas on the understanding of selected ecological concepts by college students.

Social constructivism as a philosophy of learning has gained increasing attention in science education in recent times and yet the approach is so alien to so many. Many teachers still teach by the traditional teacher-centred approaches. This research project reports the conceptual change of students after undertaking the module. It also reports the students' perceptions about the teaching/learning strategies employed in the module. It would seem that the social constructivist strategies used in the module assisted the students to improve their frameworks of ecological concepts. Data also tend to reveal that the students enjoyed the approach to learning and had positive views about the social constructivist teaching/learning approach.

Project 3: With the advent of the new curriculum framework for South Africa, the outcomes based curriculum, it would seem that teachers could no longer approach teaching by the traditional transmission methods. Colleges of education have been criticised for producing teachers who do not seem to be adequately prepared for their job. Presently, the argument seems to be that teachers would need in-service education on a wide scale and the colleges of education would seem to be important in-service teacher education centres. This research, using case study methodology, investigated the potential of one of the colleges of education to become an in-service teacher education institution based on its physical and human resources.

PROJECT 1

THE TEACHING OF ECOLOGY IN SCHOOLS:

A LITERATURE REVIEW

PROJECT 1

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1 INTRODUCTION

The importance of ecology in biological education is well reported. Documents on environmental education assume that ecology is an essential part of the education of all pupils (Booth and Sinker, 1979:261; Uma, 1988:67). According to Hale (1986:179) and Roberts (1997:240), ecology is central to the understanding of environmental processes. In the view of Hale, the role of ecology should be seen as an integral part of broader based environmental studies. For Adeniyi (1985:311), the study of ecology is of major importance in understanding biological phenomena. A very large number of pupils will study no biology after leaving school (Uma, 1988:71), and some understanding of ecology is just as important for those who leave school at the first opportunity (Booth and Sinker, 1979:261). Kuechle (1995:208) argued that since biology is a subject chosen by a great majority of high school students and biology is often the final science course that a student will ever take, it is important that ecological principles be a strong component of the general biology curriculum.

> Environmental crises abound. For this reason, environmental education has become part of many schools' curricula. By showing students how they can participate in resolutions to environmental problems, teachers can make issues discussed in the classroom tangible. The result is more environmentally aware citizens whose knowledge will benefit society beyond their formal schooling (Margolis, 2000:42).

In spite of the apparent importance of ecology in the school curriculum, it seems doubtful that much ecology is taught or learnt in schools (Booth and Sinker, 1979:261). Roberts (1997:240-242) opined that young people are interested in environmental issues but biology teachers have a view of ecology that is not always conveyed to students. Openshaw and Whittle (1993) found that both teachers and students perceived ecology as a difficult subject. Adeniyi (1985) also found a number of ecological concepts about which students have misconceptions. Much as some biology topics may have intrinsic difficulty, the way in which they are presented to students may be adding to the difficulty (Bahar *et al.* 1999:84).

Today more than ever before, teachers have a special obligation to inform students about environmental issues (Van Vollenstee, 1997:2). We, as teachers of biology,

are responsible for ensuring that the population at large understands the ecological processes on which all life depends (Evans, 1988:136).

In this report, I intend to discuss what ecology means in the school curriculum and the challenges that confront ecological education in South African schools. I will also discuss the approaches to the teaching of ecology and suggest a way by which teachers could approach ecology teaching.

2 WHAT IS ECOLOGY?

Booth and Sinker (1979:262) stated that a major issue facing teachers that causes them difficulty about the teaching of ecology is the definition of what should be learnt and understood. According to them, ecology is concerned with the relationships of populations of plants and animals with each other and with the environment. Roberts (1997:240) defined ecology as the scientific study of the inter-dependence of all organisms in an ecosystem and is the fundamental basis for understanding that human activity in the environment can influence the whole ecosystem. Harper (1982:123) believed that such a definition is too delimited. Hale (1991:20) also argued that this definition of ecology gives no indication of the nature of ecological science. According to her, as a science, ecology does not appear to have a strong overall philosophical or theoretical base. This presents ecologists with a problem in communicating ecological science to the wider world, and, in relation to schools, positively influencing the curriculum.

The word *ecology,* as derived from the Greek words *oikos* and *logos,* (Owen, 1976:2; Thienel *et al.* 1979:489) simply means a study of homes. In ecological context it would mean a study of habitats or environments. The Reader's Digest Great Illustrated Dictionary explains 'environment' as the aggregate of circumstances surrounding an organism or a group of organisms. Specifically, according to the dictionary, it means (a) the combination of external physical conditions that affect and influence the growth and development of organisms, and (b) the complex of social and cultural conditions affecting the nature of an individual or community. The concept of the environment covers just about everything associated with organisms and it has about the same meaning as 'surroundings' (Owen, 1976:1). This would imply that ecology deals not only

with the biophysical but the socio/cultural, economic and political influences on organisms in their surroundings. Hereto, ecologists have been interested only in the biophysical, namely, the interactions between organisms and with the physical environment. Correctly so, it seems, because dealing with the other aspects of the environment would mean touching on aspects like attitudes and values that would contradict the purpose of ecology as a science that is supposed to be value-free. The scope of ecology, however, has changed (Hale, 1987:14) and ecologists have in recent times become increasingly interested in the human impact on the environment leading to studies on pollution and development and conservation. It seems one cannot emphasise the human impact on the environment without referring to attitudes and values. Humans are organisms with the most destructive influence on the environment (Cochrane *et al.* 1974; Owen, 1976) and a change of human attitudes and values would essentially need to be part of such ecological education. In fact, ecologists now study the effects of human activities on the natural world (Cochrane *et al.* 1974:12). But is that what ecology in the school curriculum is about?

The science of ecology is a fairly new one. It started only over one hundred years ago (Smit and Van Dijk, 1987) but in recent years, it has become a household word (Owen, 1976:2) and has become a subject of much misuse and abuse (Hale, 1987:14). Hale (1987) correctly, perhaps, argued that the widespread use of the term does not necessarily imply an equally widespread understanding of what it means. The term ecology has begun to enter discussions about economic development, industrial growth, and standards of living (Owen, 1976:2). Politicians, economists, environmentalists, pressure groups, and a host of others use the term with apparently different meanings from the understanding of biologists. There is much misunderstanding as to what ecology is, and as Owen (1976:4) stated, 'although the present awareness of ecology may have been stimulated by apparent dangers of pollution, this is not primarily what ecology is about. It is a much bigger and a more complex subject than this. Ecology is not even primarily about man.' Even among ecologists there seems to be different understandings and misconceptions of the term and hence the difficulty and confusion about its teaching.

To develop a better understanding of what ecology really is, I would like to refer to the following definition of Putman and Wratten: 'Ecology may be considered the science of natural history – the scientific study of how animals and plants live, and why they live the way they do: a study aimed at understanding the basic underlying principles of operation of natural systems' (1984:13). Earth's natural systems work in harmony. They are self-regulating and bio-regenerative and they are balanced. We need to learn and understand more about how the natural systems of our earth function. As Odum (1989:6) stated, the earth's life-support systems involve a complex array of sub-systems, and we do not have a clear understanding of how the whole thing works. That is what, I think, ecology is about. The professional ecologist is interested in finding out how the balance of nature is achieved (Owen, 1976:20). Such a study covers so wide a field that it is necessary for the ecologist to approach his work from clearly defined directions (Thienel *et al.* 1979:489).

To understand the subject, according to Owen (1976:4), it is necessary to abandon an entirely man-oriented approach and to consider instead the inter-relationships of all life and the environment. In doing so, I think, the principles (concepts) of the subject need to be identified – principles that will be taught to and learned by students. According to Booth and Sinker (1979:261) the principles of ecology are elusive and tend to mean different things to different people. They believed that this is partly because of the complicated nature of the subject and the gaps in our understanding of it. According to them (Booth and Sinker, 1979:264), the principles of ecology have yet to be defined but it is possible to distinguish a number of useful concepts. They listed the following as the important concepts to be learned in an ecology course:

- Physical attributes of the environment.
- Populations, communities, and ecosystems.
- Trophic levels: material flow, primary production, consumption, and decomposition.
- Energy flow.
- The species structure of an ecosystem.
- Ecological niche.

- Interaction between species.
- Variation in performance of organisms in relation to variation of abiotic factors.
- Mobility of individuals and populations in relation to the environment.
- Succession and change.

Ecological concepts have been developed over the years. For example, as reported by Smit and Van Dijk (1987), the concept of inter-relations of organisms (biotic factors) was developed between 1707 and 1788. The concept of physical (abiotic) factors was developed in about 1859 and the concept of community evolved in the 1870s and 1880s. The concept of succession (change) arose in 1890 and the pyramid of numbers as an ecological concept was developed in 1935. Ecology is a rapidly developing subject (Putman and Wratten, 1984:11). Irwin (1999:1) gave the following as the basic concepts of ecology. They are: 'Trophic levels', 'material cycling', 'energy flow', 'limiting factors', and 'constant change'. Indeed, these five principles seem to embody all the principles listed by Booth and Sinker. But Irwin (1999) explains that as a relatively new science, many ecological terms have not yet been standardised and there is still some discussion among ecologists about their use. It is hoped that as new information is gathered from research activities on ecology, its principles shall be clarified in course of time to help improve our understanding of the subject. The first of the objectives of the 1985 senior secondary biology syllabus for South African schools is to provide a course that will develop in pupils an understanding of fundamental biological principles. It would seem that the identification of the principles/concepts that under-gird ecology would ensure an understanding of what the subject is about and therefore its successful teaching.

Having discussed what ecology is supposed to be about and the principles to be learned by students, I will proceed to discuss the factors affecting the teaching of the subject in South African schools.

3 FACTORS AFFECTING THE TEACHING OF ECOLOGY

Booth and Sinker (1979) identified the following issues as among those that contribute to preventing the effective teaching of ecology in schools:

(a) The nature of the subject.
(b) Difficulties and confusion about how to teach ecology.
(c) Examination syllabi and papers.
(d) Lack of confidence of teachers.
(e) Lack of facilities.

Uma (1988) found the following difficulties in teaching ecology as perceived by Nigerian teachers:

(a) Difficulties in the education system, such as lack of provision of appropriate teacher training.
(b) Syllabus difficulties, such as ecology not often being geared towards solving major biological problems.
(c) Problems of approach in ecology teaching which form the greater part of the perceived problems.

Uma (1988) also cited Moss and Theobald (1979) who found that the major difficulties in teaching ecology in Kenya were:

(a) The large amount of time required for teaching ecology is disproportionate in relation to other syllabus topics in four-year course leading to O-level.
(b) The weighting given to ecology in the syllabus is not reflected in the examination.
(c) Identification of local flora and fauna is often considered difficult.
(d) Finding a suitable habitat within the environs of a secondary school.
(e) The shortage of appropriate, inexpensive equipment.
(f) Lack of opportunities for making simple quantitative measurements and interpreting collected data.
(g) Insufficient teacher training, both pre-service and in-service, in the teaching of ecology.
(h) Maintenance of student interest during the study of ecology.

Although these findings were made about two decades ago, they would seem to be valid even today, especially in South Africa. I will discuss the challenges confronting the teaching of ecology in South Africa under two broad headings, namely; curriculum issues and the teacher factor.

3.1 Curriculum issues

3.1.1 Ecology in the South African school curriculum

Ecology as a school subject found its way into the South African school curriculum only recently. In fact, ecology first appeared in the school curriculum in 1977 (DoE, 1977). Prior to 1970, ecology was not even taught as part of biology courses in many South African universities and colleges (Boltt, 2001. pers. comm.). Consequently, there are many teachers in the South African education system that did not experience ecology as part of their formal education. The result is that there are many teachers who are unable to cope adequately with the teaching of the subject. Knowledge of subject matter is critical in teaching (Eisner, 1993) and it would seem unlikely that teachers who have not had sufficient background 'knowledge' in ecology would be able to teach it effectively. It becomes even more critical if one considers the complex nature of ecology.

3.1.2 Syllabi on ecology

School curricula have been criticised for not providing an adequate and balanced approach to this subject area (Hale, 1991:20). Syllabi, according to Evans (1988:137), can be criticised for presenting narrow, somewhat inward-looking perspective of ecology. A tendency that causes difficulty for teachers, in the view of Booth and Sinker (1979:262), is the isolation of ecology as a separate subject within biology rather than treating it as an integral part of the course. Kinchin (1993) found that 96 per cent of schools investigated in England and Wales treated ecology as a discrete topic. A cursory look at the South African school curriculum seems to show that ecology is treated as a discrete topic. Uma (1988:67) reported that in Nigeria the "Alternative Biology" syllabus that seemed to integrate ecology with other biology topics was taken by only few privileged schools. The majority of students followed the "Biology" syllabus that treated ecology as a discrete topic.

The 1977 amended biology syllabus for the senior secondary course in the Cape Province of South Africa also treated ecology as a discrete topic among other biology topics. Themes on ecology were covered in section 9 that happened to be the last section of the syllabus (DoE, 1977). The revised syllabus of 1985 did not fare any better. Only some themes were moved to section 1 to be studied in standard 8 but still remained a discrete topic among the biology topics. Ecology, according to Owen

(1976:20), is not a discrete topic and as Uma (1988:67) argued, the separation of ecology into a syllabus topic is an open invitation for many schools to effectively leave it out of their courses altogether.

The problem is sometimes aggravated by the fact that syllabi are usually arranged in such a way that ecology is placed at or near the end of sequence of topics. The tendency is that teachers tackle syllabi from the beginning and work towards the end. In such a situation, ecology is not taught at all or only partially tackled. Themes on ecology in the matriculation section of the 1985 biology syllabus for the Cape Province of South Africa appear as the last topic in the syllabus. Experience shows that syllabi are not usually completed and the topics near the end fall away. Harper (1982) proposed that ecology be integrated in the biology syllabus. He proposed the following scheme (Table 1) by which themes on ecology could be integrated with other biology topics:

Table 1

Topic	Ecological concept
Photosynthesis	Food chains (part); woodland structure; ocean and freshwater stratification.
Nutrition	Nutrient cycles; soils (part); food chains (part); parasitism, predation, symbiosis, commensalisms.
Respiration	Energy flow.
Gas exchange	Oxygen and carbon dioxide cycles.
Osmo-regulation and transpiration	Water cycle; soils (part).
Reproduction	Population dynamics; dispersal; distribution (part).
Genetics	Physical and biotic factors of the environment; competition; population genetics; adaptation; distribution (part); social organisms.

Adapted from Harper (1982)

Although the scheme may not be the only way in which ecological themes may be integrated with other biology topics, it shows, at least, that integration is possible. One would want to believe that an integration of relevant ecological concepts with biology topics in the syllabus would help to make ecology more meaningful to students.

3.1.3 Ecology content of biology syllabi

The content of many biology curricula, it seems, do not emphasise the teaching of ecological principles adequately. According to Booth and Sinker (1979:264), an ecology course would be concerned with experiences leading to acquiring or developing the following:

- Ways of approaching ecology.
- Knowledge of concepts.
- Knowledge of and the ability to use models.
- Knowledge of theories.
- Skills.
- Techniques – practical and mathematical.

Evans (1988:136) regretted that many school biology syllabi dealt inadequately with either man's impact on the environment or global environmental problems. He believed that there is the danger that syllabi would be presented in a way that under-emphasised man's interaction with the environment. The trend seems to have changed, though, with increasing attention being paid to human influences on the ecosystem. For example, one of the aims/objectives of Biology (ordinary level) syllabus of the West African Examinations Council (1993) is for students to be able to 'identify the ecological relationship between man and his environment and be able to adopt preventive measures against the spread of diseases and a deterioration of his environment.' By this aim/objective, the syllabus seems to recognise the need to prepare students on environmental awareness. Similarly, one of the objectives of the 1985 Cape Province biology syllabus is to develop in pupils a love and appreciation for the South African fauna and flora and a recognition of the urgent need for nature conservation. But be it as it may, I will want to argue that, that is not what ecology is primarily about (Section 2 of this report has discussed what ecology is about). I believe that students primarily have to understand the principles of ecology and their attitudes to their environments will naturally develop from there.

Hale (1991:21) and Openshaw and Whittle (1993:59) also expressed concerns about the content of ecology in the school curriculum of England and Wales. They contended that key concepts were omitted. Hale (1991) reported that the Science National Curriculum of England and Wales contained 15 per cent biological science

components of which ecology comprised a minor component. Hale (1991) also reported that the majority of students of England and Wales in the last two years of compulsory education take the model B science course. The model B is a reduced course covering only 10 of the 17 attainment targets. She argued that students who opt for the model B course are unlikely to receive grounding in the key principles engendering basic ecological literacy. In South Africa, the matriculation (Grade 12) biology syllabus covers only 'population dynamics' under ecology. Other themes are studied earlier in standard 8 (Grade 10).

It would appear that school syllabi do not accord ecology the coverage it deserves in relation to its supposed importance. This, however, does not appear to be the case in South Africa. The school syllabus seems to cover ecology adequately. The problem rather seems to hinge on the timetable allocation to biology. Most schools in the Eastern Cape Province of South Africa, for example, have only about four hours of instruction per week for biology. This is woefully inadequate to cover all the 'material' in the syllabus thoroughly. School timetables are usually arranged in 35-minute time slots. This makes it impossible for teachers to undertake fieldwork that is so essential in ecological teaching except to arrange fieldwork outside the normal timetable or disrupt the school programmes. The tendency is that teachers would teach the ecological concepts superficially or leave them out of their courses altogether. In some cases teachers may teach the theory and leave the practical to be studied during excursion time if it ever takes place.

3.1.4 Exposure of learners to ecology

Ecology in the school biology curriculum appears to be taught too late in the academic lives of pupils. Uma (1988) reported that a survey undertaken in Nigeria showed that 'Nature Study', that forms a base for ecological learning, was hardly included in the curriculum of even the youngest classes. He further reported that ecology teaching at the secondary school level started in the third term of the final five-year course. Hale (1991) also reported that in England and Wales many primary schools have not gone beyond the nature table for their ecology. In South Africa, ecology is taught as late as grade 10. It may be argued, therefore, that the curriculum seeks to prepare students for examinations and does not emphasise the understanding of ecological concepts and sensitivity to their environments. One may agree with Uma

(1988:70) when he suggested that the biology syllabus be designed in such a way as to teach aspects of ecology right from year one.

The new curriculum framework for South Africa, Curriculum 2005, lays emphasis on environmental education. It is hoped that such a curriculum would be able to bring about improvements in the teaching and learning of ecology in schools. Bahar *et al* (1999:84) argued that changes in syllabi could result in biology topics becoming accessible to students.

3.1.5 Textbooks and the teaching of ecology

Textbooks are by far the most used resource of teachers (Kuechle, 1995:208; Wagiet and McKenzie, 1991/92:32). Citing Gould (1977), Wagiet and McKenzie (1991/92) reported that the textbook was used in more than 60 per cent of lessons in biology, and teachers, therefore, regard it as a very important teaching aid. Wagiet and McKenzie (1991/92) cited Wagiet (1991) who found that 87 per cent of respondents indicated that no other literature other than the prescribed textbooks had been utilised in the teaching of ecology. Kinchin (1993) also found that approximately half of schools sampled in England and Wales used their general course textbooks in the teaching of ecology. With the seemingly high dependence of teachers on textbooks for teaching ecology, it would be reasonable to expect textbooks to have an immense influence on how ecology is taught in schools.

An examination of some textbooks on biology used by South African schools showed that most of them are structured according to the design of the curriculum. Teachers, according to Kuechle (1995:208), use the structure of the textbook to determine the structure of the course resulting in biology classes being taught chapter by chapter. He found that the majority of authors and publishers of high school biology textbooks placed concepts dealing with ecology in the final chapters of the book. If teachers follow the organization of a textbook to teach their biology courses, it would seem reasonable that high school biology students must complete the entire textbook to learn all the content. Unfortunately, students are not completing an entire text during a biology course. In such a case, the ecology section that usually occurs in the final chapters of the book is the most likely to be left out. At best it would be treated only superficially. Environmental educators, according to Kuechle (1995:208), have

expressed concerns that concepts of ecology are not being learned in the present curriculum and the nature of textbooks on ecology could be a contributory factor.

Textbooks usually treat ecology as a discrete topic among other biology topics. Kuechle (1995) reported that out of the 12 high school biology textbooks he examined, only one of them integrated ecological concepts in all the chapters of the book. This does not present the integrated nature of ecology with the other aspects of biology to students. Ecology taught this way can only give a skewed view of the subject to students. Students are for example unable to relate the process of photosynthesis to the food chains and energy flow in the ecosystem. In South African public schools, the government usually provides textbooks to students. Because government usually deals with particular publishers, most schools tend to use similar textbooks. For this reason, students are not likely to be exposed to a variety of textbooks. There is, therefore, only a small chance that students would use textbooks that integrate ecological concepts into all the chapters. Consequently, most students learn ecology as a discrete topic with no relation to other biological concepts.

3.1.6 Examinations on ecology

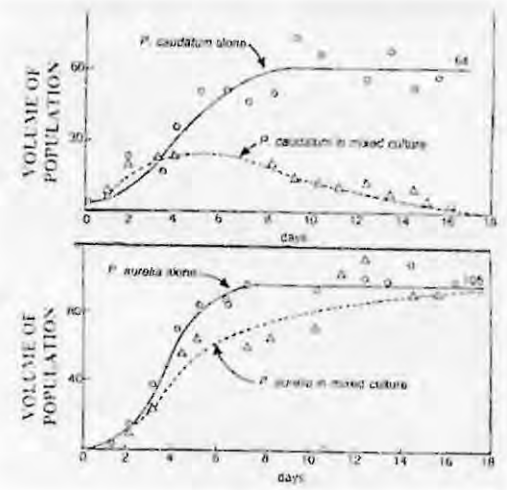
The importance placed on a topic in an examination paper and the type of questions set on it is likely to influence the students' attitude to the topic. Hale (1991:21) reported that ecology in the Science National Curriculum of England and Wales comprises a minor component. The implication is that the examination paper may equally contain only a few questions on it that students could ignore. In the West African Examinations Council's biology (ordinary level) examination paper, the question on ecology is optional. What it means is that students can effectively avoid studying ecology with no apparent consequence on their examination results. In South Africa, the matriculation biology examinations currently cover only *population dynamics* under ecology. An analysis of the 1999 matriculation biology examination papers for the Eastern Cape province of South Africa shows that in the 'standard grade' paper, the ecology question constituted only about 8 per cent of the total marks and in the 'higher grade' paper only about 6 per cent. Comparatively, questions on 'gaseous exchange and respiration' for example in the same paper constituted about 15 per cent of the total marks in the higher grade paper and about 12 per cent in standard grade paper. Even though the questions appear challenging (see figures 1 and

2 for sample questions), it would appear that students could conveniently avoid answering questions on ecology with no major impact on their overall grades in biology. In a situation like this where examination papers allow students to avoid answering questions on ecology, teachers may equally find an excuse to avoid teaching it altogether. Harper (1982:126) perhaps correctly stated that the separation of ecology into a syllabus topic and one or more special examination questions is an open invitation for many schools effectively to leave it out of their courses altogether. This could be one of the reasons why according to Uma (1988:67) the teaching of ecology in many schools tends to be the most neglected sphere of biology.

Figure 1

1999 matriculation biology examination question (standard grade)

The following graphs show the results obtained when *Paramoecium caudatum* and *Paramoecium aurelia* (protozoans) are bred separately and also mixed together. The protozoans were given a constant supply of food which includes bacteria and water. Study the graphs and answer the questions that follow.



1. From the graphs identify the type of growth curve formed by both *P. caudatum* and *P. aurelia* when they are bred separately.
2. Which phases can you identify in the growth curve referred to in 1?
3. Which type of competition exists when *P. caudatum* is cultured alone?
4. Which type of competition exists when the two species are cultured in the same container?
5. Which Paramoecium species experienced great growth when cultured separately? Support your answer.
6. Which species is out-competed (overpowered) when the two species are cultured in the same container?

Figure 2

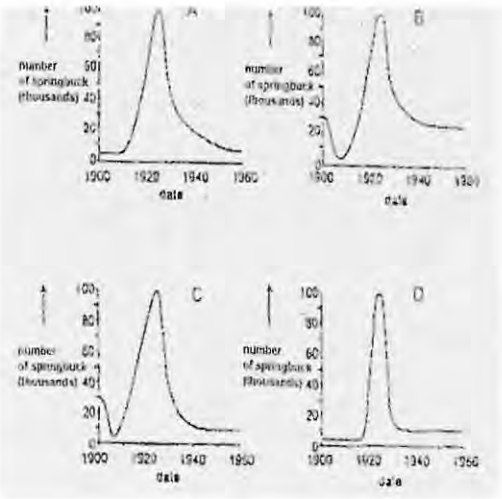
1999 matriculation biology examination question (higher grade)

Read the passage below and answer the questions that follow:

Prior to 1907 there were 4 000 springbuck, and their predators in the Kalahari. It was estimated that this area could have supported 30 000 buck at this time. In 1907 this region was declared a nature reserve and all predators such as lions and cheetahs were eradicated. By 1925 the buck population had increased to 100 000 and everything in reach, grass, tree seedlings, and shrubs were eaten. The area had become overgrazed and over-browsed. In the following two winters 40% of the bucks starved to death. The buck population continued to decrease to about 10 000 individuals. The area continued to be depleted and the damage to the plant productivity will be evident for a long time.

1. Use the information in the passage to illustrate a food web that existed before 1907.
2. Name: (i) Two density dependent factors; and (ii) one density independent factor which caused a decline in the buck population after 1925.
3. Name the type of competition that occurred in the deer population. State reason for your answer.
4. Are deer K-strategy species or r-strategy species? State a reason for your answer.
5. What was the original carrying capacity of the habitat?
6. What is likely to have been the cause of most of the damage to shrub productivity?
7. Suggest a way in which the habitat could have been restored to its former state.

Which of the following graphs (A,B,C,D), shows correctly the changes in the deer population?



Secondly, questions on ecology in the examination papers tend to be mostly set to depict ecology as a discrete topic as shown in figures 1 and 2 above. The questions do not generally test the students' ability to draw links between ecological concepts and other biological concepts. Students are not challenged to learn ecology in a holistic

manner but rather as an isolated discrete set of facts. This way, examination papers do not seem to help students learn ecology meaningfully.

3.2 The teacher factor

Ecology has been acknowledged as a difficult subject to teach. Booth and Sinker (1979) identified five groups of reasons that account for the difficulties teachers face in teaching ecology. One of them was teachers' lack of confidence. Harper (1982:123) argued that the lack of confidence was a rational response to the fact that ecology teaching is difficult. In his opinion, ecology teaching demands an expertise that one cannot reasonably expect from the average biology teacher. Although one may agree that ecology is a difficult subject to teach, one may not attribute teachers' lack of confidence solely to that. An important dimension seems to be the fact that many teachers who teach ecology may not be appropriately qualified (Kinchin, 1993:32; Uma, 1988:70). Kinchin (1993:32) reported that teachers had expressed concern that biology was no longer being taught by specialists in their schools. He found that 73 per cent of responding biology teachers in England and Wales considered themselves as non-specialists in teaching ecology.

In South Africa, the National Teacher Education Audit (1995) revealed that 60 per cent of African teachers were not appropriately qualified for the subjects that they taught. Shortage of science teachers was also reported. The statistics seem to suggest that most teachers who teach ecology in the biology syllabus of schools may not be qualified to teach the subject. Even biology teachers who are qualified in the subject may not necessarily be competent to teach ecology. As it was alluded to earlier in section 3.1, prior to 1970, ecology was not taught in many South African universities. Even though ecology has been part of the biology curriculum of the colleges of education in the recent past, lecturers of the colleges of education did not seem to have the competence to prepare the would-be biology teachers adequately in the subject (Boltt, 2001. pers. comm.). The result is that most high school biology teachers of our schools do not appear to be well equipped to teach ecology.

To study ecology adequately, according to Hale (1991:25), some knowledge and competence in other subject skills is necessary. These skills, according to her, include mathematics and the use of modern forms of technological equipment. Experience of

some South African teacher education programmes would seem to suggest that one would not expect to find these skills in many of the present crop of South African teachers who teach ecology. Ecology teaching in schools would, therefore, be expected to be deficient in those areas as well.

Because many teachers of biology seem to be ill prepared to teach ecology, they resort to teaching methods that do not help students to learn ecology meaningfully. Opie (1986), for example, reported that South African teachers make extensive use of textbook reading as an instructional method. Hale (1986:179) argued that the teaching of ecology implies fieldwork but school ecology is predominantly taught in the classroom. Opie (1986) found that some South African teachers viewed fieldwork as a luxury exercise largely divorced from classroom practice and hence many of them did not employ it. In the next section, I will discuss approaches to teaching ecology as revealed in the literature.

4 APPROACHES TO ECOLOGY TEACHING

Biology teaching in schools has been generally criticised as being ineffective (De Beer, 1996; Okebukola, 1990). Booth and Sinker (1979:262) contended that the methods used for teaching ecology have often resulted in unsatisfactory end-points and have achieved little real understanding among the pupils. A situation where teachers describe ecological concepts to students and ask them to copy notes from the chalkboard would not seem to bring about meaningful learning.

Wright and Backe (1992:33) suggested that a programme of excellence in biology should employ instructional strategies that include the collection and analysis of data, both laboratory and fieldwork, use of living organisms, group and individual instruction, a diversity of questioning techniques, a focus on current major issues, and much less emphasis on textbooks. Researchers (Applegate, 1995; Bailey and Watson, 1998; Gibson *et al.* 1999; Klepper, 1990; McTiffin, 1996; Okebukola, 1992; Wheater and Dunleavy, 1995) have found that fieldwork, group work and co-operative learning, projects/hands-on activities, games and drama/role-play, and concept mapping could be used to bring about meaningful learning of ecological concepts in students.

4.1 Fieldwork

Most teachers recognise that ecology is a field-based subject but the provision of adequate field experience for pupils is generally lacking (Hale, 1986: 179). Hale (1986:182) explained that ecological fieldwork advances the understanding of natural processes and their interactions. According to Booth and Sinker (1979) and Uma (1988) many biology teachers have had little experience of carrying out ecological work themselves and so they lack the confidence to undertake fieldwork.

> Many teachers feel insecure when taking pupils into the field. They are operating outside the familiar structured environment of the classroom, with its four walls shutting out the complexities of the real world, and they are without such crutches as textbooks and overhead transparencies. Furthermore they will often be placed in a situation where they do not have an answer to the many questions that arise as the children explore their surroundings. No matter how carefully teachers have planned and prepared, they will always have to contend with the unexpected (Nightingale, 1987:17).

But as acknowledged by Harper (1982:123) ecological fieldwork is difficult. The problems of undertaking ecological fieldwork as reported include the following: the difficulty of administrative and logistic preparations for field trips, determination of appropriate study sites, selection of appropriate teaching strategies, identification of organisms, follow-up and evaluation activities (Booth and Sinker, 1979; Hale, 1991; Klepper, 1990; Openshaw and Whittle, 1993). Opie (1986:9) argued that there is a pressing need for the development of guidelines in using the outdoors for teaching. Such guidelines may, supposedly, help at least the inexperienced teacher.

4.1.1 Administrative and logistic preparations

The most important part of a field trip, according to Klepper (1990:245), is preparation. She proposed the following checklist of arrangements to be made prior to undertaking a field trip:

1. Secure administrative approval for a specific time, date and place.
2. Discuss with an administrator your liability as teacher in charge.
3. Visit the site before the trip; make reservations if necessary. Take colour slides if possible to be shown to students before the trip.
4. Arrange for transportation; school buses are best.

5. Arrange for a substitute for yourself and for other teachers who may accompany you.
6. Send permission forms and a letter to parents describing the field trip.
7. Notify other teachers of the dates of absence and distribute a list of students attending.
8. If collecting plants and/or animals is going to be an activity, secure permission beforehand.
9. Be familiar with laws on protected species.
10. Prepare handouts for students (rules and regulations, food and clothing, equipment, group assignments, maps, fauna and flora common to the area, notebook instructions, itinerary and costs).
11. Prepare field lectures, if these will be part of the activities.
12. Collect field guides and other reference books that may be of help.
13. Provide a good first aid kit; locate the nearest hospital or clinic in case of emergency.
14. Classroom preparation of the students before the trip is of equal importance.

Although this checklist appears comprehensive and useful to the teacher who may be planning a field trip, points 3 and 4 seem to suggest that ecological field studies must be conducted far away from the school. The checklist by itself would seem to scare any prospective teacher from undertaking fieldwork. Hale (1986) has encouraged the use of the local environment for ecological field studies. She argued (p.182) that the local environment, even in the most urbanised areas, provides the educational potential to demonstrate ecological principles and concepts. If the aim of ecology teaching is to help students understand ecological principles and concepts as was discussed earlier, then students would not necessarily have to study a tropical rain forest or a rocky seashore to understand ecology. Opportunities abound in every school environment for students to observe events that demonstrate ecological concepts such as food chains, adaptations, succession, and nutrient recycling. Using the local environment for ecological field studies seems to have an advantage of cutting off a lot of administrative and logistic preparation as well as financial costs that go with distant excursions and less disruption to the school timetable. Students can for example use a double period of 70 minutes duration to study a rubbish dump and return to class in time to attend the next lesson. What most teachers may probably

need is how to identify appropriate study sites within the school environment for ecological field studies.

4.1.2 Determining appropriate ecological study sites

Booth and Sinker (1979:265-266) listed the following as the characteristics of good field teaching sites that could assist teachers to determine good study sites in their environments:

- Patterns in the distribution of the component parts of the area.
- Gradients in the distribution of things in space or in time.
- Simple systems, small enough in scale to scan at a glance and low enough in number of species to be comprehensively listed.
- Communities of markedly different levels of structural complexity.
- Clearly demonstrable inter-relationships between organisms and their environment.
- Really measurable environmental variables and processes.
- Adaptive variations within species and plasticity of form (in plants) or response (in animals) that can be (shown to be) linked to environmental change.
- Observable interactions between species.
- Discrete populations of readily identifiable animal species.
- Interesting, attractive, and identifiable species of plants or animals to capture students' imagination.
- A reasonable selection of good teaching plants and animals.
- A sufficient diversity of species.
- Students must be able to come into close contact with plants and animals.
- The site should lend itself to the setting up and maintenance of a variety of field experiments.

A critical look at the above checklist would seem to suggest that ecological field studies could be conducted in most school environments or just over their fences. Many South African schools are located in rural areas where most of the features of 'good' ecological study sites, as claimed by Booth and Sinker (1979) above, may come handy. Even in urban school environments teachers should be able to find

appropriate ecological field study sites. The school garden, aquarium, pond, local sewage system, and compost heap all provide possible sites for ecological investigations.

It would be unrealistic to expect that all the characteristics listed above would be found in every school neighbourhood. It should, however, be reasonable to expect to find some of the features in every school environment, urban or rural. Teachers, it would seem, need to take advantage of the enormous potential their immediate surroundings have to offer in terms of ecological field studies. So much, as suggested by Opie (1990:72), can be achieved in a ten-minute walk around the school grounds, or an hour's ramble through the gardens of a sympathetic neighbour. Excursions to distant places could then be used only to complement locally based fieldwork where necessary or feasible (Hale, 1986:183).

4.2 Instructional strategies for teaching ecology

The teaching of ecological subjects has covered a wide range of activity including: fieldwork practical, laboratory practical, report work, seminars, and debates (Wheater and Dunleavy, 1995:179). These activities are intended to help students explore the basic principles that apply to the general study of ecology (Fail, 1995:522). In so doing, teachers employ instructional strategies aimed at helping students learn ecological concepts meaningfully, or do they? Duit and Treagust (1998:20) suggested that conceptual change approaches must be considered whenever science instruction is designed. In this section I will explore some instructional strategies that have been used by researchers and authors to help improve students' understanding of ecological concepts.

4.2.1 Group work and co-operative learning

Wilmot and Euvrard (1999:6) distinguished between group work and co-operative learning though they emphasised that there may be overlaps. According to them, whereas group work might consist of learners who have been assigned to work together, co-operative learning means to learn profitably together. The purpose of group work in biology education, in any case, must be to achieve co-operative learning aims. That is, students work together in small groups to maximise each other's understanding of science concepts. According to Wheater and Dunleavy

(1995:183), co-operative learning is a useful method of teaching ecological theory and practice. Learning is enormously enhanced when it becomes a shared enterprise with other learners (Applegate, 1995:363).

4.2.1.1 Group work in ecology teaching

Applegate (1995) used quizzes as a teaching method to enhance students' understanding of ecological principles in a field ecology course. The quizzes were aimed at helping develop competence in site analysis of ecological influences that had resulted in the state of a site based on evidence at hand. In ecological terms this would cover a wide range of concepts including abiotic factors, biotic components, food chains, biotic inter-relationships, adaptations, and succession. He reported that when students worked co-operatively, they not only improved their grades in the quizzes, but that they evaluated the approach positively. In his model, students are taken to a site such as abandoned agricultural fields, old-field borders, filled wetlands, and abandoned home-sites. Each student is given a quiz sheet with a series of questions designed to test his/her ability to observe and integrate ecological principles to determine how changes have occurred at the site. Students take the quiz individually and then they are provided a second copy of the same quiz sheet to reconsider their original responses after consultation with others in a group.

Wheater and Dunleavy (1995) also discussed models of group work they used for studying (a) woodland plant distribution involving vegetation types, tree biomass, vegetation structure, and tree distribution; (b) stream ecology field practical involving invertebrate types, water pH, dissolved oxygen, and conductivity of water; and (c) ecological issues report and seminar. The model used to study the woodland plant distribution (model A) was managed as follows:

1. The class is divided into two, each half being sub-divided into smaller groups.
2. All the class examine two different woodlands and then each half concentrates on one of them.
3. The sub-groups obtain data regarding different aspects of the woodland that they are concerned with.
4. The results obtained are collated in the laboratory. Each sub-group exchanges data with a sub-group from the other woodland site, analyses both sets of data and produces a report that compares the two woodland blocks.

The stream ecology field practical aimed at comparing two sites on the same stream. The model of management of the group work (model B) was as follows:

1. Two sites are chosen, usually above and below a major influence on river quality.
2. The class is split into sub-groups at each site with each sub-group collecting a different set of data.
3. Members of the sub-groups split to form new sub-groups until each student has collected all sets of data being investigated.
4. The sub-groups exchange results with a group from the other site and, after data analysis, they produce group reports comparing the water quality at the two sites of the stream.

The two investigations described above seem to have the same aim; namely: to compare two different sites of the same ecosystem and the two different models used to manage the group work could apply for each other. The models seem to apply in cases of ecological field study especially where two different sites are being compared. What is common between the two models (A and B) is that different groups of students collect data from different sites and then collate their results. That is, results are shared between the two main groups studying different sites. But whereas individuals in a sub-group do not necessarily have to experience data collection of every investigation in model A, every student takes part in every data collection in model B. The latter (model B), though appears laborious, seems to provide an opportunity for every student to experience a wide range of data collection techniques.

These models (A and B) of Wheater and Dunleavy appear to be similar to that of Applegate described earlier. The similarity can be found in the fact that they are both applicable in fieldwork teaching situations. But they are different in the sense that whereas in the Applegate's model students initially conduct investigations individually, in the Wheater and Dunleavy's model students start by collecting data collectively in small groups.

The third model (C) used by Wheater and Dunleavy applies more in classroom situations. It involves students obtaining information from library and other sources in

order to produce a report and oral presentation on a single ecological issue. In the model:

1. Groups select a topic within a brief determined by the teacher.
2. The topic is split into separate parts and each student researches one aspect.
3. Groups hold regular meetings with the teacher to check the progress of the work.
4. The group then collates all the information and writes the report together.
5. The report is presented to all or part of the rest of the class.

Although this model does not involve field investigation as in the models previously described, it seems to have things in common with them. The similarity can be found in the fact that in this model (C), as in the Applegate's model, students initially conduct their own investigation before bringing it to the group. As in the Wheater and Dunleavy's models (A and B), the individual efforts are put together into a group product.

4.2.1.2 Benefits of group work

Although there are other models for undertaking group work, any model would have to be assessed in terms of its ability to bring about an understanding of ecological concepts in students. Authors (Applegate, 1995; and Wheater and Dunleavy, 1995) acknowledge the benefits of group work in teaching ecological concepts. Wheater and Dunleavy (1995:179-180) identified three main groups of benefits that may be derived from the use of group work in teaching ecology. They are:

1. Academic development: students of different educational backgrounds in a group complement each other in the group for enhanced learning.
2. Personal and social development such as intra-group communication, leadership skill development and individual responsibility.
3. Logistic and practical reasons: increasing the scale of investigation and overcoming the problem of handling a large class.

4.2.1.3 Precautions to be taken when using group work

As useful as employing group work in teaching ecology might seem to be, Wheater and Dunleavy (1995:183) caution that it requires efficient management and should, therefore, not be attempted lightly. Areas of concern according to Wheater and

Dunleavy (1995:182) are: (a) group selection, (b) group management, (c) teacher's role, and (d) group work assessment.

Authors (Applegate, 1995 and Wheater and Dunleavy, 1995) seem to agree that groups used for group work need to be large enough to enable all the tasks to be readily completed, but small enough to prevent some students from hiding behind the efforts of others. Applegate (1995:364) expressed concern about what he referred to as the "free-rider dilemma" in group-work. The answer perhaps lies in ensuring that every member of a group has a definite task to perform.

Group composition has also been mentioned as a potential problem in group-work. Self-selection may work, if friends tend to work well together (Wheater and Dunleavy, 1995:182) but Applegate (1995) reported that he found more thoughtful responses from students when he created the groups (mixing skills and backgrounds) than when friends matched with friends. In terms of group management, Wheater and Dunleavy (1995:182) seem to, correctly perhaps, suggest that role allocation may be essential to enable efficient management.

Group work can be demanding on the teacher's time and his/her availability. To offset this problem, other teachers could be drafted in, where possible, to provide a range of expertise and experience. Both Applegate (1995) and Wheater and Dunleavy (1995) agree that demands on the teacher's time and attention could be lessened if students are given adequate initial briefing and the teacher takes part in the regular progress meetings of the groups.

As regards the assessment of the group product, Applegate (1995) acknowledges that it is a difficult activity to perform. It would be especially difficult where some contributions are greater than others. To resolve such a dilemma the teacher may in addition to the single shared group mark allocated, consider awarding some marks for attendance and also taking students' self and group assessments into account. Group work would in this way become a useful method for teaching and assessing students in ecology. We have made our students believe that working together on something that matters is cheating (Applegate, 1995:364). It seems to be time that teachers made students learn that problems are better handled through negotiation and interaction

with others in a group. Co-operative learning, if properly implemented, has been shown to improve achievement, critical thinking, intrinsic motivation to learn, relationships and students' social competencies (Brombacher, 1996:28).

4.2.2 Projects/Hands-on activities

The teaching of science, according to Chiappetta (1997:22), should be consistent with the nature of scientific inquiry. Students learn best through inquiry and the scientific method as practiced by practitioners of the discipline (Gibson *et al.* 1999:217). "Project" as an inquiry approach has been used by researchers and educators to teach ecology and the approach has been found to be invaluable. The works include those of Dangerfield *et al* (1987), Fail (1991), and Gibson *et al* (1999). A general goal of using the approach is to encourage students to become more ecologically literate through a specific hands-on experience (Gibson *et al.* 1999:217). In the biology classroom, students should be asking questions, resolving discrepancies, figuring out patterns, representing ideas, discussing information, and solving problems (Chiappetta, 1997:22). "Projects", it seems, challenges students to undertake these activities in the study of ecology as they provide students with opportunities for original work.

Dangerfield *et al* (1987) used "projects" as a method to teach undergraduate ecology courses. In their study students were made to develop projects themselves by formulating their own hypotheses and designing experiments to investigate them. The students also explored published works. They were asked to produce written reports of their experimental work in the style of a scientific paper. They were also encouraged to criticise published experimental studies. The ecological concepts that the students investigated were: (i) Habitat preferences (of three different species of a genus of woodlouse *Porcellio*), (ii) vertical distribution (of the different species of the *Porcellio*), (iii) survivorship (tolerance of the different woodlouse species to extremes of temperature and humidity), (iv) feeding and growth (effects of food quality on the growth of the three species of *Porcellio),* and (v) palatability (extent to which the different species are able to exploit a wide range of food types. They found that students learned a great deal as for example the students responded that they would now be less accepting of theory. This finding seems to indicate that the students learned, from the results of their projects, how scientific theories are developed and the apparent weaknesses they could have. According to them, students claimed that

they felt more confident in their own abilities and felt that the responsibility they took for their own work was rewarding. Teachers too benefited as they had an opportunity to discover some of the students' misunderstandings.

Fail (1991) also used "Project" as a teaching method to teach college and high school ecology courses. He made students plan and set up individual projects of their own design, collect data and write up their projects in standard scientific format. According to him, the concept of science as adventure was stressed constantly. Students were routinely treated as scientific colleagues that helped them to develop confidence in their scientific abilities. In his model, Fail (1991) provided students with ideas on possible projects to undertake and gave them encouragement and advice on how to proceed. The projects that the students undertook were about the following ecological concepts: (i) Biomass and production, (ii) decomposition, (iii) species composition within a biome, (iv) species associations of a rare and endangered plant in an ecosystem, (v) seasonal faunal structure of an ecosystem, and (vi) survival assessment of a plant species in a habitat. The role of the teacher remained only a facilitator. He found that though challenging, the method was rewarding to both teacher and students as it provided a lasting impression of how co-operative science might work.

Gibson *et al* (1999) in using "Projects" to teach 'succession' found that the approach improved the teaching of ecology. Students acquired science process skills and hands-on experience of ecology. They reported that students appreciated the hands-on nature of their experience as this is lacking in the more traditional "cook-book" practical that students are often asked to undertake. The main concept that Gibson *et al* (1999) intended was 'succession'. In doing so, the students were made to develop hypotheses and then design experiments to investigate the importance of environmental factors (biotic and abiotic) on the growth of seedlings. Students had to produce written and oral reports of their investigations.

It may be learned from the reports discussed above that "projects" can be a useful approach to teaching ecological concepts. Students are in the process guided to formulate hypotheses and then design experiments to investigate the hypotheses. The reports have shown that projects on ecology can be undertaken in schools with the

simplest of materials and sparest of budgets (Fail, 1991:170). There would seem to be no tangible excuse, therefore, for teachers not to include "projects" in their ecology courses. The approach seems to deviate from the traditional methods where students are made to undertake standard 'cookbook' experiments. As students formulate their own hypotheses and design their own experiments, they see science as an adventure and learn scientific techniques and science process skills. This way, students are likely to obtain a 'hands on' (Gibson *et al.* 1999:221) experience in ecology leading to an understanding of the concepts.

The authors whose works have been discussed in this section made students to present their reports on the projects both orally and in written form. I would suggest that teachers go even further to establish school journals and publish such student reports in them. That would seem to have the potential of motivating students and enhancing their confidence in writing scientific reports early in their academic lives. This seems to be presently lacking in most of our schools.

4.2.3 Games and drama/role-play

Games and drama/role-play have also been used by educators and researchers to teach ecological concepts to good effect. Jordano-Barea (1987) showed how the game of chess could be used as an analogy to help students learn basic ecological concepts and their application in the field. For example in considering that each chess piece occupies a position and plays a specific role, he explained the concept 'niche'. Several other analogies were used to explain concepts such as population, habitat, ecosystem, and mutualism. Although the model could not be used to explain certain concepts such as birth rate and evolution, it appears to be useful in explaining many basic ecological concepts to students.

Aston (1988) used a 'paper exercise' as a game to teach A-level students the concept of 'energy flow' in an ecosystem. He acknowledged that methods for the study of 'energy flow' at school level, as revealed by the literature, are time-consuming. In his opinion, the 'paper exercise' can give an overview of the theory and practical work before a real community is tackled. The game consists of students using pieces of paper with names of organisms and energy flow processes to construct an energy flow diagram of an ecosystem. Students also work out the amounts of energy transferred at

each interface. The game, as used by Aston (1988), also reinforces students' understanding of other concepts such as food web, respiration, trophic level, growth and biomass. He found that students enjoyed the challenge of deciphering data and working out concept maps. He also found that the activity led to lively discussions among students in their groups. Although the game was designed for A-level students, he believed that a simplified version could be used for learners of lower grade levels.

McTiffin (1996) on her part used a game board, dice and cards to teach 'food chains' and 'food webs'. She used a checkerboard in whose columns concepts relating to feeding relationships (e.g. producer, primary consumer, secondary consumer, habitat, food chain, food web) in an ecosystem are written. As teams take turns to throw the dice, they move the counter on the checkerboard according to the number read on the dice. The team then picks a card on which names of organisms are written. The team is given a maximum of two minutes to draw an organism on the card picked that relates to the concept indicated on the checkerboard where the counter has fallen. Through drawing and interpretation, according to McTiffin, pupils become familiar with the diversity of plants and animals in food chains and webs. She reported that the learners enjoyed the lesson immensely, worked together in teams effectively, and appeared to develop a clearer understanding of the topic.

Bailey and Watson (1998) used a game (ecogame) to teach children the following ecological concepts:

- Relationships between organisms in living systems.
- Concept of inter-dependence.
- Food chains and food webs.
- Distinction between producers and consumers, herbivore and carnivore, predator and prey.
- Material recycling.
- Waste, decay, decomposition.
- Adaptation.

According to them, the game functions through the medium of role-play/drama in which pupils take on the roles of living organisms in a habitat and then compete, as real organisms do, for survival. According to the authors, pupils quickly identify their

habitat and assume their character roles. They reported further that the relationships that develop between characters often become very real to the pupils. What an intriguing way to get learners hooked to ecological concepts! They reported that pupils who played the game (ecogame) to learn ecological concepts scored much higher in a test than those who did not. According to them, the game involves active learning rather than reliance upon transmission methods. They concluded that it is reasonable to proceed, on the basis of their findings that the strategy can contribute to the establishment of ecological concepts in the minds of pupils.

The value of such a teaching strategy to teach ecological concepts cannot be over-emphasised. Even though the strategy would seem to work better with younger children, the authors reported that trials suggest that the game has been well received by pupils of all ages. Supposedly, it can also be adapted for students of the high school level as well.

One may conclude from the researches reported above that:

(a) Games and drama/role-play can be used as a learning strategy for students of all ages to learn ecology meaningfully.
(b) The approach helps learners to work in groups and collaboratively.
(c) Learners learn actively through games and drama/role-play.
(d) Learning ecology is made fun through games and drama/role-play.

It would seem that although 'games' and 'drama/role-play' are effective methods of teaching ecological concepts, it would appear, however, that it would take the more inventive teacher to come up with games that would suit different classroom needs. That should however not be a source of discouragement for teachers. The models described here seem adaptable to meet the needs of ecological teaching in all situations.

4.2.4 Concept mapping

Concept mapping as a learning strategy is based on the constructivist principle that individuals learn meaningfully by building knowledge on the basis of what they already know (Briscoe and LaMaster, 1991:214). Concept mapping requires learners to plot concepts and their inter-relations in a meaningful organisation network (Okebukola, 1992:218). As students make concept maps they reorganise newly

acquired and existing concepts into a hierarchical network and depict relationships among concepts (Briscoe and LaMaster, 1991:214). Studies have shown that the concept mapping strategy helps students to learn science concepts meaningfully (Briscoe and LaMaster, 1991; Okebukola, 1990; Okebukola, 1992). Several studies have been cited in the literature as having made similar findings. Okebukola (1990) found evidence to provide support for the potency of the concept mapping technique in bringing about a meaningful learning of ecological concepts.

Ecological concepts are inter-linked and learning the concepts in isolation would only promote rote learning. If students would learn ecological concepts meaningfully, they should be able to see how the concepts are inter-linked. For example, feeding relationships in an ecosystem embody a host of inter-linked concepts including producers, consumers, trophic levels, food chains, food webs, energy transfer, ecological pyramids, decomposition, and nutrient recycling. Teachers need to employ teaching methods that can assist students to identify the links between and the inter-relatedness of ecological concepts. Concept mapping appears to be a promising strategy to help students to meet this need. As Okebukola (1990:495) suggested, perhaps if students who are engaged in the study of ecology are encouraged to prepare concept maps after a given period of instruction, meaningful learning will prevail. Different instructional strategies may have been used to teach various concepts but preparing concept maps would probably help students weave threads between the concepts. Concept mapping, according to Briscoe and LaMaster (1991:215), assists learners to 'know what they know'.

4.2.5 Integrating instructional strategies

Although research findings seem to show that the different instructional strategies discussed in this report have been used successfully on their own to teach particular concepts, they are often used in conjunction with one another. For example, Dangerfield *et al* (1987) used group work in their study on 'projects' and Jordano-Barea (1987) also used group work/co-operative learning when he used the game of chess to teach ecological concepts.

It would seem that in the normal school situation, teachers would have to integrate the different instructional strategies in teaching ecology. It may be possible, for example,

to use games to explain concepts, group work to undertake fieldwork, concept mapping to identify links between concepts, drama/role-play to reinforce understanding of concepts, and projects to learn science process skills.

What seems common about the instructional strategies discussed in this report is that all of them appear to be constructivist in nature. Constructivist perspectives focus pedagogical attention on cognitive activity and social interactivity of learners (Taylor, 1998:1112). The instructional strategies discussed, namely; group work/co-operative learning, games and drama/role-play, project/hands-on activity, and concept mapping are arguably constructivist in nature.

Vance *et al* (1995) used two constructivist approaches to teach ecology at the middle school level. In one of the approaches, they used class debate, role-play, group work, poster development (project), and concept mapping as instructional strategies. In the second approach, they employed as instructional strategies group work, hands-on activity, questioning, research (project), and creative writing. The concepts taught were food web, energy flow, pyramid of energy, pyramid of biomass, and nutrient cycles.

They (Vance *et al.* 1995) believed that students who were taught by the constructivist approach would perform at least as well in tests as with traditional teaching/learning approaches. Lord (1999) also found that students taught by constructivist strategies performed significantly better on exams than those instructed by the teacher-centred (traditional) approaches. Both authors (Lord, 1999 and Vance *et al.* 1995) reported that students rated the constructivist approach highly. These findings seem to support the potential of combining group work/co-operative learning, project/hands-on activity, games and drama/role-play, concept mapping and other constructivist teaching strategies in the teaching of ecology in schools.

5 CONCLUSION

In this report I have highlighted some ecological principles that ecology teaching in schools could focus on. In the light of the discussion and in view of the fact that students do not seem to be learning ecology adequately in schools, I further discussed the challenges facing ecology education in South African schools.

It was evident that the challenges confronting ecological education were mainly curricular and the quality of teaching. For this reason, I revisited the literature on the approaches of teaching ecology. In particular, I looked at fieldwork and instructional strategies. It would seem that fieldwork is inevitable in ecological education and even though it seems to be a formidable task to undertake, teachers could take advantage of the potential of their local environments to undertake fieldwork with their students. The literature reveals that local environments offer substantial opportunities for ecological fieldwork.

Because ecology in the school curriculum seems to be about teachers assisting students to learn ecological concepts meaningfully, it becomes imperative for teachers to adopt instructional strategies that would assist students to do so. Instructional strategies discussed in this report are group work/co-operative learning, project/hands-on activity, games and drama/role-play, and concept mapping. Commonly the strategies were found to be constructivist in nature. Constructivist strategies have been found to support students' learning of ecological concepts better than the teacher-centred transmission approach.

> Past teaching strategies concentrated upon covering as much content knowledge (i.e. factual knowledge) as time allowed, with great emphasis being placed on students' being exposed to as many definitions of ecological terms as possible. Teaching sequences and related activities seemed sensible to us as teachers, but often the students could not see the relationship between theory and practical work or why they were doing the work (Vance *et al.* 1995:2440).

In some instances, teachers have used the 'transmission' approach without any fieldwork and depended heavily on the use of textbooks to teach ecology. The literature seems to indicate that using group work, co-operative learning, projects, hands-on activities, games and drama/role-play, concept mapping, or a combination of these can help students to learn ecological concepts meaningfully. It would seem that if teachers would take advantage of the potential of their local environments for fieldwork and adopt constructivist learning/teaching strategies, students might learn ecological concepts meaningfully as espoused by most biology curricula.

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PROJECT 2

CONSTRUCTING ECO-CONCEPTS:

STUDENTS' EXPERIENCES OF A CONSTRUCTIVIST APPROACH TO LEARNING ECOLOGY

PROJECT 2

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

My experience as a lecturer at a College of Education has revealed to me that most students do not enter the college with a sound understanding of many biological concepts. Students usually attribute their apparent lack of understanding of the biological concepts to their experiences at school.

Hayward (1999:10) states that the overwhelming majority of South African schools provide education of extremely poor quality. This statement echoes De Beer (1996:25) in his claim about biology teaching in South Africa as being 'mortally ill'. De Beer (*ibid*) argues that there are teachers who do an injustice to the subject by overloading pupils with masses of tedious information, and by using teaching techniques that guarantee boredom. He further asserts that biology teaching in our schools boils down to a lot of 'chat and chalk'.

The results of the Third International Mathematics and Science Survey (TIMSS) show that South African students performed poorly in comparison to students of other participating countries (HSRC, 1998). At the national level, students of the Eastern Cape province scored lower than the South African average. The TIMSS study was designed to assess the students in terms of their readiness to apply their science knowledge in real life situations (HSRC, 1998:47). The poor performance of the students could be explained in part by the kind of teaching and learning they had experienced in their schools. In the view of Yager (1991:53), even students who score well in standardised tests often are unable to successfully integrate memorised facts with experience-based interpretations.

Teaching and learning are not synonymous; we can teach, and teach well, without having the students learn (Bodner, 1986:873). According to Van Harmelen (1999:13), behaviourism as a scientific theory of teaching has been the dominant theory of education in most of our schools. The 'chat-and-chalk' approach to teaching is essentially

behaviourist but that is what most of our teachers seem to be familiar with. Faith in objective scientific knowledge has served as the unquestioned basis for most of the teaching in schools (Claassen, 1998:35; Yager, 1991:53). Positivist epistemology as encapsulated in behaviourist psychology, assumes that knowledge is out there to be discovered. Until recently, there was no doubt at all that knowledge could be transferred intact from a teacher to a student (Von Glasersfeld, 1987:3). In a sense, knowledge was likened to a commodity that can be transferred from those who have it to those who do not. The teachers' task, thus, is to become somewhat expert in what is known, and then pass information along to their students (Hinchey, 1998:41).

Across the globe, there is widespread dissatisfaction with education (Atkin, 1998:650; Claassen, 1998:34). In South Africa, the need for a change in teaching approaches is highlighted by the introduction of a new curriculum framework that moves away from traditional behaviourist views of teaching and learning to social constructivist views (Kuiper & Wilkinson, 1998:208). The new curriculum framework for South Africa, Outcomes-Based Education (OBE), advances a paradigm shift from behaviourist to cognitive learning. According to Spady (1996 in Kuiper, 1999:20), it is a paradigm of educational functioning that differs strongly from the traditional approaches to schooling; requiring learning with understanding rather than rote learning of facts. The philosophy underpinning OBE arguably has its roots in social constructivism (Claassen, 1998; Department of Education, 1997; Kuiper, 1998).

In recent times, the influence of the theory of behaviourism on science education has been waning and social constructivist ideas have gained growing attention (Duit & Treagust, 1998). 'In many parts of the world, the promotion and acceptance of constructivism is such that it now has the characteristic of a new orthodoxy of science education' (Hodson & Hodson, 1998:33). Yager (1991:53) describes the constructivist model as the most promising learning approach and yet the constructivist perspective is so alien to so many (Hinchey, 1998:43).

This study reports how some college students perceive constructivism as a learning approach. The goal of the study is to report the effects of a learning module on ecology on the understanding of selected ecological concepts by college students. The report has been divided into five chapters. In chapter two that follows, constructivism as a philosophy of education and its implications for the teaching of ecology in particular and science in general is considered through a literature survey. Chapter three discusses the research methodology. The topic of study, in relation to the researcher's experiences, is put into perspective. In this chapter, the choice of research paradigm, the research goal, and the methods of study are also indicated. Chapter four reports the research findings and chapter five, the last chapter, discusses the emerging themes from the findings.

CHAPTER TWO
LITERATURE SURVEY

This chapter reports a brief literature survey on social constructivism, a philosophy of education that underpins this study. Firstly, I present an overview of behaviourism as a theory of education and its influences on teaching and learning. Social constructivism as a philosophy of education and especially for science learning is discussed next. Finally, I highlight the implications of the tenets of social constructivism for science teaching as they may apply in this study.

2.1 BEHAVIOURISM AS A THEORY OF EDUCATION

"Teachers' views of teaching and learning influence their classroom practice. Currently these beliefs support traditional practice, best characterised as a 'transmission' approach to teaching and an 'absorptionist' approach to learning" (Prawat, 1992:356). These views of teaching and learning are the result of the dominant philosophy that operates within the teaching and learning situation (Van Harmelen, 1997:8). Logical empiricism has been identified as the philosophy that has most successfully articulated the dominant paradigm of the twentieth century, and behaviourism, as a theoretical position within the empirical philosophy, has had a profound and lasting influence on education (Van Harmelen, 1995:51; Yager, 1991:51). The basic assertion of logical empiricism was that an event is meaningful only if it can be verified through sensory observation (Connole, 1998:13). For the behaviourist, knowledge exists outside the knower. This view of knowledge is based on the common-sense belief that a real world exists regardless of whether we take interest in it or not (Bodner, 1986:874). In the education context, knowledge was therefore considered as a bundle of facts to be transferred from the teacher to the learner. There was no doubt at all that knowledge could be transferred from a teacher to a student and educational researchers were concerned with finding better ways of doing this (Von Glasersfeld, 1987:3).

Indeed, this theory has been used successfully in adult education such as training in nursing, the military, sports and industry. However, it has been argued that the theory is not very well suited to contexts in which learners are trying to make sense of their worlds, to develop insight, or to interpret and find meaning within their experiences (Dekker, 1993:281).

Behavioural theory and the empirical epistemology in which it is located, according to Van Harmelen (1995:64), is generally accepted by contemporary learning theories as deficient, yet, the myths which emanated from this theory continue to inform educational theory and school practice. Many students conceptualise learning as the transfer of prefabricated knowledge that is stored in the memory. Accordingly, science is learned as an accumulation of facts (Duit & Treagust, 1998:6). The traditional school practices reflect the positivist conception of knowledge, teaching and learning. 'We talk about a "body of knowledge" as if it were a physical smorgasbord for students to ingest' (Hinchey, 1998:42). Prawat (1992:388) concludes that there is good reason to believe that our current methods of instruction are inadequate and insufficient. In the last few decades, the behaviourist approaches to education have been challenged (Taylor, 1998:1111) and social constructivist ideas have gained growing attention in science education (Duit & Treagust, 1998:19).

2.2 SOCIAL CONSTRUCTIVISM AS A PHILOSOPHY OF EDUCATION

Social constructivism as a particular approach to learning within cognitive psychology, has at its centre the importance of meaning as constructed in the minds of individuals through the many social settings that make up their lived experiences in their attempt to make sense of the world (Bodner, 1986:873; Driver & Oldham, 1986:106). Individuals are, however, not free to construct any knowledge, their knowledge must be viable (Bodner, 1986:874). For the social constructivist, knowledge is constructed in a social context. Duit and Treagust (1998:8) state that 'the process of constructing meaning is always embedded in a particular social setting of which the individual is part.' Yager (1991:54) puts it this way: 'We can only know what we have constructed ourselves but

such learning always takes place in a social context.' Social constructivists also believe that language plays an important role in learning. 'Knowledge is co-constructed through social interaction, and language functions as the means by which participants co-construct meaning as they plan, act, interpret, report and reflect together' (Hodson & Hodson, 1998:40). One of the salient features of cognising organisms, according to Von Glasersfeld (1987:8), is that they are capable of learning and language creates the possibility of thought (Hodson & Hodson, 1998:36).

The constructivists reject the traditional view that looks for a "match" between knowledge and reality (Bodner, 1986:874). One's theories "fit" so long as they enable one to function successfully in particular settings (Lerman, 1992:2). We can never hope to construct a match with reality, because we can never know that reality - we could never know if or when a match was achieved. What the learner creates is his or her own perspective (Jaworski, 1994:22). In the view of Prawat (1992:354), the new constructivist approaches to teaching and learning, which many reformers advocate, are inconsistent with much of what teachers believe, a problem that may be overcome if teachers are willing to rethink their views on a number of issues.

2.2.1 SOCIAL CONSTRUCTIVISM AND SCIENCE LEARNING

Social constructivist ideas have gained growing attention in science education over the past years (Duit & Treagust, 1998:19). This is so because empirical studies provide ample evidence that students' learning in many fields in the science curriculum is substantially different from the scientific concepts held by scientists. Most of these conceptions are held strongly and hence resistant to change (Driver & Oldham, 1986:106). In the view of Yager (1991:53), most persons have misconceptions about nature for example, and the typical school is ineffective in altering the misconceptions. For some children, the scientific ideas taught may be applied for stereotyped school contexts such as in examinations but not applied outside the formal school setting to explain everyday phenomena (Driver & Oldham, 1986:106).

Constructivists recognise the importance of what learners bring with them to the learning situation. Duit and Treagust (1998:19) refer to Ausubel (1968) who stated that the most important single factor influencing learning is what the learner already knows. The ideas that students bring to the science classroom may not always be in accord with the way in which these phenomena are interpreted in school science (Driver & Erickson, 1983:47). Constructivist theory requires teachers to design responsive teaching strategies aimed at countering the resilience of students' intuitive and naive conceptions and enabling them to construct counter intuitive scientific conceptions (Taylor, 1998:1113). For some students, it is only when they find that their idea does not work that they feel obligated to revise their 'knowledge' (Bodner, 1986:875). 'Dissatisfaction with an existing idea may reside in its failure to predict correctly or to control events beyond its previous restricted context - that is, it is no longer fruitful in the new situations which the learner has to confront. It may also be located in recognition that the new view meets the conditions of intelligibility and plausibility more satisfactorily than the existing idea' (Hodson & Hodson, 1998:34).

From the constructivist perspective, according to Driver and Oldham (1986:110-111), learning has the following implications:

(a) Individuals are purposive and interact actively with the environment to make sense of it.

(b) Knowledge is constructed by individuals through social interactions and experiences with the physical environment.

(c) Individuals' knowledge and belief structures influence the meanings they construct in a given situation.

(d) Constructing meaning is an active process. It takes place through a dynamic process in which a learner generates possible hypothetical meanings and checks these for 'fit' in the situation.

(e) Understanding is not the same as believing. For example it is possible to understand a theory without necessarily believing it.

(f) Learning scientific ideas involves conceptual change.

These ideas on constructivist learning have implications for science teaching. If a teacher follows a constructivist belief then there is likely to be evidence of such consequences in his or her teaching (Jaworski, 1994:32).

2.2.2 IMPLICATIONS OF SOCIAL CONSTRUCTIVISM FOR SCIENCE TEACHING

Constructivism says nothing at all about teaching. However, many constructivists have claimed consequences from a constructivist philosophy for teaching (Jaworski, 1994:26). This view is echoed by Hodson and Hodson (1998:33) who assert that constructivist theories of learning do not necessarily entail constructivist approaches to teaching but provide some clear pointers towards teaching strategies that might assist students in the task of conceptual reconstruction. 'Learning theories tend to be descriptive, theories of instruction, prescriptive; as a result, one cannot directly inform the other' (Prawat, 1992:4).

A number of schemes have been suggested to guide the planning of the sequence of activities aimed at promoting conceptual change in science classrooms (Driver & Oldham, 1986:116). According to Vance *et al* (1995:244), using constructivist teaching and learning strategies involves an initial exploration of students' ideas. Then students get into progressively larger groups to further compare, discuss and explore their concepts. This is followed by general class discussion in which the teacher summarises the main student ideas on the chalkboard using consensus approach. Hodson and Hodson (1998:33-34) propose the following sequence:

- Identify students' ideas and views.
- Create opportunities for students to explore their ideas and test their robustness in explaining phenomena, accounting for events and making predictions.
- Provide stimuli for students to develop, modify and, where necessary, change their ideas and views.
- Support their attempts to rethink and reconstruct their ideas and views.

Yager (1991:56) discusses a model that includes four aspects: invitation, exploration, proposed explanation and solution, and taking action. Kuiper (1998:11) suggests three steps: First of all, the teacher needs to know what ideas the learners already have about the topic to be taught. This will form the basis for the second step. The second step is to allow learners to work by themselves or in groups on some problem situations about the topic and in which they need to use their already existing ideas. Thirdly, the results of this work needs to be discussed with the teacher and the class so that the teacher now has the opportunity to present the appropriate scientific ideas and the learners can understand why and how these ideas are a better fit than their own.

All these constructivist-teaching schemes proposed by the different authors seem to be embraced by the model suggested by Driver and Oldham (1986:116-118). This model comprises five phases: orientation, elicitation, restructuring, application, and review. In the orientation phase, pupils are given opportunity to develop a sense of purpose and motivation for learning the topic. During the elicitation phase, pupils make their ideas explicit. This can be achieved by a variety of activities such as group discussion, designing posters or writing and may involve the presence of a physical phenomenon designed to emphasise thinking. In the restructuring phase that follows, pupils discuss their ideas. They are given the chance to develop an appreciation that there can be a range of different notions to explain or describe the same phenomenon. During this phase, pupils may feel dissatisfied with their existing conceptions and hence open to change. The fourth stage is the application phase. Here pupils are given the opportunity to use their developed ideas in a variety of situations, both familiar and novel. The final stage is the review phase. Pupils are invited to reflect on how their ideas have changed by drawing comparisons between their thinking now and at the start of the unit. All the models put forward have been shown to help students to learn meaningfully. In any case, it seems unlikely that a constructivist would say that any model is wrong. This is an ontological stance that constructivists take care to avoid (Jaworski, 1994:33). Ideas from these different models were employed in the design of the module used for this research.

The constructivist teaching models described in this section seem different from each other in approach yet they are similar in a number of ways. All of the models with the exception of that of Driver and Oldham (1986) start by exploring the ideas that the learners have on the topic to be taught. Even though Driver and Oldham (1986) do not start with the elicitation of the learners' prior ideas on the topic, they include it in their scheme. They rather start with the 'orientation phase' in which the learners are orientated for the learning of the topic. This initial preparation of the learners is not found in the schemes of the other authors though I would consider it a useful approach especially where one is dealing with young learners. Constructivists recognise the importance of the ideas that learners bring with them to the learning situation and hence the exploration of these ideas in the constructivist teaching models discussed in this report.

Having gained insight into the learners' initial ideas on the topic, all the authors suggest the provision of opportunities for the learners to explore their ideas through some form of investigations to see how their ideas might explain a phenomenon or solve a problem. This phase of the learning process according to Driver and Oldham (1986), Vance *et al* (1995), and Yager (1991) must involve learners discussing in small groups. For Kuiper (1998), the activity could be done in groups or individually. Hodson and Hodson (1998) do not specifically mention group discussions but it seems implied since they argue (1998:38) in favour of collaborative learning.

After learners have tested their initial ideas through some form of investigation, Vance *et al* (1995) and Kuiper (1998) suggest that the whole class should discuss the various ideas together. However, whereas Vance *et al* (1995) propose that the teacher summarises the main ideas on the chalkboard using a consensus approach, Kuiper (1998) prefers that the teacher use the opportunity to present the appropriate scientific ideas to the learners. Yager's (1991) model, however, suggests 'proposed explanation and solution' to the phenomenon explored in the previous learning phase, which in the other models seems to be incorporated in the learning phase where learners investigate their initial ideas on the

topic. It is at this stage after the learners have put their ideas to test and discussed with others, that, in the view of all the authors, learners modify or change their conceptions.

Yager's (1991) model goes into a fourth and final phase that seems to be similar to that of Driver and Oldham (1986). Yager (1991) refers to this phase as 'taking action' but Driver and Oldham (1986) call it 'application phase'. During this phase learners are given the opportunity to use their developed ideas in a variety of situations. The other models however do not include this phase. Hodson and Hodson (1998) rather include a fourth phase in which the teacher supports the learners' attempt to rethink and reconstruct their ideas and views. Even though Hodson and Hodson (1998) do not elaborate on it, one would understand it to mean that the teacher presents alternative views that could better explain the phenomenon as indicated by Kuiper (1998).

Driver and Oldham (1986) include a fifth phase in their model. They refer to it as 'review phase'. During this phase, learners are invited to reflect on how their ideas have changed a process that seems to be in concord with ideas of constructivist learning.

The different constructivist teaching schemes as discussed show that even though they are different in approach they have a lot in common. One may, however, not expect every constructivist learning experience to follow the same pathway. As Yager (1991:56) explains, the extent to which a teacher allows students to construct their own meaning will vary for teachers, individual students, and particular classrooms. The module used for this study takes ideas from the different models discussed in this section. It, however, takes into account the students involved and the learning environment.

CHAPTER THREE
THE RESEARCH METHODOLOGY

3.1 THE RESEARCH CONTEXT

The college of education, where this study was conducted, is located in a rural area in the Eastern Cape province of South Africa. It provides teacher education for both intermediate and senior phase teachers' diploma. The college admits students from mostly rural schools where instruction is supposedly, largely teacher-centred with teachers as transmitters of 'knowledge'. At the college, the 'chat-and-chalk' approach to teaching, in my opinion, is perpetuated. The consequence is that the students enter the college with poor understanding of science concepts and leave with hardly any improvements. In the behaviourist approach to teaching and learning, there is no emphasis on exploring understanding and it is not surprising that it rarely produces it (Yager, 1991:54).

As a teacher educator, I have always cherished the idea of supporting teachers to prepare themselves for the challenges of the new educational dispensation in South Africa especially in science education. For a teacher to be able to teach effectively, he or she must have a thorough understanding of what he or she teaches. One knows something only when one can explain it (Yager, 1991:54).

Ecology forms a prominent aspect of most biology syllabi (Webb & Boltt, 1990:187) and given its importance in understanding environmental processes (Hale, 1986:179), teachers who teach it to young children need deeper understanding of the concepts involved than mere memorised facts and definitions. In the words of Eisner (1993:75), 'if the quality of the content being taught is poor, it does not matter if the quality of teaching is good.' Ecology also forms an important component of the Natural Sciences Learning Area of the new curriculum framework for South Africa. In the view of Doberski (1998:216), the descriptive way of presenting information on ecosystems to students only provides a

'dead end' and according to Wright & Backe (1992:33), no science student should be judged proficient merely because of repetition and accurate recall of facts.

As we prepare teachers to implement OBE in schools, it seems that ecology is an area that needs special attention. Even though Bahar *et al* (1999:84-86) do not rank ecological concepts among biology topics that pose most learning difficulties to students, authors like Openshaw and Whittle (1993) and Webb and Boltt (1990) emphasise the inherent difficulty for students of all ages in the learning of ecological concepts. Adeniyi (1985) lists a number of ecological concepts about which students have misconceptions both prior to teaching and also as a result of teaching. Roberts (1997:242) points out that the majority of teachers believe that ecology is important but they have a view of ecology that is not always being conveyed to students.

For the ten years that I have taught at this college, ecology has always been part of the biology curriculum. Students have never shown good understanding of this topic or performed well in examinations on it both before and after teaching. If I reflect on my own teaching, I wonder if the 'transmission' approach used in teaching the course over the years could not partly account for the poor performance of the students in it.

In this study, a learning module on some ecological concepts was implemented with a group of the college students. The design of the module was informed by constructivist ideas. It was hoped that the learning strategies in the module would provide the students with learning experiences that would enhance their understanding of the concepts. It was also hoped that as science teachers-to-be, the students would be impressed by the teaching and learning strategies employed in the module and probably reflect on them for their own practices.

3.2 RESEARCH DESIGN

This section of the report is about the research goal, the philosophy underlying the research design, the participants of the study, and the methods of data collection. The constructivist nature of the module used in the study is also discussed.

3.2.1 RESEARCH GOAL

The goal of this study was to report the effects of a module on ecology on the understanding of selected ecological concepts by college students. I therefore attempted to answer the following research questions:

(a) How have constructivist-learning strategies enhanced students' understanding of the ecological concepts: *ecosystem, habitat, niche, food web, and adaptation*?

(b) What responses have the students developed about a constructivist approach to learning from this module of work?

As a means of answering these research questions, I designed a module (appendix A) on the ecological concepts and implemented it with the third year class of the Intermediate Phase Teachers' Diploma students of a college of education. The module focused on the five particular concepts because of the links that they have and also because of the limited time frame within which the study was conducted. The students constituted a scheduled class taught by the researcher (as a lecturer of the college) and the ecological concepts involved also formed part of the biology curriculum of the college. The students were engaged in the learning module that was designed according to constructivist ideas. The module included classroom, laboratory, fieldwork, and library activities. The students were informed to take notes on the teaching and learning approaches to be used in the module as they were going to be requested to comment on them at the end of the course.

I designed the module to include an initial inventory of the students' ideas on the ecological concepts to be learned. The purpose was to let the students express in writing their understandings of the concepts before undertaking the module and how these might change as a result of undertaking the module. The second activity engages the students in watching videos on some ecosystems. After watching the videos the students formed small groups to discuss how they understand the ecological concepts. The group discussions are supposed to provide the students with an opportunity to share their understandings with their peers and to re-think their ideas and views. Constructivists believe that 'knowledge' is constructed through group interactions (Driver and Oldham,

1986:110; Solomon, 1991: 34; Taylor, 1998:1112). The group discussion is followed by fieldwork in which the students undertake a practical study of ecosystems in small groups. Through such a practical study, the students are expected to experience natural ecosystems and consolidate their understanding of the ecological concepts as they experience them in the field. After the fieldwork the students report their findings to the whole class for discussion. At this stage the teacher supports the students with the appropriate scientific ideas as suggested by Kuiper (1998:11).

For the learners to know how their initial ideas on the concepts have changed after undertaking the module, the module includes a second inventory of their ideas on the ecological concepts. The students are asked to provide written responses to the same questions they answered at the beginning of the module. This is in concord with the view of Driver and Oldham (1986:118) that in constructivist teaching, learners must be given the opportunity to reflect on how their ideas have changed.

3.2.2 THE PHILOSOPHY UNDERLYING THE RESEARCH DESIGN

I chose to work within the interpretive paradigm. The interpretive perspective places emphasis on understanding what is going on (Connole, 1998:20). Counter to positivists, interpretivists seek subjective perceptions of individuals (Cantrell, 1993:84) and in the view of Cohen and Manion (1994:36), the central endeavour in the context of the interpretive paradigm is to understand the subjective world of human experience.

In this study, I intended to report on a learning module designed on the basis of constructivist principles and to analyse how the participating students and observers have perceived the experience. It was a form of case study. The emphasis was on the meanings constructed by individuals and the complexities of educational situations (Van Rensburg, 1995:31) and no value stance was assumed (Anderson, 1990:157).

Methods are neutral (Cantrell, 1993:85) serving the purposes of the researcher the way a hammer may serve different purposes as a tool and good case studies incorporate multiple

sources of data (Anderson, 1990:163). Questionnaires (appendix B) formed one of the main sources of data for the study. According to Anderson (1990:207), a questionnaire can permit the collection of reliable and reasonably valid data relatively simply, cheaply and in a short space of time. As a participant observer, I made observations about the involvement in the learning activities of the subjects and kept field notes. At the heart of every case study lies a method of observation (Cohen & Manion, 1994:107). Notes on informal discussions (Anderson, 1990:160) with the subjects were also taken. Independent observers were also used to make observations about the subjects during the learning processes. The careful use of two or more observers according to Cohen and Manion (1994:238) can lead to more valid and reliable data. I also interviewed five of the subjects (see appendix C for transcripts) to corroborate findings from the questionnaires. Interviews are prime source of case-study data (Anderson, 1990:160) and the purpose of interview is to allow the researcher to gather descriptive data in the subjects' own words and to access the unobservable (Cantrell, 1993:96). Abdullah and Scaife (1997:83) report that interviewing about concepts is an effective method for enquiring into the nature of students' science learning as it can reveal a lot about what students really know or do not know, as well as their misconceptions. In this study, I used written responses to questions as Shipstone (1984) used in his study, to determine the conceptual change of all of the subjects since it was not possible to interview all of them for their conceptual change.

3.2.3 SUBJECTS

The subjects of this study were the third year biology students of a college of education. There were 21 students comprising 11 females and 10 males. They were all studying for the Intermediate Phase Teachers' Diploma and offered biology as one of their major subjects. The matriculation symbols in biology for these students ranged between 'D' and 'E' higher grade with the majority of them on the 'E' symbol. Two of them had 'C' and 'D' standard grade symbols respectively. They had all passed the first and second years' biology at the college. For all of them, the only background knowledge of ecology they had, if any, was the biology they learned in standard 8 some five or more years before, possibly, through the teacher 'transmission' approach (See page 4 par. 2.1).

3.2.4 DATA COLLECTION

This research endeavour is essentially qualitative. A number of data collection instruments (triangulation) were used in an attempt to answer the research questions. Cohen and Manion (1994:241) define triangulation as the use of two or more methods of data collection in the study of some aspect of human behaviour. They suggest that triangulation can be a useful technique where a researcher is engaged in case study. The strength of the design, and in turn merit and credibility of the study, is increased through the use of triangulation (Cantrell, 1993:92).

Written responses to diagnostic questions were used as part of the learning module to determine the conceptual change of the students with respect to the particular concepts highlighted in the study. These consisted of inventories of the students' initial and post learning ideas on the concepts considered in the module (Thijs, 1992:163). Questionnaires (appendix B) consisting of both open-ended and close-ended questions were used to probe the students' impressions about the teaching and learning approaches used in the module. This was administered at the end of completing the module (Thijs, 1992). Two non-participant observers commented on the following aspects about the students in the course of the study: co-operation, excitement, curiosity, and involvement in the learning activities (see appendix D). The non-participant observations were meant to corroborate or otherwise the observations made by the researcher as a participant observer. As a participant observer, I took notes on the involvement of the students in the learning activities throughout the study period. Finally, interviews were conducted with five participants about their conceptual development as well as their impressions about the teaching and learning approach used in the module. I used an audiotape recorder to record the interviews that were later transcribed (see appendix C). The selection of the subjects for interviews was based on observations made about them by the researcher in the course of the study. These included curiosity, involvement, attentiveness, and attendance on the part of the subjects concerned. Although the research was not to investigate the relationship between involvement and performance, it was expected to be an interesting observation to explain the students' understandings of the concepts learned

in the module. According to Bodner (1986:874), students who actively participate in the learning process often learn more than passive students do.

I analysed the data for evidence of improvement of the students' understanding of the ecological concepts in question, their attitudes towards and impressions about the teaching and learning approaches used.

3.2.5 THE LEARNING MODULE - A CONSTRUCTIVIST APPROACH

The design of the module on ecology used in this research was informed by the constructivist ideas on teaching and learning discussed in the literature survey. Ecology like most other biology topics lends itself very well to the constructivist approach to teaching and learning. The module was divided into five phases (activities). They were the inventory of students' prior ideas on the ecological concepts; videos on terrestrial and aquatic ecosystems; group discussions on the ideas and meanings made by the students from watching the videos; field investigations of the college environment as an ecosystem; and the reporting of the findings from the fieldwork and class discussions of the reports.

3.2.5.1 INVENTORY OF STUDENTS' PRIOR AND POST LEARNING IDEAS

The module shows its constructivist character by starting from students' prior ideas (Thijs, 1992:156). The activity consisted of written responses to open-ended (Thijs, 1992:163) and data-response questions also used by Webb & Boltt (1989:7) in their study. According to Wratten and Hodge (1999:202), prior assessment can identify areas of misconception and confusion. The same questions were repeated at the end of the unit (Wratten & Hodge, 1999:210). It was a second inventory of the students' ideas to make them aware of the changes in their own ideas (Thijs, 1992:163). By responding to the same questions in both inventories of their ideas, the students could easily compare their pre and post-learning ideas and see how their conceptions have changed.

The elicitation of learners' prior ideas on a topic can be achieved by a variety of activities such as group discussion, designing posters, writing (Driver and Oldham, 1986:118), asking questions (Yager, 1991:55), or interviewing (Kuiper, 1998:11). In this module, questionnaires were used as it provided a convenient approach to keep records of the students' responses. By responding to the same questions at the end of the module, the students could see in writing how their ideas have changed.

3.2.5.2 VIDEOS ON ECOSYSTEM TYPES

This phase in the learning process was meant to focus the students' thinking on the concepts to be learned (Driver & Oldham, 1986:118). The videos were all obtained from the National Films Library, Pretoria. They were: 'What is ecology?' 'Let's look at Tsitsikama forest', and 'Let's look at life on a rocky shore'. They were intended to provide experiences on a variety of ecosystems for the students. Killerman (1998:8) found that video programmes on topical subjects help to make biology lessons more effective.

3.2.5.3 GROUP DISCUSSIONS

In the third phase, the students were given an opportunity to discuss in small groups the meanings they had made from the videos on the concepts being learnt. This is in consonance with the constructivist view that the construction of knowledge in the classroom goes beyond interaction between teacher and students, to the wider interaction between the students themselves in the social and cultural environment of the classroom (Jaworski, 1994:28). In a social environment, the human learner is challenged by other individuals who have a powerful role to play. Through the use of language and social interchange, individual knowledge can be challenged and new knowledge constructed (Jaworski, 1994:25). Scientific knowledge is both personally and socially constructed (Hodson & Hodson, 1998:38). The language-based discussion, negotiation, and consensus building that take place among students in co-operative learning are firmly grounded in constructivist principles (Staver, 1998:518).

3.2.5.4 FIELD INVESTIGATIONS OF THE ENVIRONMENT

At this stage of the learning process, the students went out in small groups to study different sites of the college environment in relation to the ecological concepts being studied. They were given worksheets to guide them and to record their observations (O'Neal, 1995:136). The groups were set up in such a way that each member had a task to perform (Kuiper & Wilkinson, 1998:218). Lisowski and Disinger (1992:23) found that field-based programmes in the sciences are effective in assisting students' understanding and retention of selected ecological concepts. 'To see, smell, hear and touch the environment and to perceive the spatial limits and predict temporal changes of the ecosystem have an indelible mark on the minds of the students' (O'Neal, 1995:138). And in the view of Hale (1986:182), the local environment provides the educational potential to demonstrate ecological principles and concepts.

For Vance *et al* (1995:245), constructivist teaching and learning experiences depend to a great extent on the use of group work. Our certainty about observations is greatly increased by receiving confirmation of them from others (Solomon, 1991:30). When students do fieldwork in groups, they are able to share ideas and confirm their observations from other members of the group.

3.2.5.5 CLASS DISCUSSIONS ON FIELDWORK

These activities constituted the last and final phase of the module. Each group was given an opportunity to report its findings from the fieldwork to the whole class using a variety of media. With the lecturer (researcher) co-ordinating ideas in the discussions, all students were encouraged to ask questions and make contributions in the process of constructing meaning. Teachers operating within an inquiry-based learning mode must include all student contributions in discussions, but subject them to rigorous scrutiny, including criticism by other students (Hodson & Hodson, 1998:40). The teacher takes the role of the committee chair that reconciles, organises and manages goals and agenda and the modeller who challenges learners' knowledge. Constructivist science teachers are the intermediate agents between learners and curriculum science (Watts & Jofili, 1998:175).

CHAPTER FOUR
RESEARCH FINDINGS

This chapter reports findings from the research data. Students' responses are reported in their own words though the students are not referred to by their real names. It may be worth noting at this stage that subjects seemed to have difficulty with the comprehension and use of English that was the medium of communication in the process of data collection. One may find evidence of this from the written and verbal responses of the students in the inventories of their ideas on ecology, questionnaires, and interviews.

The report begins with the conceptual change of the students. The students' prior and post learning ideas on the ecological concepts are compared. This is followed by their responses to the questionnaires and how they commented on the teaching approach used in the module. The findings from the interviews and how they corroborate findings from the responses to the questionnaires come next. Finally, the non-participant observers' comments are used to corroborate observations made by the researcher as a participant-observer and the responses of the students to the questionnaires and interviews.

4.1 STUDENTS' PRIOR AND POST LEARNING IDEAS ON ECOLOGY

The same questions were used in both inventories of the students' prior and post learning ideas on the ecological concepts. Students used written responses to answer the questions. By responding in writing to the same questions in both inventories of their ideas, students are able to compare and see how their ideas have changed. The questions were in two parts. Question 1 consisted of open-ended questions in which students were required to express their understandings of the concepts. Question 2 was made up of data-response type questions in which the students were required to show their understanding of the ecological concepts from prose form data on an imaginary ecosystem. The imaginary ecosystem is about a tree growing in a grassland and its immediate surroundings. It shows the following features of an ecosystem: biotic and abiotic components, different habitats, niches of organisms, food chains, variety of interactions among organisms, and different

forms of adaptations. To demonstrate an understanding of the concepts *ecosystem, habitat, food web, niche, and adaptation,* a student was expected to be able to identify them in the imaginary ecosystem and explain them.

4.1.1 THE CONCEPT ECOSYSTEM

To demonstrate an understanding of the concept 'ecosystem' in question 1, a student was expected to be able to show that in an ecosystem (a) there are biotic and abiotic components, (b) organisms interact among themselves, (c) different habitats exist, (d) organisms occupy different niches to keep the system going, and (e) energy flows through an intricate food web. If a student was only able to identify some of these features of an ecosystem, he or she was considered to have partial understanding. If a student does not include any of these features in his or her response or does not provide a response at all, he or she is regarded as having no understanding of the concept. In question 2 a student was deemed to understand the concept 'ecosystem' if he or she identified the imaginary environment as an ecosystem and explained it by the features of an ecosystem present in it. A student was considered to have partial understanding if he or she identified the environment as an ecosystem but was unable to support it with reasons.

The students showed poor background knowledge of the concept 'ecosystem'. In responding to the open-ended questions in the inventory of their initial ideas on ecology, 17 of the 21 students attempted to explain the concept 'ecosystem'. One of the four students who did not attempt to answer the question wrote as follows: *'I studied ecology in standard 8 and I have forgotten'* and another said, *'I don't understand this, what it is all about. I didn't study ecology.'*

The others who attempted to explain the concept did not give complete explanations. For example *'Ecosystem is a place containing different organisms, performing different activities. For an example if I go to a zoo, I will find animals and plants and these have to be treated nicely because they are part of our day to day lives.'*

Some of the students explained 'ecosystem' in ways that were completely different from the biologist's view of the concept. For example *'It is the system of collecting all the organisms in a systematic way where other organisms live on land and in water, hence we get mutualism, predators, etc.'* No student was able to explain the concept according to the biologist's view. It seems that the students only had hazy ideas about the concept.

With respect to the data-response questions, only 4 students could identify the environment described in the prose as an ecosystem. These subjects could however only give partial reasons to support their claims, as for example:

'Because there are so many animals that live in one environment. Others depend on others for their food.'
'Because each organism depends on another to survive and they form a cycle.'
'Other animals depend on the tree in order to survive. There are some animals which live in this tree. Food web – there are animals and insects who feed on Each other. Others are adapted to the situation.'
'The tree serves as the habitat where interrelationships occur between these different species.'

In explaining their understanding of the concept ecosystem in the post-learning inventory, all the students produced longer answers than their pre-learning ideas and were able to name some components of an ecosystem. They showed varied improvements in their understandings of the concept from their pre-learning ideas. The following are some of their responses:

'Ecosystem is the study of relationships between plants and animals in the environment. Ecosystem is everything that is happening in the biome eg. in certain environment, what are the things that we found like what animals are found in the environment, their niches, habitats, food web, food chains, adaptations, etc. and also what type of plants eg. flowers, trees, grass, etc.'

'Ecosystem is the relationship between plants and animals. We have different types of ecosystem like desert, forest, sea, small lakes, between rocks we found snakes. Trees for birds building their nests, holes for ants, under metals, leaves for caterpillars.'

'Is the process whereby living and non-living organisms are found and it is the relationship between plants and animals and their environment. In an ecosystem we found different biomes like forests, oceans, deserts, etc. and the food chain exists. Circulation of energy is there in an ecosystem.'

'It is the interaction between plants and animals in the environment. It can happen within the biome. It is where different organisms are found like animals, humans, and plants.'

In responding to the data-response questions in the post-learning inventory of their ideas, 9 of the students referred to the environment described in the prose as an ecosystem and 2 of them called it a biome. They gave reasons that seemed partly acceptable according to the biologist's view. For example:

'The tree is a biome and the activities represent an ecosystem. Because I find that there is interrelation between organisms in and around the tree. There are habitats in the tree, different food chains which make a food web. There are also predations and adaptations of organisms.'

Seven students referred to the environment as a 'habitat' and three of them had completely 'wrong' ideas. For example Nat gave the following response: *'The tree represents shelter for human beings during summer time and also a biome for animals like rats and other birds like fowls.'* The findings show that 10 of the students improved their understandings of the concept 'ecosystem' after undertaking the module, but 11 did not show improvement. Beka for example who had no idea about the concept explained it as follows after undertaking the module: *'Ecosystem is the study of relationships between plants and animals in the environment. It is everything that is happening in the biome e.g.*

In the environment what are the things that we find, their niches, habitats, food web, food chains, adaptations, etc. and also what type of plants e.g. flowers, trees, grasses, etc.'
Table 1 shows the conceptual understandings of the individual students before and after undertaking the module.

Table 1

Conceptual understanding of students before and after undertaking module (n=21)

	Ecosystem				Habitat				Niche				Food web				Adaptation			
	Q1		Q2		Q1		Q2		Q1		Q2		Q1		Q2		Q1		Q2	
Name	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
Alex	N	P	P	P*	P	P*	P	P*	N	P	N	P	N	P	P	U	N	U	N	P
Babs	N	P	N	N	P	P*	P	P*	N	U	P	U	N	P	P	P*	N	U	N	N
Beka	N	P	N	N	N	U	N	P	N	P	P	U	N	N	P	P	N	P	N	P
Eta	N	P	P	P*	P	U	P	P	N	U	N	U	N	P	P	P*	N	P	N	P
Gig	N	P	N	P	U	U	P	P	N	P	N	U	N	N	P	P*	P	U	P	P*
Gov	N	P	N	N	P	P*	P	P	N	U	P	P	N	N	P	P*	N	U	P	P*
Hela	N	P	N	N	N	P	P	P*	N	P	P	P	N	P	N	P	N	U	N	P
Kid	N	P	N	N	P	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
Kit	N	P	N	P	N	U	P	P	N	P	N	N	N	N	N	P	N	U	P	P
Lazo	N	P	N	P	N	U	N	P	N	U	P	P	N	N	N	N	N	U	P	P
Loba	N	P	N	N	N	U	N	P	N	U	N	U	N	P	N	P	N	U	N	P
Lufa	P	P*	N	N	P	P	P	U	N	P	P	U	N	P	N	P	N	U	P	U
Mdu	N	P	N	P	P	P	P	P	N	U	P	U	N	P	P	P*	N	U	N	P
Nat	N	P	N	N	P	U	P	P	N	U	N	N	N	N	N	P	N	N	N	P
Set	P	P	P	N	P	U	P	P	N	U	P	U	N	N	P	P	P	P*	P	P
Shus	N	P	N	P	P	U	P	P	N	U	N	P	N	P	P	U	N	U	P	U
Siya	P	P*	N	P	N	U	N	P	N	U	P	P	N	N	P	P*	N	U	N	P
Solo	N	P	N	P	P	U	P	P	N	U	N	P	N	P	P	P*	N	P	N	P
Thando	N	P	N	N	N	U	N	P	N	P	N	U	N	P	N	U	N	U	N	U
Tumi	N	P	N	P	N	U	N	P	N	U	N	U	N	P	N	P	N	U	N	P
Xasa	N	P	P	N	N	U	P	P	N	U	N	N	N	P	N	P	N	P	N	P

Q1= Question 1 Q2= Question 2
B= Pre-learning ideas A= Post-learning ideas
N= No understanding P= Partial understanding
U= Understanding P* = Partial but improved understanding

4.1.2 THE CONCEPT HABITAT

In responding to the open-ended questions (question 1) many of the students could explain the concept habitat as a place where an organism lives and gave appropriate

examples in their prior learning ideas on the concept. Five students did not attempt any explanations at all. One of them only listed examples of habitats without attempting to define the concept. One defined the concept but did not give any examples. Only 4 of those who attempted to explain seemed to have completely wrong ideas about 'habitat'. One of them for example had the following explanation: *'A habitat is group of organisms living together depending on each other for example humans which depend on their parents.'* It was found that 11 of the students had partial understanding of the concept 'habitat'. Their examples were however mostly textbook examples. To demonstrate an understanding of the concept, a student was expected to define habitat as a living place in an ecosystem where an organism lives and survives and also to give examples.

In the data-response questions (Question 2), a student was expected to demonstrate an understanding of the concept by being able to identify all the habitats described in the imaginary ecosystem and to show that a habitat can be occupied by more than one kind of organism. In responding to the data-response questions, 9 of the students were able to identify some habitats from the ecosystem described in the passage. 10 of them correctly thought that a habitat could be occupied by more than one kind of organism.

After undertaking the module, most students seemed to have improved on their understandings of the concept though 3 of them explained the concept almost the same way as they did prior to learning. Many provided examples from their experiences of the learning process. Even those who did not attempt any answers in the inventory of their prior ideas, now produced responses as follows:

'When we talk about habitat, we mean different places where we found some different organisms in the environment eg. we found ants in holes, lizards under rocks, worms in holes, birds in nests, snakes in holes and grass in the soil, etc.'

A student who had given a completely wrong explanation of the concept 'habitat', was able to improve his answer this way:

'Firstly habitats are places in which organisms live. There is a terrestrial type i.e forests, mountains and there ponds, sea, and rocks. Those who live in the rocks are having their own way of living in order to survive. For example, animals like rabbits which live in rocks are having their own way of life unlike frogs which use water and damp places as their habitat.'

All the students could identify habitats of the environment described in the prose at this stage. Most of them named more than three habitats. 12 of them believed that one habitat could be occupied by more than one kind of organism. Nine of them thought otherwise. This shows that all of the students improved their understanding of the concept 'habitat' after undertaking the module though not equally well. It was evident that gaps still existed in the understanding of some of them. Table 1 shows the conceptual change of the concept 'habitat' by the individual students. For example Siya showed the following pre and post-learning ideas on the concept 'habitat':

Pre: *'A habitat is a group of organisms living together depending on each other. For example humans which depend on their parents. They depend on certain source of energy in order to survive.'*

Post: *'Firstly, habitats are places in which organisms live. There is a terrestrial type i.e. forests, mountains, and there are ponds, sea and rocks. Those who live in the rocks are having their own way of life in order to survive. For example animals like rabbits which live in rocks are having their own way of life unlike frogs which use water and damp places as their habitat.'*

4.1.3 THE CONCEPT NICHE

In their prior learning responses, only 3 of the students attempted to explain the concept 'niche' but all of them got it 'wrong'. The following were their responses:

'Is basically the point in a habitat that an animal occupy.'

'Niche are organisms that do belong in the same species, for instance the cows do not belong to carnivores.'

'It is the type of flowers where you place it and give it a bright colour even if you are far from it.'

It appears that the students had poor understanding of the concept at this stage. None of them could describe the niches occupied by the different organisms in the environment described in the imaginary ecosystem. To demonstrate an understanding of the concept, a student was expected to explain that a niche is the functional role of an organism in its ecosystem and to support the explanation with an example. In the data-response questions, a student was deemed to understand the concept if he or she was able to explain it with an example taken from the imaginary ecosystem. The student was also expected to show that organisms living in the same habitat do not necessarily occupy the same niches. After undertaking the module however, all the students explained niche as the role of an organism in its environment. Thirteen (13) out of the twenty-one (21) students gave examples that were relevant to explain the concept such as the following: *'It is the role that is played by an organism in an environment e.g. fungi (mushroom) help in the recycling of nutrients back to the soil.'* All of them except three students were able to find that even though organisms may live in the same habitats, they may occupy different niches. Ten of these students were able to support their answers with appropriate examples taken from the imaginary ecosystem as for example: *'They do not occupy the same niches. For example millipedes feed on cellulose, centipedes feed on ants, ants feed on mushrooms. Centipedes are carnivorous and millipedes are herbivorous.'* The conceptual change of the students with respect to the concept 'niche' seemed remarkable since they appeared to have no ideas on it before undertaking the module. (See table 1 for the conceptual understanding of the concept 'niche' by the individual students). Respondent Babs for example showed the following conceptual change:

Pre-learning ideas: *'It is the type of flowers where you place it and give it a bright colour even if you are far from it.'*

Post-learning ideas: *'Niche is the role played by an organism in the environment. Plants produce food for animals. Some frogs live in water. Mushrooms help in the recycling of nutrients by decomposition. Snakes control the population of frogs.'*

4.1.4 THE CONCEPT FOOD WEB

In question 1 the students were expected to demonstrate an understanding of the concept 'food web' by including the following in their explanations: (a) it is a system by which food energy flows through an ecosystem, (b) light energy is converted to food by producers, (c) the food energy is transferred from one organism to another by a process of eating and being eaten (food chain), (d) food chains in an ecosystem are interconnected to form a food web. In question 2 the students were expected to demonstrate an understanding of the concept by: (a) indicating that sunlight is the ultimate energy source for organisms in the ecosystem and that organisms depend on each other for energy, (b) identifying all the food chains in the imaginary ecosystem, and (c) using the food chains identified to construct a food web. Before undertaking the module, none of the students was able to explain the concept food web according to the biologist's view. Five of them did not attempt any answers at all. For those who attempted answers, the 'best' explanations of the concept seemed to confuse food web with food chain:

'It is the process of getting food like animals eat grass and carnivorous animals will come and eat the animals which are eating grass. For an example impala eat grass and lion will eat impala.'

'Food web is the food chain for example there are animals that eat others and those animals are eaten by others so all they make up food web.'

Only 4 of the 21 students reported that sunlight is the main source of energy in the environment. Out of this four, only one was able to explain his answer as follows:
'Sun is the source of energy because the tree absorb radiant energy from the sun for the process of photosynthesis and therefore the organisms are able to get food from the tree e.g. bees make honey from the tree flowers.'

All the students except five stated that organisms in the ecosystem depend on each other for energy and they were able to explain it in terms of feeding relationships. Only 7 of

them stated that they expected all organisms in natural environments to have sunlight as the ultimate source of energy though only one of them provided what could be described as a more satisfactory explanation thus:

'The main source of energy is the sun and all the organisms depend on producers for energy.'

Sixteen out of the twenty-one students did not know that the ultimate source of energy in the ecosystem is sunlight. Only one student could identify some food chains from the imaginary ecosystem and write them out correctly with arrows pointing in the right direction. Even this subject (Gig) could not translate the food chains into a food web. Indeed none of the students could construct a food web.

The inventory of the post-learning ideas showed that all of the students attempted to explain the concept 'food web'. Most of them described it as a collection of food chains. Few of them equated it to a 'food chain'. Only two subjects explained it in terms of energy flow in the ecosystem through feeding relationships.

Ten of the students stated that the main source of energy for organisms in the environment is sunlight. Eleven of them said the tree is the main source of energy for the organisms. This eleven did not indicate the source of energy for the tree. All of them said that organisms of the environment depend on each other for energy and they explained it in terms of food chains and gave relevant examples. Only 7 of them would expect organisms of other natural environments to have the same source of energy as the one described in the passage. Eight of the subjects were able to identify food chains from the imaginary ecosystem, and use them to construct appropriate food webs. Even though the students showed improvements in their understandings of the concept after undertaking the module, many of them did not show thorough understanding according to the criteria indicated earlier in this section. Table 1 shows the conceptual understanding of 'food

web' by the individual students. For example Eta showed the following conceptual understanding of 'food web' before and after undertaking the module:

Before: *'Food web is the way animals feed themselves like one eat other. People also eat other animals. Food web I can say is a chain one eat other.'*

After: *'Food web is the collection of all food chains where organisms depend on each other to get energy. The grasshopper gets energy from grass and the spiders get their energy in grasshoppers.'*

4.1.5 THE CONCEPT ADAPTATION

In question 1 the students were expected to demonstrate an understanding of the concept 'adaptation' by explaining it as the means by which organisms overcome the challenges of the environment to survive in the ecosystem. They also needed to support the explanation with an example. In question 2 they were expected to list all the challenges for which organisms of the imaginary ecosystem would require special adaptations. To demonstrate a thorough understanding of the concept, the students were also expected to identify all the adaptations shown by organisms of the imaginary ecosystem. In the prior learning inventory of their ideas, four of the students did not attempt any answers at all. None of those who attempted to explain the concept was either able to provide 'satisfactory' explanation or give suitable examples:

'Adaptation is whereby the animals or plants survive in order to live in areas where there is a rain or whether there is sunlight for plants in order for photosynthesis to take place in wet areas. So adaptation has to do with condition suitable for that type of plant or animal.'

Only 4 students could mention at most one environmental problem for which the organisms would need special adaptations in the imaginary ecosystem. In all cases, the problem mentioned was related to predation. Six of them were able to give examples of adaptations of organisms in the imaginary ecosystem but none of them gave more than one example.

The post-learning ideas of the students on 'adaptation' showed that they had improved their understanding of the concept. Relevant examples were given by most of the students except that, as in their pre-learning ideas, all the examples were related only to predation. It was perhaps interesting to note that students gave examples from their experiences of the fieldwork undertaken in the module. Only one subject (Nat) did not answer this question.

With respect to the data-response questions, only 5 of the 21 students named some problems of the environment for which organisms would need special adaptations. The other students rather described the concept instead of the problems. All of them except one were able to give examples of adaptations of organisms in the environment described in the passage. What was perhaps interesting was that some students included adaptations they found during the fieldwork of the module which were not indicated in the passage. Table 1 shows the conceptual change of the individual students. Mdu for example showed the following conceptual change:

Before undertaking module: *'Adaptation means time or season when you can see an animal or tree. The period for that tree to show up or to reproduce.'*

After undertaking module: *'It is how to overcome a problem or the way of protecting itself e.g. when bird or butterfly see their enemy they fly away or multicoloured spiders camouflage so that the enemies do not identify them easily.'*

4.2 STUDENTS' RESPONSES TO THE QUESTIONNAIRES

The questionnaires asked the students not only to respond to the different aspects of the module, but also the extent to which they thought they understood the concepts in the module and their views about the teaching approach employed. In all, twenty out of the twenty-one participants responded to the questionnaires.

4.2.1 STUDENTS' VIEWS ON THE MODULE

In this section, I report the students' responses to the different activities undertaken in the module.

4.2.1.1 INVENTORY OF LEARNERS' PRIOR IDEAS

The students seemed to have enjoyed most of the activities. Activity one in which the learners' prior ideas on ecology was elicited, appeared to be the least popular. The following are some of the comments of the subjects:

'Activity 1 is when I was a blank slate.'
'Because I was taught in standard 8 so now I forget.'
'Activity two and others were interesting and challenging.'

However, all the students responded that activity 1 played some role in their learning of the concepts. The following constituted a cross section of their comments:

'It made me to turn back and look for what was difficult for me.'
'It made me to learn more about ecology.'
'It aroused my interest to actively participate in the learning.'
'It created my interest in the learning process.'
'It gave me interest in researching on ecology.'
'It encouraged me to have interest in living organisms and the ecosystem.'
'I checked my knowledge in ecology.'

4.2.1.2 WATCHING VIDEOS ON ECOLOGY

Thirteen students commented on the videos. For example:
'It makes me to sleep and become dull, sometimes to be lazy and unfamiliar with things seen in the video.'
'Because the person who speaks in the video I'm not hearing clearly.'
'It was too fast and the lecturer doesn't repeat.'

On the whole the problems raised by the students on the videos could be categorised into three namely, the language used by the commentators, the ideas in the videos covered too quickly, and dull. Only seven subjects did not have any complaints about the videos. In any case, all of them indicated that the videos helped to improve their understandings of the ecological concepts. In my opinion the videos were interesting and stimulating. This view is also shared by one of the non-participant observers.

4.2.1.3 GROUP DISCUSSIONS

Only one student said that he or she did not enjoy the group discussions that took place after watching the videos. The reason given by this student was that '*my group mates are not all participating and sometimes they undermine some opinions*'. It may seem that this subject was not able to tolerate dissenting views in group-discussions. If it were not so, one would have expected other members of the group to give similar report. Two other subjects indicated that they would have preferred to work in other groups just for a change and to have an opportunity to interact with other learners of the class. In this study, the groups in which the students worked remained the same.

4.2.1.4 FIELDWORK

All of the students think that it was necessary to follow the videos and the group discussions up with the field investigations. Reasons given are:

'Videos provided background knowledge only.'
'It helped us to discover different concepts.'
'Easy to learn with living specimen.'
'Applying what was seen in the videos in real life situation.'
'To discover things not mentioned in the video.'
'The more you see examples and do practical on your own, the easier it makes to understand.'
'It makes the lesson to be clear.'

'Because it helps us to have a better understanding of ecology.'
'When I observe it, I know it and when I do it practically, I will not forget.'

All of the respondents, except four, reported that they learned things from the fieldwork that could not have been learnt in the classroom. The four, with different opinions, believe that the lecturer could have told them everything in the classroom. Out of this four, only one however thinks that it would have been easier to learn the ecological concepts merely by listening to lectures rather than the learning processes used in the module. This subject is the only one who may not want the class to undertake more field studies in the future. His or her reason is that 'there would be a lot of time being wasted'. The other nineteen students would want the class to undertake more field studies in future for the following reasons:

'It stimulates love for the subject.'
'To add to one's understanding.'
'We learn many things within one lesson.'
'Because I want to learn more about the concepts.'
'It is much interesting and we can learn and understand better.'
'It makes students to work and not to be lazy.'
'It motivates the learner to learn.'
'We should know our environment and respect it.'
'To learn about living organisms and the environment.'
'For further information or knowledge.'

Problems that students had with the fieldwork were: fear of the wild animals such as snakes, insects and frogs and also the bushes, and the weather such as rain and the afternoon sun. One student commented as follows: '*it makes me dirty*' and another complained about the laziness and non-cooperation of some of his or her group members.

4.2.2 STUDENTS' VIEWS ON THE TEACHING AND LEARNING APPROACHES

In all, twenty of the students answered the questionnaires. Fifteen of them said that they were familiar with the teaching and learning approaches used in the module and five of them said they were not familiar with it. All of them however found things new about the approach. The following were the new experiences they reported to have had in the module they undertook: the use of videos in the learning activities, fieldwork, learners doing investigations on their own, group work, learners working at their own pace, learners taking responsibility for their learning, learners reporting findings from their investigations, sharing of ideas among learners, learners active in the learning process, learners coming up with own ideas, learning involving critical thinking, learner motivation, practical nature of learning activities, and learners doing most of the work on their own.

Nine of the twenty students reported that other lecturers of the college use this approach of teaching and learning. They listed Education, Xhosa, Mathematics, English, Religious education, Afrikaans, and Life skills as the subjects in which lecturers of the college employ this approach of teaching and learning. In view of the fact that all the respondents offer the same subjects at the college, the responses of the eleven students who said that the lecturers do not use the approach in their teaching, seem to contradict the former.

According to the students, the teaching approaches used by the lecturers include lecturer telling, eliciting learners views but these views not discussed, no research activities on the part of the learners, passive learning, no class discussions, library research, learners sometimes taught in groups, written assignments, assessment by tests and examinations.

All the students indicated that they liked the teaching and learning approaches used in the module. Their reasons were the following: work was done by learners themselves, learning activities were practical, interesting, enjoyable, concepts understood without much difficulty, approach helps learner to discover on his or her own, helps one to learn

more, learner does things on his own, it is fun, it gives everyone a chance to part-take in the project, encourages learners to learn more, it considers the pace of individual learners, it shows us a new way of teaching, there is discussion and sharing of ideas, learner makes own observations, learner is active, it helps learners to work in groups, and it gives clear understanding when one sees and feels something.

4.2.3 EXTENT OF LEARNING MADE AFTER UNDERTAKING MODULE

All the students indicated that they did not find the learning process difficult and only four of them felt that they were being left behind in the learning process at one stage or another of the course. The others said that they were able to cope well with the pace. Table 2 shows the extent to which the students think the module has helped them to understand the ecological concepts. Most of the students believe that they understood the concepts very well or just well as a result of the module. Only one student thinks that he or she did not understand the concept 'habitat' much. Another one thinks that he or she did not understand the concept 'food web' much, two of 'niche', and three of 'adaptation'. Of all the concepts learned, it was only 'food web' that one student reported that he or she did not understand at all. It seems that the students ranked their post-learning understandings of the concepts more highly than the inventory of their post-learning ideas suggests. Table 3 presents the performances of the students in the two inventories of their ideas on ecology.

Table 2

The extent to which students think they understood the ecological concepts after undertaking the module expressed as percentage (n=20)

Understanding of Concepts	Ecosystem	Habitat	Food Web	Niche	Adaptation
Very well	60	90	30	50	60
Just well	40	5	60	40	25
Not much	0	5	5	10	15
Not at all	0	0	5	0	0
Total	100	100	100	100	100

Table 3

Responses to questions on the ecological concepts expressed as percentage (n=20)

Question		Ecosystem		Habitat		Niche		Food web		Adaptation	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	A	0	0	5	67	0	62	0	0	0	66
	B	0	10	0	14	0	0	0	0	0	5
	C	14	90	52	19	0	38	0	62	10	24
	D	86	0	43	0	100	0	100	38	90	5
2	A	0	0	0	5	0	48	0	14	0	14
	B	0	10	0	14	0	0	0	33	0	10
	C	19	38	67	81	43	38	52	48	33	71
	D	81	52	33	0	57	14	48	5	67	5

A = complete answer. **B** = partial but improved answer (in case of partial pre-learning answer). **C** = partial answer. **D** = incorrect answer or no response.

Pre = Pre-learning response. **Post** = post-learning response.

4.2.4 STUDENTS' PERCEPTIONS ABOUT THE TEACHING APPROACH

All of the students want future courses in biology to be conducted by this approach. As biology/science teachers-to-be, all of them would like to teach their lessons by the approach used in this module. These views seem to negate the view of the one student who said the approach was time wasting.

Positive things that the students found about the teaching approach are:

'Group work, co-operative learning, practical activities, learners doing independent investigations, learners coming up with different opinions, learners taking responsibility of their own learning, activities not boring, learning becomes easy, learning encouraged, learning environment not threatening, learners encouraged to do research, students learn with concrete specimen, lessons interesting, all students participating, people learn to observe and discuss, learners active, no need of memorisation of concepts, learners motivated.'

Suggestions that subjects put forward that could make the teaching and learning approach better are:

'More time needed for the work, other science teachers must provide support, field work must be conducted in the mornings and not in the afternoon when students are already tired, and field work must not be limited to the college premises.'

The most common of these suggestions was the need for more time for the activities. It seems that the learners needed more time to complete the various activities in the module. One may suppose that sufficient time to complete the activities in the module would probably have supported their learning.

4.3 INTERVIEWS WITH SUBJECTS

Five students were interviewed (see appendix C). Two of them Gov and Gig had been observed to be very active and seemed to have enjoyed all the learning activities. Kid, Nat, and Set had been absent at one stage or another during the course. Even though Set

had been absent on some occasions, he appeared to have understood the concepts as well as subjects who had attended all the sessions. Kid and Nat did not show as much understanding of the concepts as Gov, Gig, and Set.

The interviewees indicated that they had experienced the teacher telling approach to teaching in the high schools in which they had to memorise facts to reproduce in tests and examinations without real understanding.

Interviews confirmed the students' commendations of the teaching and learning approaches used in the module. Set described it as 'superb'. They were all happy with the activities conducted in the module especially the fieldwork as was found from the questionnaires. The problem of the commentaries in the videos not being clearly understood emerged again in the interviews as in the questionnaires though not many of them seemed to have that problem.

All of the interviewees believe that they learned the ecological concepts with understanding. As it was asserted by Set, *'even when I am going to write exams, I see no need to sit down to pour down things I have memorised. It is right in front of me. I always see it because I did it.'* The interview however revealed that they did not really have deep understanding of the concepts. Of course, subjects Gov and Gig who attended all the sessions appeared to have better understanding of the concepts. Even though Set did not attend all the sessions, his understanding of the concepts was comparable to those of Gig and Gov. Set explained that he made extra effort to catch up with the others. Indeed, all those who did not attend some of the classes, seemed to have genuine reasons for not attending and regretted it. They admitted that their absence from the sessions affected their understanding of the concepts adversely. All of them would want to employ the approach used in the module in their teaching practices. They agreed that the teacher must understand the content to be able to use the approach effectively and that it may require a lot of preparation on the part of the teacher.

4.4 PARTICIPANT AND NON-PARTICIPANT OBSERVATIONS

As a participant-observer, I observed that the students seemed happy with and enjoyed the learning processes. There was high level of co-operation amongst the participants as they showed a lot of involvement, interest and excitement in all the activities. These observations were corroborated by the non-participant observations (see appendix D).

These observations seem to confirm many of the responses of the subjects in the questionnaires and interviews. With respect to one student that was observed to be dozing during the video shows, I found from subsequent observations that he seems to have difficulty with concentration especially if the activities involved watching something or listening for a long period of time. My casual conversation with him revealed that he was interested in the module.

Evidence of students' enthusiasm, co-operation, excitement, interest, and enjoyment of the module could be found from the:

(a) Willingness to remain behind after college hours to work.

(b) Involvement in group-discussions.

(c) Reluctance to break up their discussions to attend lessons in other subjects.

(d) Occasional calls on me, as a lecturer, to share some ideas with them.

(e) Readiness to do field work in the hot afternoons when they were supposedly tired.

(f) Readiness of some groups to go deep into the bushes during the fieldwork to places I would not want to go myself.

(g) Dominant comment in the questionnaires that they needed more time to do the fieldwork.

(h) Request for one of the videos to be shown a second time.

With regard to the understanding of the ecological concepts in the module, they seemed to have improved their understandings on the whole but not equally well. This is evidenced in the post-learning inventory of their ideas (see table 3) on the concepts and also from the interviews. Non-participant observer B made a similar observation.

CHAPTER FIVE
DISCUSSION AND CONCLUSION

The main goal of this study was to report the effects of a module on ecology informed by social constructivist ideas on the understanding of selected ecological concepts by college students. To obtain information for this research, I implemented a module on ecology informed by constructivist ideas with students of a college of education. I used written responses to questions to take inventories of the students' ideas on selected ecological concepts before and after learning. Questionnaires, interviews, and observations were also used to gather data.

In the preceding chapters, I firstly discussed background of the study. Social constructivism as a promising approach to science education was indicated. In chapter 2, a literature survey on social constructivism as a philosophy of education and as opposed to behaviourism was conducted. Chapter 3 outlined the research methodology. The chapter indicates the research context, goal and questions of the research, and the philosophy underpinning the research design. The research instruments are also described in that chapter. Chapter 4 reports the findings made from the data. It includes an evaluation of the students' conceptual change with regards to the concepts learned in the module and their responses to the teaching and learning strategies used in the study. In this concluding chapter, I discuss the themes that emerge from the data and then draw conclusions.

5.1 THE IMPACT OF THE MODULE ON THE UNDERSTANDING OF THE ECOLOGICAL CONCEPTS BY THE STUDENTS

In the study of the ecological concepts in this research, it would seem that the social constructivist learning strategies used in the module assisted the students to improve their frameworks of the concepts. But while data gathered are in support of the prediction that social constructivist strategies would promote meaningful learning of the ecological concepts by students, the inherent design and other weaknesses of the module would

appear to limit the extent to which the students learned the concepts. A replication of the study with improvements on the design of the module would be a promising direction for further research.

In this study, it emerged that the students think that they would have learned more if they had undertaken practical investigation of a variety of ecosystems. It would appear that a more extensive study of a variety of ecosystems would have broadened the students' scope of understanding of the ecological concepts. It also emerged that the students were constrained by time and other logistics in undertaking activities in the module. For example the students had to conduct fieldwork at times that did not seem conducive for such activities. Discussions among students were frequently shortened because of the college timetable that allowed only limited time slots. As was found by Kuiper and Wilkinson (1998: 217), lack of timetable slots for innovations is one of the problems of using social constructivist strategies in teaching.

It was found that the ecological concepts considered in the module of this research were not understood equally well by the students. The concepts 'ecosystem' and 'food web' appeared to be the least understood. The individual students also showed varying degrees of understanding of the different concepts. The findings seem understandable since the concepts have varying levels of complexity and the students entered the learning situation with different frames of prior ideas. Researchers seem to agree that learners may come to the learning situation with misconceptions that might resist change even after teaching (Adeniyi, 1985). The disparities in the students' conceptual frameworks after undertaking the module may also be explained by how much they got involved in it. For example, Nat who appeared to have poorer understanding of most of the concepts than the other students had been observed to be less active in undertaking the module. According to Bodner (1986: 874), students who take active part in the learning process often learn more than passive students do. Again it was observed that the students seemed to have difficulty in expressing themselves properly in English. This could have influenced the responses that were obtained from them in the data gathering process.

5.2 STUDENTS' PERCEPTIONS ABOUT SOCIAL CONSTRUCTIVIST APPROACH TO LEARNING

From the data it would seem that the students enjoyed the social constructivist approach to learning the ecological concepts and perceived it as an effective teaching strategy. However, the responses of the students to certain aspects of the module need to be discussed. Even though all the students indicated that Activity 1 had a positive effect on their learning of the concepts, it seems that some of them were not comfortable with it. In that activity they provided written responses to questions to show their initial ideas on the ecological concepts. It appears that the students would have preferred to be warned before hand about the 'test' so that they would prepare for it. As students who were used to the behaviourist approach to teaching and learning, it seems that they had wanted to impress the teacher rather than explore their initial understandings of the concepts. Perhaps teachers who employ constructivist strategies to teach students who are inexperienced with the approach may consider using other strategies to elicit students' prior ideas instead of written 'tests'.

Even though all the students believe that the videos used in the module had positive effects on their understanding of the concepts, most of them had complaints about them. The complaints were that the (a) videos were dull, (b) language used in the commentaries was difficult to understand, and (c) that the ideas in the videos were discussed too quickly by the commentators. In the opinion of the researcher as concurred by an independent observer, the videos were interesting and the commentaries were easy to understand. The students' problems may be explained by their apparent difficulty with the comprehension of English. All learning depends on language and communication (Yager, 1991: 53-54). Teachers who teach in the social constructivist mode may have to pay attention to the language proficiency of the learners in the medium of instruction.

In this research, the students seemed to commend highly the role of the fieldwork in the understanding of the concepts. Only one student felt that the fieldwork was a waste of time. He or she thinks that they could have learned the concepts by merely listening to

lectures from the teacher. One may understand learning in the view of this student to mean the memorising of teachers' facts. The literature is replete with research findings that uphold the role of fieldwork in learning ecological concepts. Teachers may be encouraged to include fieldwork in the teaching of ecology to help students to make meaningful learning of ecological concepts.

5.3 CONCLUSION

When students learn by absorbing the teacher's information, they tend to learn by rote and are often unable to make meaning of and connections between concepts (Okebukola, 1990:501). This seems to be the case in our schools. Teachers describe ecosystems to students, ask them to copy and memorise lengthy notes from the chalkboard. Under this atmosphere, the student is incapable of flexible and critical thinking (Okebukola, 1990:501). From the findings of this study, it would seem that, the social constructivist approach helped the students to improve their frameworks on the ecological concepts: *ecosystem, food web, habitat, niche, and adaptation*. The social constructivist approach, it would appear, has a tremendous capability for helping learners cope adequately with the demands of difficult concepts. Biology teachers would need to be aware of the utility value of social constructivist approach to teaching and learning. Experiences from this study would seem to suggest that teachers who may adopt the social constructivist approach to teaching ecology do have to pay particular attention to the following:

(a) The teacher must have thorough understanding of the concepts to be taught.
(b) The teacher will need thorough planning and preparation in advance.
(c) The school timetable should be able to allow for notional time to undertake the learning activities.
(d) Learners may be taught and allowed to communicate in the language they are comfortable with.
(e) A variety of ecosystems may have to be studied to broaden learners' conceptual framework of the ecological concepts.

In conclusion, this researcher wants to think that if the findings of this study are anything to go by, a schedule for learning about social constructivist strategies for instructional purposes should be built into the education programmes for pre-service biology teachers. For social constructivist approaches to teaching biology to permeate the South African teaching corps, similar programmes should also be considered for in-service teachers.

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APPENDIX A

A LEARNING MODULE ON ECOLOGY

ACTIVITY 1

INVENTORY OF STUDENTS' PRIOR IDEAS ON ECOLOGY

Name: _____

The following questions are meant to find out some ideas that you have on ecology. Please answer them to the best of your ability. Do not seek help from any external source.

Question 1
What do you understand by each of the following concepts? Support your explanations with examples if you can.

1.1 Ecosystem:

_____

_____

1.2 Habitat:

_____

_____

1.3 Niche:

_____

_____

1.4 Food web:

_____

_____

1.5 Adaptation:

_____

_____

Question 2
Read the following passage, which describes a certain scene carefully, and then answer the questions that follow it:

In the bushes behind the college buildings there is a tree. It is one of similar trees growing distances apart from each other. There are grasses, shrubs and thorn trees growing around it. In the shadow of its canopy below it, no plants seem to grow except few shade-tolerant ones. The leaves that drop from it during autumn form a pile of decaying debris during the wet season providing a lot of activity for the decomposers including bacteria and fungi. It has many branches and a lot of leaves that are balanced by the buttresses that support it at the base.

In spring and summer when the tree flowers and produces its fruits, a variety of animals may be found in and around it. The activities of birds and other animals on the tree during the day seem to disturb the owls and fruit bats that pass their day resting in the tree.

Rats, squirrels, guinea fowls, and partridges may occasionally be found under the tree picking up the seeds that have dropped from the tree. These animals will quickly scuttle for cover on the arrival of a cobra or any other carnivorous animal, relying on their strong legs to run. There are not many snakes in the bushes though, as they are easily picked up by secretary birds common in this area.

The leaves that form thick debris under the tree provide shelter for a variety of invertebrates including earthworms, millipedes, centipedes, ants and other crawling insects. They feed on the cellulose of the leaves except the centipedes that are carnivorous and feed on these other animals. In the wet season when mushrooms grow under the tree, they serve as food for ants and tortoises. Decaying mushrooms also attract houseflies and blowflies.

A hole in the upper part of the stem of the tree is a home for a swarm of bees. Here, they build their hives and make honey, not withstanding the carmine bee-eaters that prey on them. When the tree flowers, the bees get another source of nectar to make their honey. They do not have to fly far away in search of the raw materials for making their honey. It is not only the bees that suck nectar from the flowers; sunbirds and some flying insects such as butterflies also do. The insects that visit this tree may lay their eggs on the leaves and when they hatch, the larvae feed on the leaves while they undergo metamorphosis. Usually the caterpillars mimic the green colour of the leaves to avoid predation from wasps, shrike birds, spiders, etc. Here and there one may find spider webs that not only trap flying insects but small birds such as shrikes and sun birds as well.

Lichens grow on the tree trunk giving it a greyish look from a distance. The tree thus assumes a cosmetic green top and a greyish trunk. What a beauty! Moths that sit on the tree trunk by day match the colour of the stem and are not easily identified by their predators. On the lower parts of the stem, mud tunnels of termites may be seen as these little ants feed on the wood and enjoy the humid environment of the tunnel.

Now answer the following questions based on the passage:

2.1 What ecological **concept** may the tree described and the activities that go on in and around it represent? Give reasons for your answer.

_____

_____

2.2 What is the main source of energy available to the organisms in the environment described in the passage? Please explain your answer.

_____

_____

2.2.1 Do organisms in the environment depend on each other for energy? If your answer is 'Yes', please explain.

_____

_____

2.3 Do you expect all organisms in natural environments to have the same source of energy as the one described in this passage? Why?

_____

_____

2.4 Identify all the **food chains** that exist in the environment described in the passage. Write down the food chains below:

_____

_____

_____

_____

_____

_____

2.5. Can these different food chains be linked up into a **food web?** If yes, show how (construct a food web):

2.6. Describe all the **habitats** you can identify in the environment referred to in the passage.

_____

_____

2.7. Is it possible for any of the **habitats** to be occupied by more than one kind of organism? Explain:

_____

_____

2.8 Do the organisms in these habitats occupy the same niches? Explain with an example.

_____

_____

2.9 List the environmental problems that the organisms of this environment face for which they may require special **adaptations.**

_____

_____

2.10 Describe briefly the adaptations shown by the individual organisms to survive in this environment:

_____

_____

ACTIVITY 2

VIDEOS ON ECOSYSTEM TYPES

In this activity you are going to watch videos which present some types of ecological biomes and which highlight some ecological concepts. Your task is to watch the videos attentively to see how far they might help you to understand some ecological concepts.

You need to pay particular attention to the following concepts: **ecosystem, habitat, niche, food web, and adaptation.**

ACTIVITY 3

GROUP DISCUSSION

Now you must discuss in groups the meanings you make of the concepts **ecosystem, habitat, niche, food web, and adaptation** as you have learned from the videos.

Write down your group's understanding of the concepts on the newsprints provided.

Has your group's meaning changed your initial understanding of the concepts?

Think of your college environment as a biome or a community of organisms. Discuss and write down:

a) Why you think the environment can be described as an ecosystem.

b) What habitats can be identified in the environment.

c) The food chains that exist here.

d) Names of organisms you have ever found in the environment.

e) The adaptations of different organisms you have seen in this environment.

f) The special roles played by these different organisms to keep the biome alive (niches).

ACTIVITY 4

FIELDWORK

You have in your previous activities watched videos on ecosystem types and some ecological concepts. You will now go out to study the college environment to see how it functions as an ecosystem.

Your tasks shall be to observe:

a) The features of the environment for which it could be described as a living unit (ecosystem).

b) The different living areas for organisms (habitats) in the environment.

c) The organisms that live in these habitats.

d) How the organisms interact with each other.

e) The challenges that the organisms in this environment face.

f) How the organisms cope with the challenges of the environment (adaptations).

g) The feeding relationships that exist in this ecosystem (food web).

h) The roles played by the different organisms to keep the ecosystem alive (niches).

i) The human influences on the environment.

You will work in groups and every group will report its findings to the whole class after the study.

To make your study easier, you may follow the following worksheet:

1. Make a list of all the organisms you find in this environment.

2. What special features do you find to be of interest about the organisms?

3. Make a list of all the living places for organisms (habitats) that you observe in the environment.

4. How different from each other are the living places you have identified?

5. What organisms do you find in each living place?

6. What roles do different organisms play to keep the environment going as a living unit (niches)?

7. What is the food eaten by each of the organisms you have identified? (If you cannot answer this question immediately, you can find out from the library or your textbooks later).

8. What conditions do you find that pose problems or challenges to the organisms in this environment?

9. What special features do the organisms have that enable them to cope with the problems/challenges listed in question 8 (adaptations)?

10. Can the organisms in this environment be connected together through their feeding relationships (food web)? Try to work out a food web:

11. Make a list of attributes that makes this environment a living unit (ecosystem):

12. What do you think can destroy the continued existence of this living unit? (List as many as you can think of):

13. What influences do humans have on this environment? Explain.

ACTIVITY 5

CLASS DISCUSSION

Each group will now report its findings from the fieldwork to the whole class.

The report must be based on the worksheet used in Activity 4.

Members of each group shall be expected to provide support to their presenter.

Everybody must feel free to ask questions during the presentations.

You may use a variety of media e.g. O.H.P., charts, diagrams, photographs, chalkboard, real specimen, models, etc. for your presentations.

It is expected that you will learn from each other's experiences through the presentations.

APPENDIX B

QUESTIONNAIRE ON THE IMPLEMENTATION OF THE LEARNING MODULE ON ECOLOGY

In the past few weeks, you have gone through a course to study some ecological concepts. You are requested in this questionnaire to give your impressions about the teaching and learning approaches used in the course.

Please fill in your opinions or make ticks ( ) as necessary in the spaces provided.

1. Are you familiar with the teaching/learning approach used in this course?
   Yes ( )
   No ( )

2. What did you find new about the approach of teaching/learning used in this course with respect to the teaching/learning methods you know?

_____

_____

3. Do your other lecturers of the college use this approach to teach their courses?
   Yes ( )
   No ( )

3.1. If your answer to question 3 is 'Yes', please name those subjects in which the approach is used: _____

_____

3.2 If your answer to question 3 is 'No', please describe briefly how courses are taught in your other subjects: _____

_____

_____

4. Did you like the approach used in teaching this course?
   Yes ( )
   No ( )

4.1 Explain your answer to question 4 _____

_____

5. In this course, you undertook different activities. Tick ( ) the activity or activities that you enjoyed the most:
   Activity 1: Giving your initial ideas on ecology ( )
   Activity 2: Watching videos on ecology ( )
   Activity 3: Group discussion on the videos ( )

Activity 4: Field study of the college environment ( )
Activity 5: Class discussion on the field study ( )

6. Which activity or activities did you **not** enjoy?
Activity 1 ( )
Activity 2 ( )
Activity 3 ( )
Activity 4 ( )
Activity 5 ( )

6.1 Give reason(s) for your choice of answer(s) to question 6: _____
_____

7. Did you find the learning process difficult?
Yes ( )
No ( )

7.1 If your answer to question 7 is 'Yes', please explain.
_____
_____

8. Did you at any stage of the course feel that you were being left behind in the learning process?

Yes ( )
No ( )

9. In Activity 1, you were asked to provide the ideas you had on ecology at that time.

9.1 Did you find the instructions easy to understand?
Yes ( )
No ( )

9.2 What role did that activity play for you in the whole learning process?
_____
_____
_____

10. In Activity 2, you watched videos on ecology.

10.1 What problem(s) did you encounter with the videos? _____
_____

10.2 Did the videos help to improve your understanding of the ecological concepts learned in the course? Yes ( ) No ( )

11. In Activity 3, you shared what you learned from the videos with your colleagues. Did you enjoy the discussions?
Yes ( )
No ( )

11.1 Do you think that it was necessary to follow Activities 2 and 3 up with the field-work?
Yes ( )
No ( )

11.2 Give reasons for your answer to question 11.1: _____
_____
_____

11.3 Did the group discussions help to change or modify your understanding of the ecological concepts learned from the videos?
Yes ( )
No ( )

11.4 How did you find the group activities?
Boring ( )
Time wasting ( )
Interesting ( )
Other (Specify) _____

11.5 Would you have preferred to work with other people than those of your group?
Yes ( )
No ( )

11.6 Please give reasons for your answer to question 11.5:
_____
_____
_____

12. In Activity 4, you conducted a field study of the college environment. What did you like about the field-work?_____
_____

12.1 What did you **not** like about the field-work? _____
_____

12.2 Did you understand what you were supposed to do during the field-work?
Yes ( )
No ( )

12.3 If your answer to 12.2 is 'No', indicate the aspects that you did **not** understand?

_____

12.4 Were there any things you learned from the fieldwork that could **not** have been learned in the classroom?

Yes ( )
No ( )

12.5 Explain your answer to question 12.4: _____

_____

_____

13. Do you think that it would have been easier to learn the ecological concepts by just listening to lectures in the classroom rather than the processes used in this course?

Yes ( )
No ( )

13.1 If your answer to 13 is 'Yes', please explain why. _____

_____

_____

_____

14. Would you want the class to undertake more field studies in future?

Yes ( )
No ( )

14.1 Give reasons for your answer to question 14. _____

_____

_____

15. To what extent do you think you understand the concepts learned in this course?

Ecosystem: Very well ( )
Just well ( )
Not much ( )
Not at all ( )

Habitat: Very well ( )
Just well ( )
Not much ( )
Not at all ( )

Niche: Very well ( )
Just well ( )
Not much ( )
Not at all ( )

Food web: Very well ( )
Just well ( )
Not much ( )
Not at all ( )

Adaptation: Very well ( )
Just well ( )
Not much ( )
Not at all ( )

16. Would you want future courses to be conducted by the approach used in this course?
Yes ( )
No ( )

16.1 Give reasons for your answer to question 16: _____
_____
_____
_____

17. As a biology/science teacher-to-be, would you like to teach your lessons by the approach used in this course?
Yes ( )
No ( )

18. What are the positive things you found about the approach used in teaching this course? _____
_____
_____
_____
_____
_____
_____
_____

19. What suggestions do you have that would make this teaching/learning approach better? _____
_____
_____
_____
_____
_____
_____
_____

APPENDIX C
INTERVIEW WITH SUBJECTS

INTERVIEW WITH SUBJECT Gov

13 June 2000

Question (Q): I called you because during our course on ecology, I observed that you were highly motivated. I could see that you were very enthusiastic with the work. You worked hard, you cooperated well with others, and you were even encouraging others to work. I want to know what motivated you so much?
Response (R): I can say that I was motivated because firstly, I love the career that I have chosen. I love teaching and I love the subject that I am doing, that is biology.

Q: You are going to become a science teacher. In that course, I used a particular approach in teaching. Did that approach have anything to do with your enthusiasm or only because you love the career and the subject?
R: I can say that this constructivist approach uplifts my standard of learning.

Q: So how do you compare your understanding of ecology before we started the course and now after the course? How do you feel within yourself about your understanding of ecology?
R: Before I was memorising it. I didn't what it is about. It was memorisation before but now since you taught us, we do things practically so now it makes me to understand easily because before we were just learning but nothing we do practically or go to the field to make research.

Q: Before this course, when and where did you ever study ecology?
R: I did ecology in standard eight at Archie Vellile High School at Dimbaza.

Q: So there you were only listening to the teacher and copying notes?
R: Yes, from the chalkboard but I knew nothing because I just copy notes about ecology but I didn't really understand it.

Q: In the approach used in this course, I started by asking you to write for me what you knew about ecology. I gave you a sort of a test. How did you feel about the test?
R: Eh, I was unhappy because I was not having the idea for instance, the 'niches', that was a new term to me.

Q: Did you think that I was going to use the marks you would obtain as part of your final assessment?
R: No. You told us that you wanted to know the ideas we already have on ecology.

Q: After that 'test', we watched videos. We watched three videos and we repeated one of them.
R: Yes, Tsitsikama forest.

Q: Tell me, those video sessions, how did you find them?
R: I don't understand sir.

Q: Okay, do you think for example that the videos were boring, time wasting, or the like?
R: No, it was not boring.

Q: But I saw some students who were dozing.
R: No, the videos were not boring because we learned about ecosystems so that is something that is happening in ecosystems so it was interesting to me.

Q: But why do you think that some students were sleeping?
R: Hmm, may be they were not interested.

Q: Did they say anything afterwards to your hearing?
R: No, nothing.

Q: What about the atmosphere in the room? I think the room was hot. Somebody wrote in the questionnaire that the room was too hot.
R: Yes, I think so but it depends on individuals.

Q: And for you?
R: I was not having any problem because since I was having the interest in what was going on, I didn't feel that the room was so hot. If you have interest in something, I don't think it can make me to become hot.

Q: After the videos, I asked you to work in groups to discuss your understandings of the ecological concepts. Do you think that the group work helped you in anyway to understand the concepts?
R: So much, sir.

Q: How?
R: In the group, we were sharing ideas.

Q: Did your group members really bring ideas?
R: So much. Too much. Otherwise in my group, we are all participating all of us in the group. There is no one who is depending solely on others. Everybody is contributing.

Q: After the group discussions, we went out to do fieldwork. What comments do you have about the fieldwork?
R: No comment sir, because in the fieldwork we were participating and nobody was lazy. Everybody was working.

Q: What about the times we used for the fieldwork?
R: We needed more time because I remember that we were interrupted by rain. The time was little to us otherwise, may be, much investigations could have been done.

Q: We were doing the fieldwork in the afternoons, then after the rain, I think the rain was on Tuesday, then we were to resume the investigations on Wednesday afternoon. When we were to go in the afternoon of Wednesday, some students suggested that we postpone it to Thursday morning because the afternoon was too hot and so we postponed it to Thursday morning. What is your comment about that because people felt that the afternoon was not a convenient time to do fieldwork?
R: Since it was in the afternoon and the weather was too hot, yes I agree and I think others were hungry. So I think that is why they didn't want to work in the afternoon.

Q: If you become a teacher and you wanted to do this kind of thing with your learners, what time would you consider most appropriate to do it?
R: I think the morning.

Q: When we came back from the fieldwork, we did class discussions. Each group reported its findings and the whole class discussed the reports. Would you say you learned anything from it?
R: Yes I learned many things.

Q: If that is so, there were five main concepts that we learned. Which of them would say you understand very well.
R: Niche.

Q: Can you explain the concept niche to me?
R: Okay a niche is the role played by an organism in the ecosystem.

Q: Like for example?
R: For example, the role that a tree plays in an ecosystem. A tree is a producer. Its role is to produce food for other organisms.

Q: By what process?
R: Process of photosynthesis.

Q: What will the tree need to be able to conduct photosynthesis?
R: Water, sunlight, chlorophyll, and carbon dioxide.

Q: In the absence of green plants, what is likely to happen to the ecosystem?
R: Mm, the ecosystem there would be no food chains.

Q: And if there are no food chains?
R: Other organisms may suffer.

Q: Suffer in what way?
R: There are organisms that depend on the green plants so they will suffer.

Q: Suffer in what sense?
R: They will die.

Q: Why?
R: Because the food that they depend on is removed.

Q: That's interesting. Now this approach that we used in learning the concepts, we call it social constructivism. As a teacher, would you want to use it?
R: Yes.

Q: Why?
R: Come again sir.

Q: Why will you use social constructivist strategies in your teaching?
R: I will use it because I want my learners to think critically because this new approach leads learners to think critically and to be creative. It leads learners to work on their own and not the teacher always to tell the learners. The learners can work on their own.

Q: The purpose of teaching is that learners would learn. They would understand what they learn. In terms of understanding does this social constructivist approach solve that problem?
R: Yes, I think so.

Q: So you will like to use it as a teacher.
R: Yes.

Q: Whatever teaching methods are used, there are bound to be problems and difficulties. What do you consider to be the difficulties of using the social constructivist approach?
R: Mm, I think there will be no problem.

Q: If for example the teacher doesn't understand the topic he or she is teaching very well, how may it affect the use of constructivist strategies?
R: No, the teacher must understand what she is teaching.

Q: What about the part of the learners?
R: You mean if they don't understand?

Q: No. Consider for example that you are a teacher at Sada Higher Primary. You wanted to teach your learners about the environment and you wanted to use constructivist strategies. What are the likely problems that the learners could create to make the approach difficult or the lessons to be unsuccessful?
R: Okay, if the learners don't participate well. I think this approach needs participation and co-operation. If there is no co-operation, I think it will be difficult. Every learner must co-operate. They must show interest.

Q: What about material resources that you may need?
R: I don't think so. If I want resources, that I don't have, I have the right to say to the learners to bring them from home.

Q: Would you encourage teachers to use this approach to teach?
R: Yes sir.

Q: Thank you.
R: Okay sir.

INTERVIEW WITH SUBJECT Gig

14 June 2000

Q: We have completed our course on ecology. Do you have any comments on the course?
R: I have many comments on the course.

Q: Yea, I want to know them.
R: The course was very interesting. It was very interesting because of the activities for example the fieldwork.

Q: During the course I saw that you were very enthusiastic. You were hardworking. What made you so enthusiastic? What motivated you?
R: The reason is that I like biology very much. I like it.

Q: This biology that you like so much, the method that I used to teach it was not the normal way you are taught. Did the methods used have any influence on your motivation?
R: Yes for example it was different from my former experiences.

Q: What was different about it that made you so interested?
R: As I have said, it was the activities and the group work.

Q: At this stage just try to compare your knowledge of ecology before we started the course and now.

R: What I can say is that this is not the first time to learn ecology. I did it in my matric years. I found that my teachers they used to come to class and write notes on the chalkboard and we copy the notes and that is all. We write the notes, learn them by heart, and then write the test. But now we did activities where search and the pamphlet I read on constructivism says that the student must do the experiment and so we went to the field to do research.

Q: So these things we did, did they help your learning?
R: Yes.

Q: You know we learned some ecological concepts. Which concept do you think you understand best?
R: I can say habitat.
Q: Can you tell me how you understand habitat?
R: Firstly, it sounds as if it is a difficult word but as I understand it, habitat is where an organism lives. Where you can find the organism in the ecosystem. It may not be living there for example, you can find a bird here in the college but not living here for example it sleeps outside but during the day, it came here in search of food.

Q: So if you go into a particular ecosystem, are you likely to find different habitats there?
R: Yes.

Q: Do you expect to find every organism in that ecosystem in every habitat?
R: No.

Q: Why not?
R: The reason is that for example you find a hole and you notice for example that there are some feathers. This shows that this hole is the home for the bird. There are some birds that live in that hole. But you find that there is no bird at that time so that means that, that organism lives in that habitat.

Q: Okay there is evidence that that organism lives in that hole. Let's take that hole for example, what other organisms apart from the bird can use it as a habitat?
R: The mouse, rats, snakes.

Q: What organisms are you not likely to find I that hole?
R: Sir, the question is not clear to me.

Q: Let me put it this way. The hole you are talking about, will you expect to find say, tadpoles in it?
R: Yes.

Q: Under what conditions?
R: For example in the morning you can find the toad in the hole.

Q: I am asking about the tadpole.
R: The tadpole, no. You can't find it there.

Q: Why not?
R: The reason is that the tadpole lives only in water.

Q: So that means that that hole is a habitat for some organisms and not for every organism.
R: Yes.

Q: The course that we did, we used some learning strategies and I divided the activities into four or five. I started by asking you to write down you knew about ecology at that stage. Did that activity give you any problems?
R: Yes.

Q: What were the problems?
R: Because I had to remind myself of the ecology I learned years ago in the high school.

Q: Was it difficult to remember what you had learned?
R: Yes.

Q: When you were doing that exercise, did you see it like doing a test for marks so that if you didn't do well, you could be unhappy? Did you see it as a test in which you had to do well to impress the lecturer? Did it matter to you whether you performed well or not?
R: Yes.

Q: Why?
R: Because I have to think.

Q: Why did you have to worry if you didn't know it after all I told you that I just wanted to know the ideas you had on ecology at that stage?
R: Well, you told us but like all tests, my aim was to do well in it. You see, we are used to writing tests for marks.

Q: After the 'test' you watched the videos. Any comments about the videos?
R: Yes, there are comments. For example it was my first time to watch video for the purpose of learning and so I found that I must be serious. For example you are watching and you must listen to what is being said at the same time. The first time I found it difficult and I ended up finding that I have not seen it all.

Q: Some students asked me to repeat one of the videos, were you one of them?
R: Yes, Tsitsikama forest.

Q: When I repeated the video, how did you benefit from it?
R: I benefited from it. I understood the concepts now.

Q: Do you think that video is a good medium of learning?
R: Yes, very much.

Q: When you were watching the videos, I saw that some students were dozing. Why do you think that they were dozing?
R: I can say that it is because they were not used to videos for learning as I said before and they were not taking it seriously. May be they were not interested.

Q: After the videos, I asked you to discuss what you learned from the videos in groups. In your group, did that the other learners had learned anything from the videos?
R: Yes sir.

Q: Everybody?
R: Not everybody.

Q: Those who were not able to participate well in the group discussion, did they include those who were sleeping when the videos were played?
R: No

Q: For those students, what went wrong?
R: I think the problem is that they were not used to watching and listening at the same time.

Q: What about the language used by the commentators in the videos?
R: And also the language. It wasn't easy to understand. For example, it was the first time to hear the word biome.

Q: What about the pace of the commentary?
R: It fast though not too fast. It was not easy to digest the first thing before another thing was said. That is why we asked for the Tsitsikama video to be repeated.

Q: How did you find the atmosphere of the room where the videos were shown? Was it healthy enough. How did you feel inside the room?
R: It was warm, not hot. It was okay for me.

Q: Did other students complain?
R: No. I didn't hear any complaints.

Q: Still on the group work. You say you learned from the discussions. To you, what is the Importance of group work?
R: For example, after we watched the videos, you asked us to discuss. May be there are some things in the video that I did not understand or hear clearly. Others who heard or understood it, will explain to all of us.

Q: After the videos and the group discussions, I still asked you to conduct field investigations. Do you think that it was necessary, after all you had seen a lot from the videos already?
R: Yes sir.

Q: The videos were not enough?
R: They were enough.

Q: Then why did we still have to do the fieldwork?
R: It is because constructivism requires students to do research on their own in order to make them clear about anything.

Q: You see, the purpose of teaching is to help learners to learn and understand. If by watching the videos you have understood the concepts, why do we have to do anything else?
R: For example I didn't know that this college is a biome. So it was to help us to understand more.

Q: Did the fieldwork help you to understand more?
R: Yes, for example, I have seen the birds there, holes, and leaves as habitats for caterpillars. So I have seen them and touched them.

Q: During the fieldwork what problems did you encounter?
R: In my group?

Q: Yes, in your group and even the other groups if they said anything to your hearing.
R: My problem is that, other members were participating but they afraid. If I said there is hole there, let's check what organism we can find there, they were afraid. They said no what if it is a snake?

Q: If we were to do fieldwork again, what suggestions would you give me to help to make the students more comfortable?
R: Mm, firstly you must make sure that eh, I don't know. My suggestion is that you must first go there to see if there are any dangerous organisms there.

Q: Did you come across any dangerous animals?
R: No sir.

Q: When we were doing the fieldwork, we were working in the afternoons then it rained one afternoon. I suggested that we continue the next day in the afternoon. Some students suggested that we rather work in the mornings. What was the problem with the afternoon?
R: For those who were saying that we go there in the morning, their problem was that they want to go home early.

Q: I thought that they found the afternoons too hot to work.
R: And also the weather.

Q: Do you like this social constructivist approach we used to learn the ecological concepts instead of say the lecturer sitting you in the classroom and telling you everything about ecosystems?
R: Yes I like it

Q: Why do you like it?
R: This first reason as I said earlier, is that from my own experience, we used to sit down and the teacher will notes for us on the board and we copy the notes. The teacher tells us we are going to write a test next week. So we write the notes, memorise them and then write the test. So I found that the learner must do the thing on his own in order to know or learn better.

Q: Now you are preparing yourself to become a teacher. Would you want to use constructivist strategies in your teaching?
R: Yes.

Q: Why?
R: It's because every learner must do everything on his own for things like experiments and fieldwork.

Q: Does that help learning?
R: Yes, they help the learner to understand.

Q: If you want to use constructivism in your teaching, what do you think that can be a problem for you? Take yourself as teaching at Luvuyo Higher Primary school for example. You want to teach your learners about the environment and you want to employ constructivist strategies. What are the likely problems you might face?
R: The first problem will be the learners especially in group work.

Q: What will be the problem with group work?
R: From my experience during the teaching the practice, the learners when you give them a task, they do not work as a team. Not all of them participate.

Q: Is there no way by which you can motivate them to participate?
R: Yes, I can motivate them.

Q: But what is the problem? Why won't they want to participate?
R: You see, I went to Luvuyo for teaching practice. At Luvuyo, the pupils have been taught by their teachers that if a leader is appointed to lead a group, he will remain a leader a leader for the group throughout the whole year. It is the leader who does everything.

Q: If the learners are not able to communicate in English, will that be a problem?
R: No, they can communicate in Xhosa the home language. It doesn't matter in science.

Q: What about material resources. Will that be a problem?
R: No.

Q: How will you obtain materials?
R: If there materials I need which are not available or any shortages, I'll try to make my own apparatus.

Q: It seems that you are interested in constructivism. Will you want to encourage teachers to teach by constructivist strategies?
R: Yes.

Q: Why?
R: It's because it is making us to learn better. It is interesting. The teacher learns, the learners learn.

Q: Thank you very much.
R: Thank you.

INTERVIEW WITH SUBJECT Nat

15 June 2000

Q: Good morning. Eh when were doing the course on ecology, I noticed that you didn't attend all the sessions. Can you tell me why you were not able to attend all the sessions?
R: Sometimes I was not able to come to school because I have some problems at home. Problems of money and other times the problems of my children.

Q: Do you think that your inability to attend all the sessions on ecology affect you in any way?
R: Yes sir,

Q: In what way did it affect you?
R: Sometimes when the learning process comes, my mind at that time is not in what we are learning in the classroom.

Q: Where will your mind be?
R: (Laughter) Thinking of the problems that I've already told you.

Q: Okay, do you think that you learned enough in ecology?
R: No sir.

Q: Do you remember any of the sessions that you didn't attend?
R: The fieldwork.

Q: Did you watch all the videos?
R: Yes.

Q: When we were doing discussions on the fieldwork, were you present?
R: Yes.

Q: Which of the ecological concepts that we learned do you have problem with?
R: I think it is adaptation.

Q: Which one do you think that you understand best?
R: I can try the food web and ecosystem.

Q: Can you explain to me what is a food web?
R: The food web I think is a repetition of what animals eat.

Q: Repetition? What do you mean by repetition? Can you give an example?
R: Like the grasshopper eat grass and the grasshopper is eaten by frog and frog is eaten by the snake and the snake is eaten by a bird and the bird died and the bird is eaten by ants.

Q: That gives us what I will call a food chain. What you have described to me is a food chain. How similar or different is it from a food web?
R: (*Long silence*) I don't know.

Q: You also say that you understand ecosystem. Can you explain ecosystem to me?
R: An ecosystem is where living things and their environment eh I'm not quite sure.

Q: No problem. The teaching methods I used, you know I could have just come to the class and told you about ecosystem, habitat, niche, food web, food chains, and adaptations. I could have lectured to you but instead of doing that, I decided to use a different approach where I showed you videos, you did group discussions and fieldwork. Now, what comments do you have about the approach I used?
R: The method was right but we go to see video there are many things that happened in the video I skipped some of them.

Q: When we did the fieldwork, even though you didn't attend fully, did you see some of the things you saw in the video?
R: Yes sir, like frogs, plants and the rocks.

Q: Do think that the approach I used was necessary? Couldn't I have just lectured you?
R: The method was right because it was practical, yes.

Q: In terms of learning or understanding, do you think that it was better than lecturing you?
R: Yes, it was better.

Q: Why do you say it was better?
R: Because we did things practically and when someone does not understand, she asked from other students. I mean it is easier when we do it groups.

Q: Did you study ecology at any time before this course?
R: No.

Q: Not in the high school?
R: No.

Q: I want to describe the process I used in this course as based on social constructivist ideas. As a teacher-to-be, would you want to use that approach in your teaching?
R: Yes.

Q: Okay thank you.
R: Thank you sir.

INTERVIEW WITH SUBJECT Kid

15 June 2000

Q: Yea, I have spoken to some of your colleagues already about our course on ecology. Can you tell me why you didn't attend some of the sessions?
R: I had some problems. There was a phone call inviting me home.

Q: How many times were you absent?
R: I'm not sure.

Q: Did you watch all the videos?
R: It is the animals, plants, vultures, prey.

Q: There were three videos. The first one was 'what is ecology', the second one was let's look at Tsitsikama forest', and the third was 'let's look at life at the rocky sea shore'. The one on Tsitsikama was repeated. Did you watch all of them?
R: No.

Q: Did you do all the tests?
R: Yes.

Q: And the group work?
R: Yes.

Q: You didn't watch some of the videos. Did it affect your learning of the ecological concepts?
R: No.

Q: So you think you understand the concepts well?
R: Yes, but now I don't remember.

Q: Why not?
R: I must look up first.

Q: Look up where?
R: I took down some notes which I will like to refer to.

Q: Let me remind you. We studied five concepts: ecosystem, habitat, niche, food web , and adaptation. Which of them do you understand best?
R: Ecosystem.

Q: Right, can you tell me what you understand by ecosystem? What must an ecosystem be composed of?
R: There must be animals and plants.

Q: Only? What do you expect the plants and animals to do with each other?
R: To benefit.

Q: To benefit from what?
R: Like the animals that eat grasses on land they live with that.

Q: I see. Now I want to ask you about the teaching methods that I used. Do you have any comments about the methods I used?
R: No

Q: No comments? Whether you liked it or not, whether something could be done better in future?
R: No.

Q: Did you study ecology in the high school?
R: Yes, in standard eight.

Q: How did your teacher teach you ecology at that time?
R: She was using the old method.

Q: What is the old method? Just try to recall how your teacher went about her teaching. Describe it to me.
R: She explained the term first and then after describing the term, then moving to the content itself.

Q: How did she do the content?
R: She described the concepts and what is found in the ecosystems and how they benefit from each other.

Q: How different is that method used by your teacher at that time and the method I used?
R: This one involves the learner, that one it is the teacher who is talking most of the time.

Q: In the two cases, which one did you find learning easier?
R: This one.

Q: Why? What made it easier?
R: This OBE goes with the learner's pace. You are forced in the old one to memorise what the teacher was telling you. You are encouraged in this one to come with your views.

Q: Next year you are going to become a teacher in the classroom. Which of the two approaches would you like to use to teach your learners?
R: This new one.

Q: Why?
R: Because it makes the learner to think.

Q: So you were thinking?
R: Yes. It is not the teacher who always comes with the information, the learners must come with their information as well.

Q: Okay, thank you very much.
R: Okay sir.

INTERVIEW WITH SUBJECT Set.

15 June 2000

Q: The reason why I invited you is that during our course on ecology, I noticed that you were not always present. If you will remember, you wrote the second test here in my office after the others had written it already. Can you tell me why it happened like that?
R: The problem was money and I was forced to go to King Williams' Town for a day or two.

Q: The fact that you didn't attend some of the sessions means that you must have been affected in terms of what you learned.
R: I don't think so.

Q: Why not?
R: I made effort to catch up.

Q: How did you make the effort?
R: I went to the library to do research on my own. I also contacted my classmates about what had been done in my absence and took down some notes from them to add to what I had read myself.

Q: But that was a lot of effort I suppose. If say you had been present it would have been easier for you.
R: Yes.

Q: It means that you will agree with me that it is better to attend all lessons.
R: Yes that is true. It is better sir.

Q: We learned some concepts. Which of the concepts are you most happy with?
R: I'm happy with niches.

Q: Okay. Tell me about niches, your understanding of niches.
R: It is the role played by an organism in the ecosystem, for instance, snakes live on mice. It is the role to make a balance between the populations so as to regulate the flow of energy.

Q: Can you use a term to describe the role of the snake in the ecosystem?
R: It is the niche.

Q: No, no, what niche is the snake occupying?
R: It is a consumer.

Q: What type of consumer?
R: It is a secondary consumer.

Q: Is it possible for two different types of organisms to occupy the same niche?
R: Yes it is possible for example owls also feed on mice so I can say that they occupy the same niche with the snake.

Q: The teaching approach I used. You saw that I did not come to the class to lecture you about ecology. We used different activities. Do you have any comments about the approach used?
R: The method was superb because we are not expected to memorise instead we are expected to experience it. I was happy with the approach. Even when I am going to write exams I see no need to sit down to pour down things that I have memorised. It is right in front of me. I always see it. So in that sense it was superb.

Q: That is fine. Did you study ecology in the high school?
R: Yes, I did.

Q: How did your teacher teach ecology at that that time?
R: That one was boring.

Q: What was the approach that was used that you say was boring?
R: It was a textbook approach.

Q: Just describe it.
R: He just came in front of the class, defined the terms, tell everything that was taking place in an ecosystem. So we were expected to revisit the work taught, study it, expect a test so there was not full involvement of learners. We were not given the chance to see for ourselves what the ecosystem looks like. We were to memorise the already acquired knowledge of the teacher. In that sense it was boring.

Q: You are going to become a teacher next year. If you have the opportunity to teach your learners about the environment, which of these approaches would you use?
R: I'll use this approach you used. To go outside for field-work. So I'll give the learners the opportunity to discuss what they have seen there so I prefer that one.

Q: Do you think that using that method will be easy on the part of the teacher?
R: Yes, it is easy because you come with ideas in some way and the learners bring theirs in a different manner so you come together and you as a teacher you also gain from the way they interacted in the groups so they also gain something from you too.

Q: But preparing for that approach of teaching do you think it will be easy?
R: I don't think so because you have to sit down and plan to give them challenging questions and tasks. So I think it will not be very easy. You have to prepare very well before you come to class.

Q: In preparing, consider the materials you would use. When we were doing this course, I had to order the videos from Pretoria. When we were conducting the activities, we needed newsprints, pens and many other resources. Consider yourself teaching in a rural area. Will these things be easy to accomplish?
R: No sir. It won't be easy because I think they will need direct finance or you may use your own money and so in the rural area it will be difficult.

Q: What will scare you as a teacher from trying it?
R: No, it won't scare me. I'll do my best possible within the resources I have.

Q: Thank you.
R: Okay.

APPENDIX D

NON-PARTICIPANT OBSERVERS' COMMENTS

NON-PARTICIPANT OBSERVER A's COMMENTS

The students seemed enthusiastic, very attentive and almost everybody seemed to be taking down notes during the video shows.

Only one student asked a question after the video. His question showed that he did not understand the concept 'ecosystem'. When the question was thrown back to the class by the lecturer, they could not answer indicating that the class had not understood the concept fully from the videos. They requested for a repeat showing of the video which the lecturer granted. They were excited as they watched the various videos on ecology especially as the concepts were clearly explained with examples in the videos.

They showed co-operation to some extent as they have been willing to stay after school to do field work and to discussions. They really worked together for a common goal.

The students were fully involved as they readily took part in all activities such as fieldwork and group discussions and the class discussions. The class discussion was quite lively.

They did not initially seem to understand the concepts being taught as they could not answer most of the questions posed by the lecturer. However, at a later stage, they seemed to have made a lot of meaningful learning. They were particularly able to contribute to bring out adaptations of the organisms in the ecosystem and also in constructing a food web of organisms fond in the environment studied.

The students seemed to have enjoyed the exercise as this broadened their ecological horizon.

NON-PARTICIPANT OBSERVER B's COMMENTS

The various tasks and activities assigned to students were within the context of subject under study. The fieldwork was activity-based, task-oriented and attention holding.

The students worked in small groups and carried out their activities in the groups. This seemed to facilitate discussion within the groups and the students were observed to co-operate very well among themselves in the groups.

There was active participation of students in the tasks assigned to them. They were seen to show keen interest in the various activities. The students also showed competency of gathering samples and specimen from the field. Each student had some tasks to perform within the group.

On the whole the fieldwork was quite successful. The students were actively involved and could gather samples from the field to be used in the laboratory which demonstrated the integration of theory learnt in class with practice.

PROJECT 3

FINDING A NICHE:

THE POTENTIAL OF A COLLEGE OF EDUCATION TO BECOME AN IN-SERVICE TEACHER EDUCATION INSTITUTION

PROJECT 3

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

Across the globe there is widespread dissatisfaction with education. Education is generally perceived as ineffective (Claassen, 1998:34) and this has led to reform efforts in teacher education in many countries. Teacher education is generally criticised as ineffective (Yager, 1991:57). South Africa is not an exception. Soon on assuming office as Minister of Education, Professor Kader Asmal declared that South African education was in crisis. Among other things, he complained about the quality of the South African teaching corps and the kind of education they had received from the teacher education institutions.

South Africa is in a period of implementing a new national curriculum, Curriculum 2005, and the need for teachers who can successfully carry the process through cannot be over-emphasised. Teachers are viewed as important agents of change in the reform effort currently under way in education and thus are expected to play a key role in changing schools and classrooms (Hartshorne, 1994:218; Prawat, 1992:354). One of the greatest challenges for teachers is the implementation of Curriculum 2005, which marks a paradigm shift from a subject or content-based curriculum to an outcomes-based education (COTEP, 1997:11).

Attempts to ensure improvement in teacher education in South Africa has culminated in the transformation and restructuring of colleges of education in the country. The measures taken by the government include the disestablishment of some colleges of education and the conversion of a few of them into Education Development Centres (EDCs). According to the Minister of Education, the ability of districts and schools to manage their own transformation is weak and the ex-colleges of education can play a key role in improving the quality of teacher development and support (Asmal, 2000:9).

Following the recommendations of a provincial task team, the Eastern Cape department of education identified some colleges of education as possible candidates for the proposed Education Development Centres to provide in-service education for teachers (Department of Education, Eastern Cape, 1999a).

This study seeks to investigate the potential readiness of Tishala College of Education, one of the candidate colleges of education, to provide in-service teacher education as envisaged by the Eastern Cape Department of Education.

The report consists of five chapters. The next chapter is a literature survey that considers the concept of in-service teacher education (INSET) in view of contemporary theories and the South African situation. Chapter three is about the research methodology. This chapter describes the research context, the choice of a research paradigm and the methods of study. Chapter four reports the findings from the data gathered. In chapter five, I discuss the findings and draw conclusions.

CHAPTER TWO
LITERATURE SURVEY

2.1 DEFINITION AND PURPOSE OF INSET

In-service teacher education (INSET) means different things to different people, depending on their perceptions of what its purpose is (Hartshorne, 1992:257). Henderson (1979:17) defined INSET as the activities that are designed, exclusively or primarily, to improve and extend the professional capabilities of teachers. Hofmeyr & Hall (1995) define it as all forms of teacher education for serving teachers. According to them, it serves a range of different purposes including the following:

- Equalisation through the upgrading of academic and professional qualifications.
- Efficiency through management training.
- Change through curriculum development, social awareness programmes and for new roles.
- Classroom competence through input on subject knowledge and methodology.
- Empowerment through action research and teacher-led initiatives.

In this report, INSET shall be understood by these definitions and the purposes that they serve.

In-service education and training are not a new idea in South Africa (Hartshorne, 1992:259) though there seems to be no co-ordinated INSET teacher education programme in the country (NEPI, 1992:15). Davidoff and Robinson (1992:6) state that 'much of what passes as INSET in this country, amongst both governmental and non-governmental agencies, is in fact crisis intervention, as agencies attempt to patch up inadequacies of a weak teacher base and training.' INSET in South Africa is, however, an area that is gaining recognition and interest from policy-makers, funders and practitioners (Davidoff & Robinson, 1992:1). Part of what motivates the interest in INSET, according to Davidoff and Robinson (p.2), is the realisation that most teachers who have been 'trained' under an apartheid education system are not teaching in a way that prepares students to meet the needs and demands of a society in transition.

2.2 TEACHER EDUCATION IN SOUTH AFRICA

The emphasis of most of the teacher education institutions, according to Johnson (1991:194-195), has been on teacher training rather than teacher education. It is widely agreed that teachers, even those with upgraded training, are not adequately equipped for teaching in the current system of 'gutter' education, let alone in a transformed education system (*ibid*).

The National Education Policy Investigation (NEPI) report (1992) on teacher education indicated that there were 102 teacher education colleges in South Africa and these colleges presented a real dilemma for educational planners. According to the report (p.14), the colleges were isolated from centres of debate on national, academic, and professional matters, and academic development was difficult. The report stated further that many of them were small and inefficient. There was widespread dissatisfaction with the courses taught at the majority of teacher education institutions especially at the colleges of education. The syllabi stressed content, and the emphasis fell on rote memorisation of facts. Fundamental Pedagogics, a philosophy of education that is attuned to that which is scientifically admissible and acceptable (Van Rensburg *et al.* 1994:430), dominated teacher education theory in South Africa. And in terms of curriculum development within the teacher education institutions, there was no relationship between pre-service teacher education (PRESET) and INSET. This is because INSET was not a significant concern for teacher education institutions (NEPI, 1992:17-18).

The National Teacher Education Audit (1995) also identified similar and other weaknesses of the teacher education institutions especially with the historically 'black' colleges. They included the following:

- The general quality of teacher education is low;
- Philosophical tensions exist within institutions ranging from those that adopt a single-theory approach (such as Fundamental Pedagogics) to others that are explicitly eclectic;
- The theory-practice divide is a continuing problem;

- Methodologies are generally teacher-centred and emphasise the recall of content with little attention paid to developing critical and analytical skills;
- Many teacher education courses have not kept pace with international advances in knowledge and methodologies as for instance there is limited use of mixed media;
- Subject knowledge is deficient in the teachers that they produce;
- Many curricula lack relevance to the changing South African context (Hofmeyr & Hall, 1995:74-75).

In a national context, the key educator problem has been identified as one of poor quality (COTEP, 1998:129). Some 30 000 teachers were unqualified, and another 45 000 had less than matriculation (NEPI, 1993:236). The National Teacher Education Audit (1995) reported that approximately 36 per cent of South African teachers were under-qualified and 60 per cent of African teachers were not appropriately qualified. The Eastern Cape province had 44 per cent of its teachers either unqualified or under-qualified (Hofmeyr & Hall, 1995). It has been argued that the greatest teacher education challenge lies not at the PRESET but at the INSET level (Hofmeyr, 1994:37; NEPI, 1992:32). The new norms and standards for educators assume that South Africa's most pressing educational problem is improving the quality of educators rather than simply improving the quantity (COTEP, 1998:115). It would appear that there is no better time for the promotion of INSET activities in the country than now. In the words of Hofmeyr *et al* (1992:33), 'South Africa's biggest challenge in teacher development lies in the area of in-service teacher education.' They argued (p.35) that primary schools, especially in rural areas, are the place to start. According to NEPI (1992:33), over 60 per cent of South African pupils are in rural schools, and the capacity of the school system to contribute towards the development of South Africa will depend to a large extent on how rural communities are given access to quality education. Butler (1992:15) argued that there is virtually no question that effective staff development programmes do change teacher practice. She asserted that staff development continues to be a critical element that contributes to teacher effectiveness and school improvement.

2.3 INSET IN OTHER COUNTRIES

Worldwide, INSET is the major focus attention in teacher development because it is seen as one of the most cost-effective strategies for improving the quality of teacher education (Hofmeyr *et al.* 1992:33). This section reports a brief overview of INSET in other countries. The countries were randomly selected from the major continents of the world namely: Europe, Asia, Africa, and America.

2.3.1 INSET in England

In England, all teachers have to undergo several hours of INSET every year (Goodey, 1990:145-146). Institutions of higher education, Local Education Authorities (LEAs), teacher centres, and the Open University undertake INSET activities (*ibid*).

2.3.2 INSET in Japan

In Japan, a variety of INSET courses are offered and the Ministry of Education revises the content of these courses from time to time. INSET activities in Japan include teacher study groups, departmental seminars and study conferences for subject teachers, and intensive conferences organised to introduce teachers to the contents of new curricula and to plan teaching materials and lessons (Pretorius, 1990:264).

2.3.3 INSET in Kenya

In Kenya, unqualified and under-qualified teachers improve their qualifications by attending in-service training courses during school holidays. There are 43 advisory centres for teachers spread throughout the country (Bondesio, 1990:298).

2.3.4 INSET in the USA

In the USA, the explosion of knowledge has caused educationists to realise that a teacher's 'training' is never complete. Teachers constantly have to undergo in-service training in general education matters and in their subjects in particular. Centres of education contribute to ensure that teachers stay in touch with new developments. Auxiliary services also assist teachers in an organised fashion and of stimulating

professional development. Some school districts even call on the services of experts in research and development to assist teachers in solving teaching problems, develop new teaching programmes or evaluate and improve existing ones (Theron & Van Staden, 1990:407).

The foregoing would seem to suggest that countries all over the world have considered INSET as an important aspect of teacher development from which South Africa could take a cue.

2.4 INSET IN SOUTH AFRICA

There is no co-ordinated in-service teacher education programme in South Africa (NEPI, 1992:15). Both the state and non-governmental organisations (NGOs) are involved in INSET provision.

2.4.1 INSET providers

The defunct Department of Education and Training (DET) provided INSET programmes including the following:

- Adult education centres that offered instruction aimed at matriculation certification for teachers.
- Full time one-year specialisation courses.
- Further training courses leading to the award of diplomas or degrees at colleges of education or universities for primary and secondary school teachers.

The NGO INSET programmes of the past included among others:

- SEP (Science Education Project) – a project that was set up to promote science education in schools lacking in facilities such as laboratories, electricity, or running water.
- ELTIC (English Language Teaching Information Centre) – centres from which teachers of English could access information on teaching approaches to promote English language learning.

- READ (Read Educate and Development Organisation) – a programme that sought to promote reading among learners as a means of improving their language skills.
- The Molteno project – a project funded by the Molteno trust to develop basic literacy.
- TELIP (Teachers' English Language Improvement Project) – a support programme for teachers who taught through the medium of English to improve their own English language competences (Hofmeyr *et al.* 1992:21).

Typically, the NGO INSET programmes concentrate on classroom competence while the departmental INSET programmes focus on upgrading qualifications as well as for curriculum change (Hofmeyr *et al.* 1992:19). Davidoff and Robinson (1992:2-3) identify other INSET providers including the private business sector. According to them, the INSET provided by the private business sector focus on effective management and administration as well as the development of cognitive skills.

2.4.2 Categories of INSET

INSET provision in South Africa may thus be categorised into those that concentrate on theory and those that concentrate on practice. According to NEPI (1992:18), INSET is not a significant concern for teacher education institutions, and NGOs are largely responsible for INSET courses aimed at providing teachers with knowledge in specific subject areas. That is, the NGOs provide practice and the education institutions provide theory. The debate in South Africa, according to COTEP (1997:123-124), has hardened into competing educational constituencies - NGOs versus institutions - with the divide between theory and practice being deepened. INSET has been the big loser in this battle. State provision has virtually disappeared while NGO provision (and the little state provision that remains) has been criticised as being ineffective. In general, the current provision of INSET is inadequate in terms of quantity, quality and focus (Hofmeyr *et al.* 1992:3). Many schools are poorly managed and under-resourced, with limited and sporadic, if any, in-service support (NEPI, 1993:237).

2.4.3 Quality of INSET

According to Hartshorne (1992:238), INSET organisations in the past tended to concentrate on equipping teachers to cope with existing syllabi and curricula, because this is what the teachers on the whole wanted. He believes that in the transition period, it will be crucial for INSET programmes to become far more involved in curriculum change in the 'what' and 'how' of young people's learning. Hofmeyr seems to echo the same view when she states:

> The government has tended to concentrate on the upgrading of unqualified and under-qualified teachers. Unfortunately, the emphasis on upgrading has produced a paper chase, with teachers pursuing higher qualifications for salary increases, often studying subjects that do not improve pupil achievement. The education departments have also provided short courses or one-day seminars for teachers on curriculum changes but the quality of these courses is often poor with negligible effects on pupil learning (1994:35).

2.4.4 Forms of INSET

South African INSET has historically, taken on a number of different forms:

- Short, often ad hoc courses aimed at improving the skills of unqualified teachers.
- Longer, formalised programmes aimed at improving skills, qualifications and salaries of teachers.
- Formalised post-graduate programmes aimed at improving the educational understanding, qualifications and salary levels of teachers.

Currently, according to the COTEP document (1998:120), short courses are used almost entirely for in-service provision. These have been criticised for delivering learning that is too localised and context-specific. The National Teacher Education Audit (1995) reported that INSET programmes in South Africa have the following weaknesses:

- Dominance of qualification-linked courses.
- Poor correspondence model in distance education.
- Too little INSET for classroom competence.
- Few school-focused, holistic approaches.

It would seem that future INSET programmes in South Africa would have to take into account the real needs of teachers. INSET programmes will also have to adopt models that would help teachers to realise those needs.

2.5 INSET NEEDS OF SOUTH AFRICAN EDUCATORS

The majority of South African teachers are disadvantaged by their conditions of work, as well as by the poor quality of their training. Their capacity is limited in several respects (NEPI, 1993:235-237). The COTEP document (1997:123-125) rightly, it seems, emphasises the importance of 'lifelong professional education for teachers', the continuum in teacher education (pre-service and in-service), bridging the divide between 'theory and practice' and the idea of in-service teacher education becoming the 'centre of teacher development activities in South Africa'. Again the COTEP documents of 1997 and 1998 indicate a move toward new initiatives regarding the in-service training and development of teachers. These are borne out of the need for the present teaching corps to be able to meet the challenges of providing relevant education for the young people of contemporary South Africa.

The literature emphasises the following INSET needs for South African educators:

- Induction and support for beginner teachers against 'practice shock' that is explained as the stressful life-adjustment of beginner teachers to the real world of teaching (Buchner & Hay, 1999:320).
- Upgrading of unqualified and under-qualified teachers,
- Upgrading of inappropriately qualified teacher educators,
- Provision of properly qualified secondary teachers for mathematics and science,
- Leadership and administrative training for principals (NEPI, 1993:240).
- Implementation of Curriculum 2005 (COTEP, 1997:11).
- Development of foundational, practical and reflexive competencies in teachers;
- Ability of teachers to cope with rapid changes in knowledge (COTEP, 1998:115).
- Reorientation of all teachers to new goals and values,
- Preparing teachers to cope with curriculum changes,

- Language development of teachers,
- Re-training in scarce or new subjects,
- Training in new teaching/learning methods (Hofmeyr *et al.* 1992:33).

2.6 INSET MODELS

The criticism of INSET provision in South Africa mostly concerns content, emphasis, and location. Kennedy (1998) argues for the importance of content in in-service teacher education. The importance of linking pre-service and in-service teacher education has also been emphasised (COTEP, 1998; Davidoff & Robinson, 1992; Hartshorne, 1992). The COTEP documents of November 1997 and September 1998 indicate a move toward new initiatives regarding INSET. It appears that South Africa may have to find an appropriate model for INSET to make it more effective and relevant.

Henderson (1979) identified three INSET models. They are course-based, school-based, and school-focused INSET. She described course-based INSET as the one that takes teachers out of their schools to be instructed in groups. The school-based INSET according to her is the model in which 'training' occurs physically within the school itself. And she explained school-focused INSET as that which can take place either on or off the job and can be provided by outside agencies such as a college or by the school itself.

2.6.1 Course-based INSET

According to Henderson (1979:18), the course-based model could do some things well, but in many areas it fails to influence practice in schools. The reasons given for the failure of course-based INSET to influence practice in schools include the following:

- There is often a mismatch between the needs of teachers and the content of courses.
- Teachers may be unable to utilise new knowledge and skills because they are unable to influence what happens in their schools, whether for reasons of status, lack of resources, lack of appropriate feedback mechanism from the course to the schools or some combination of these.

In spite of its apparent weaknesses, the course-based model has been and still is the most prevalent INSET model practised (Butler, 1992:7; Hartshorne, 1992:264; Henderson, 1979:17). It would seem that not much changed over the period of about thirteen years from 1979 to 1992.

2.6.2 School-based INSET

The school-based INSET model has limitations as assessed by Henderson (1979:19). According to her, school-based INSET is likely to succeed more in large schools than in small schools. She believes that if a school draws exclusively on its own resources for INSET purposes, there is a danger of parochialism. Another danger with the school-based model, she fears, is that the professional development of the school as a unit may dominate the professional development of individual members of staff.

2.6.3 School-focused INSET

Henderson (1979:21) favours the school-focused INSET model over the other two models. She claims that the school-focused model is a synthesis of the course-based and school-based models. According to her, school-focused INSET combines the advantages, and minimises the disadvantages, of course-based and school-based INSET. Davidoff and Robinson (1992:10) share the same view when they indicate that school-focused INSET is by far the most effective.

2.6.4 Other INSET models

Butler (1992:7) cites Parks and Loucks-Horsley (1990) who identify five types of INSET models. They are:

- Individually guided staff development. In this model, individuals identify, plan and pursue activities they believe will support their own learning.
- Observation/assessment. Here, teachers are observed directly and given data and feedback about their classroom performance.

- Involvement in a development/improvement process. In this model, teachers develop curriculum, design programmes, or become involved in school improvement processes to solve general or specific problems.
- Training. Teachers engage in individual or group instruction in which they acquire knowledge or skills.
- Inquiry. Teachers identify and collect data in an area of interest, analyse and interpret the data, and apply their findings to their own practice.

Of these five models, according to Butler, the most widely used is 'training'. She, however, believes that the 'inquiry' approach will become more widely used as the teacher-as-learner/teacher-as-reflective-practitioner paradigm takes hold (1992: 7).

Luckett (1996:10-12) proposed a model for staff development that is based on experiential learning and Participatory Action Research (PAR). The model that aims at developing reflective practitioners consists of an initial preparatory stage followed by a four-stage cyclical stage. The initial "preparation stage", according to Luckett, ensures the creation of a safe social space for the participants, where they will be able to be open and honest about their feelings and failings. It involves a reflection by the participants on the behaviour, ideas and feelings that have arisen in critical incidents in their practices. The discussions and comparisons, in the view of Luckett, enable lecturers to uncover the assumptions that under-gird the habitual ways of acting and reasoning in the practice of the participants. Through these discussions, 'it is possible to expose and deal with our defensive routines and to expose, question and re-make our mental models' (Luckett, 1996: 11). It is only at this point, according to Luckett, that an educational theory that will help participants to "theorise their own practice" is introduced. From these reflections, participants should become aware of possibilities for improving their practice.

The other stages of the Luckett's model are 'planning', 'implementation', 'observation', and 'conceptualisation and theory-building'. During the planning stage, the participants plan an 'experiment' aimed at improving their teaching practice in some way. The implementation stage involves putting the plan into action and simultaneously seeking to

notice the effects of the plan on their teaching and to intervene constructively and immediately. It also involves the collection of data for the next stage. The next stage is 'observation'. At this stage, the lecturer uses the participants to de-brief, to describe the experience using data gathered, to attend to feelings and to re-evaluate the experience. Stage four is 'conceptualisation and theory building'. This stage is characterised by 'reflection-for-action'. The participants may attempt to write up the 'experiment' as an educational case study. It can be used for further reflection, theory-building and for thinking about further improvements to practice. Here, the reflective practitioner may turn again to formal theory, and if necessary, re-conceptualise the theory in the light of his or her experience in practice.

Whereas the models described by Henderson emphasise the location of INSET provision, the Butler and Luckett's models include approaches to undertaking INSET programmes as well. It may be important for policy makers and INSET programme designers to examine the various models to be able to provide the kind of INSET model that would suit the peculiar circumstances of South Africa.

2.6.5 INSET model for South Africa in the future

Hofmeyr *et al* (1992:45-47) suggest the following INSET model for South Africa:

- PRESET and INSET planned as a continuum.
- Institutionalisation of INSET.
- Utilisation of multiple agencies for delivery.
- Introduction of institutional changes - all INSET agents in a surrounding area could use a college as a base for their activities and work in the schools.
- Establishment of supportive conditions in schools.

Davidoff and Robinson (1992:11-12) on their part believe that any INSET initiative needs to address the question of teaching methodology as an aspect of its focus. They add that teachers should be encouraged to become curriculum developers. They further consider that teachers must be supported to change their beliefs and values. To be able to bring

about change in teachers, they suggest that action research must be used as a methodology to help teachers to reflect on their practices.

It would appear that these models are promising for South Africa as they seem to be consistent with the different models advocated by various authors. However, according to Butler (1992:7), studies consistently show that the following points relate to structures for effective INSET:

- Designs are based on the principles of adult learning and a full understanding of the process of change.
- Programmes are conducted in school settings.
- Development takes place in more than one incident, and incidents are spaced over time - they are conducted long enough and often enough to assure that participants progressively gain knowledge, skill and confidence.
- Training is conveniently scheduled to avoid interfering with ongoing job requirements of participants.
- Development activities take place at a convenient location.
- Trainers have credibility with the participants.
- Participants are involved in the planning, development and presentation of training programmes.

At the moment, the Eastern Cape Department of Education is working on a strategic plan to guide its development over the next five years. INSET is one of the focus areas of the strategic plan. One of the key objectives of the strategic plan is the 'establishment of an integrated system for providing quality INSET to educators with clear policies, roles and responsibilities' (Department of Education, Eastern Cape, 1999b:33). One would hope that such a system of INSET would take cognisance of the models put forward by the authors discussed in this section. The colleges of education that have been recommended to become in-service centres (Department of Education, Eastern Cape, 1999a) would then have to be adequately equipped to meet the challenges. That is the subject of this

research. The study investigates the potential of one of the colleges of education to shift from being a PRESET to an INSET institution.

In the process of developing a policy on INSET for the Eastern Cape province, a departmental workshop for the development of an INSET framework came up with some recommendations (Department of Education, Eastern Cape, 2000). Even though the recommendations are still being discussed, it would seem that a future INSET policy for the province would be formulated around them. Some of the recommendations that seem relevant to this study are the following:

- Education Development Centres (EDCs) should be set up and operate as organic units within the parameters of the district directorates.
- The EDCs are to have the following broad functions:
  - Educator and curriculum services.
  - Education management development services.
  - Specialised education services.
  - Media resources and development services.
  - Administrative services.
  - Information technology (IT) services.
- All INSET programmes should focus on whole school development.
- Programmes should be developed for educators, including new appointees; managers; learners, including Representative Councils of Learners (RCLs); parents and communities; specialised education officers; administrative staff; unqualified and under-qualified educators; retraining to meet the demands of the curriculum; and specialised educational fields.
- Programmes should lead either toward accreditation or certification.
- There should be several different modes of delivery.
- In terms of infrastructure there should be adequate space to accommodate the INSET operations identified including residential for contact courses running for more than one day.

- INSET courses will provide their practitioners with the necessary action research skills as they engage in action research at their work site as part of the course.

It would seem that the ability of a college of education to operate as an INSET institution in the Eastern Cape in future, would depend on its potential to meet the criteria enumerated above.

CHAPTER THREE
METHODOLOGY

3.1 THE RESEARCH CONTEXT

This study attempted to study a college of education in the Eastern Cape province of South Africa. The college is located in a rural area. It provides teacher education to teachers at the intermediate and senior phase diploma levels. It lies within two education districts of the province.

The college was established in 1978 as a 'teacher training school'. It initially offered courses leading to the award of primary teachers' certificate (PTC). The entrance qualification was the standard-eight school certificate. The college has since then gone through a number of phases and offered a variety of courses.

In 1983, the college was upgraded to the status of a college of education. Students now had to enter with the senior school certificate and the college offered courses leading to the award of the primary teachers' diploma (PTD). It also provided for the upgrading of PTC teachers to acquire PTD certificates.

In 1990, the college introduced the secondary teachers' diploma courses in science, mathematics and geography. This arose out of the need for such teachers who were in short supply in the local schools.

In 1991, following pressures from students and the community, the college admitted more first year students than the college resources could accommodate. Apart from the fact that this large intake of students over-stretched the resources of the college, the quality of students admitted was also poor. In fact, some of them did not qualify according to the entry requirements of the college at that time. Many of these students could not cope adequately with the course. For this and other reasons, the students diverted their energies to protests and class boycotts at the expense of academic work. With the increase in

student numbers, the lecturing staff complement also increased by about 200 per cent. Most of the new lecturers were young and did not have long teaching experience behind them. The quality of teaching at the college and that of the teachers produced suffered as a result of these problems.

All this while, the college depended on the erstwhile Department of Education and Training (DET) for its curriculum, conduct and control of its examinations, as well as the award of certificates to its students. It was not until 1996 that the college designed its own curriculum. At this time, the college negotiated with a university for the moderation of its examinations and the accreditation of its certificates.

In 1998, the college introduced a two-year part-time upgrading course for teachers on the category B salary scale, leading to the award of the PTD. In 1999, the college further introduced two new courses. They are the three-year early childhood development (ECD) teachers' diploma for pre-service (PRESET) teachers, and the one-year higher diploma in education (HED) for serving teachers with the PTD qualification. The HED course was discontinued at the beginning of 2000.

The educational transformation and rationalisation processes going on in the province has led to dwindling numbers of students at the college. Consequently, many of the lecturers have been re-deployed. The college is due to be closed down as a pre-service teacher education institution at the end of 2000. The new direction that the college might take is the subject of this study. The provincial department of education has identified the college as a possible candidate to become an in-service teacher education centre (INSET). This study investigates the potential of the college to transform into an INSET institution.

3.2 RESEARCH DESIGN

In this section, I report the research purpose, research questions, philosophy underlying the research design, participants of the research, and the methods of data collection.

3.2.1 Research purpose

The purpose of this study is to explore the potential of a college of education as a pre-service institution to take up a new role as an in-service educational institution in view of the changing roles of the contemporary South African teacher. The following question formed the focus of the investigation: Does Tishala College of Education have the capacity to become an in-service teacher education institution?

In an attempt to answer the research question, the following aspects of the college were investigated:

(a) The physical infrastructure to support in-service teacher education.
(b) The human resources of the college.
(c) What the lecturers of the college perceive their roles at an in-service institution to be.
(d) The competence of the lecturers to teach at an in-service institution.
(e) The lecturers' knowledge about and ability to apply current teaching approaches.
(f) The capacity of the college to meet the criteria set by the workshop on the INSET framework for the Eastern Cape province (Department of Education, Eastern Cape, 2000).

3.2.2 Philosophy underlying the research design

The design of this research project is located within a qualitative approach. Qualitative research, according to Schumacher and McMillan (1993), describes and analyses people's individual and collective social actions, beliefs, thoughts, and perceptions. Data is collected by interacting with selected persons in their settings and by obtaining relevant documents. It is more concerned with understanding the social phenomenon from the participants' perspectives and it seeks to take into account subjectivity in data analysis and interpretation.

In this study, I intended to investigate the capacity of a college of education to undertake in-service teacher education activities. It was a form of a case study. A case study, as explained by Bogdan and Biklen (1982:58) and Cohen and Manion (1994:109), is a detailed examination of one setting such as a school. It seeks to describe and understand as well as to highlight the complexity and promote insights into the situation (Van Rensburg, 1995:31). Working within the interpretive paradigm, the emphasis is on the process of understanding from which one can identify the patterns of meanings that emerge, and then possibly generalise from them (Connole, 1998:20). Understanding is acquired by analysing the many contexts of the participants and by narrating participants' meanings for these situations and events. Participants' meanings include their feelings, beliefs, ideals, thoughts, and actions (Schumacher and McMillan, 1993:373).

Case studies employ a diverse range of techniques in the collection of data (Anderson, 1990:163; Birley and Moreland, 1998:36; Cohen and Manion, 1994:107). Anderson (1990:160) identifies six sources of data in case study research. They are documentation, file data, interviews, site visits, direct observation and physical artefacts. In this study, interviews and questionnaires were the main sources of data. Questionnaires are commonly used for collecting data in educational research (Schumacher and McMillan, 1993:42). They have the advantages of obtaining data from a large number of respondents and ensuring anonymity (Birley and Moreland, 1998:45). And interviews when used with care and skill are incomparably rich source of data. The interviewer can clarify questions and probe the answers of the respondent, providing more complete information than would be available in written form. The opportunity for in-depth probing makes interviews very attractive when dealing with informed respondents (Anderson, 1990:222). At the root of in-depth interviewing, according to Seidman (1991:3), is an interest in understanding the experience of other people and the meaning they make of that experience. And at the heart of interviewing, he adds, is an interest in the individuals' stories because they are of worth.

Other sources of data for this study were documents, direct observation, and physical artefacts. As a participant observer (member of staff of the college), it was easy for me to gain access to the college records and documents and to make direct observation. I could also draw on my personal experiences at the college.

3.2.3 Participants

The informants in this study were the rector and the lecturing staff of the college. The lecturing staff that participated was made up of 17 females and 10 males. They included one vice-rector, five heads of department, three senior lecturers and eighteen lecturers. Three other lecturers declined to participate for personal reasons. All the participants except one have taught at the college for more than five years. The rector happened to be the longest serving member of staff having been in office for nineteen years. I regarded the rector and the lecturing staff as key informants. They were expected to give information on how they have experienced pre-service teacher education and how they anticipate in-service teacher education at the college.

Other participants were officials of the Eastern Cape department of education. One of the officials was the district manager of the education district in which the college is situated. Three others whom I met together were members of a departmental task team that was planning the restructuring of INSET in the province.

I also interviewed an official of a non-governmental organisation that undertakes INSET activities in the province. This official had been involved in INSET activities in the province for several years. I considered her to be a useful source of information. Her experience of INSET activities was expected to be invaluable. She was also expected to provide an independent view on how INSET should be provided in the province. In this report, participants will remain anonymous and have been given fictitious names. The college studied has also been referred to by a pseudonym for the purpose of anonymity.

3.2.4 Data collection

This study is essentially qualitative. To reduce threats to reliability, a number of instruments were used to gather data. Schumacher and McMillan (1993:388) advise that the use of a combination of strategies in data collection can reduce threats to reliability. Case studies, according to Anderson (1990:163), incorporate all types of data and look for converging lines of inquiry. Triangulation is used to interpret converging evidence, as it is difficult to generalise on the basis of one case.

3.2.4.1 Questionnaires

The members of the lecturing staff of the college were all given questionnaires (appendix A) to respond to. The questionnaires asked questions on the following broad areas:

- Comments on the transformation of the college.
- Lecturer's confidence and ability to teach at an in-service teacher education centre.
- Teaching and assessment strategies practised at the college.
- Perception of roles at an INSET institution.
- Kinds of INSET that local teachers may need.
- Teaching and assessment strategies anticipated to be used at an INSET institution.
- Knowledge about and ability to use constructivist teaching and learning strategies.
- Ability to support teachers in the implementation of Curriculum 2005/OBE in the classroom.

The questionnaire was scrutinised by a colleague and then piloted on three of the respondents before it was administered on the other lecturers. In the view of Birley and Moreland (1998:45), these strategies are essential to eliminate unsuitable and ambiguous items.

3.2.4.2 Interviews

A semi-structured interview was conducted with the rector of the college to elicit his vision of the INSET institution that the college was likely to become. The interview, conducted in his office, also sought his opinions on whether the college was in a position

to become an INSET institution. By his permission, the interview was audiotape recorded (see appendix B for the transcript of the interview). I also took notes of conversations with the vice-rector and other members of staff of the college to sound out their opinions on the transformation of the college into an INSET institution.

My other interviewee was one Mrs Norton, an official of an NGO that offers in-service teacher education in the Eastern Cape. The official has had a long involvement with INSET activities in the erstwhile Ciskei and the present Eastern Cape province. The interview was also semi-structured. The purpose was to delve into her experience of in-service education in the province and to seek her opinions on how INSET could be provided in the province. By her consent the interview was audiotape recorded. The transcript of the interview can be found in appendix C. The interview took place in her office.

To obtain governmental positions on the past and future of INSET in the province, I had interviews with four departmental officials. At the district office, I talked with Mr Kata who was the district manager. The conversation was brief since the official appeared elusive and did not seem to want to volunteer information especially his personal views. I was, however, able to obtain some statistical information about schools and teachers in the district. At the provincial level, I had a conversation with three officials at one meeting. The officials were involved in the strategic planning of INSET for the province. They could not avail themselves for a lengthy meeting because their schedule of work could not allow it. They were also not prepared to give their personal views on how INSET should be provided in the province. However, the meeting gave me some insight into the present state of INSET in the province. I took down notes as the interviews progressed.

Where it was possible, the interviews were audiotape recorded and then transcribed. This was to ensure that the informants' language was reported as accurately as possible. All the interviews were conducted in the offices of the interviewees. According to

Schumacher and McMillan (1993:391-392), these strategies increase the internal validity of the research design.

3.2.4.3 Document analysis and artefacts

To obtain information about staff members and their qualifications, I examined the staff quarterly returns file of the college. Student enrolments were also obtained from the admissions register. Other documents included departmental committee reports, research reports, and correspondence from the department of education on the transformation and restructuring of colleges of education. Records about INSET related courses undertaken by the college were also obtained from the examination section of the college. Information from such sources are interpreted by the researcher to provide explanations of the past and to clarify the collective educational meanings that may be underlying current practices and issues (Schumacher and McMillan, 1993:43). I also observed and took inventory of the physical facilities of the college that might support INSET activities.

CHAPTER FOUR
RESEARCH FINDINGS

This chapter reports the findings of the research endeavour. Being a qualitative study, the emphasis is more on what the informants say and the themes that emerge from them. Quantitative results are also reported but no statistical interpretations are attached to them.

4.1 POLICY ON INSET

The data revealed that there is no policy that guides INSET activities in the province. At the provincial level it was found that:

- The department does not have any existing policy on INSET.
- A departmental task team is currently working on the development of a policy on INSET for the province.
- The policy shall be informed by national guidelines on INSET.
- Some colleges of education in the province are to be converted into INSET institutions.

At the district level it was also found that there is no policy on INSET. As was reported by the district manager, INSET is not active in the district except for workshops on Curriculum 2005 and outcomes-based education (OBE).

The rector of the college has concerns about the planning of INSET for the colleges by the department. In his opinion, any INSET policy should come from within the colleges. He had the following to say: 'My only concern is the planning. If the planning can be correct, and done by people who know it. It should be given to people who are going to do the spadework - the lecturers of the college. They are the people who should be given the latitude to plan and not the department to plan for us.' The vice-rector seemed to share the same sentiment. He regrets that the Department of Education has not involved the college sufficiently in the restructuring process. The attendance register for the workshop on the planning of INSET held on the 15th and 16th of March 2000, however,

shows that rectors and lecturers of colleges of education are involved in the planning of INSET for the province.

4.2 INSET PROVIDERS

At the moment, there are a variety of INSET providers in the province. These include universities, colleges of education, government operated teacher centres and NGOs. In the district in which this study was conducted, there is no government operated teacher centre. INSET is provided by NGOs, the college of education, and universities. All these INSET providers mainly concentrate on the upgrading of teachers' qualifications and on curriculum matters.

4.3 INSET NEEDS OF TEACHERS IN THE DISTRICT

I used the opinions of my informants to assess the INSET needs of the teachers in the district. The informants were the rector of the college, the vice-rector of the college, lecturers of the college, and the district manager of the education district.

In the view of the rector, 'all teachers have got to be trained in South Africa because the training that was given to black teachers was of poor quality'. In his opinion the areas of need are academic and didactic especially in outcomes-based education (OBE). The vice-rector on his part thinks that teachers in the district would need upgrading of their qualifications. According to him, teachers would soon require Relative Education Qualification Value (REQV) 14 as the minimum teaching qualification in South Africa and many teachers would therefore need a fourth year of study. He also thinks that principals of schools and administrators would need 'training' in management that the college can offer. According to the district manager, about 95 per cent of teachers in the district are on REQV 13 or higher. In his opinion, upgrading is not the pressing need of teachers in the district. Management and information technology are the areas he considers to be the most important INSET needs of the teachers at the moment. For the lecturers of the college, the teachers would need in-service in academic, didactic,

Curriculum 2005/OBE, professional, practical, and human rights. Table 1 shows the lecturers' opinions on the INSET needs of teachers in the district.

Table 1

Lecturers' opinion on INSET needs of teachers expressed as percentage of lecturers

(n=27)

INSET NEED OF TEACHERS	PERCENTAGE OF LECTURERS
Curriculum 2005/OBE	81
Academic	67
Didactic	67
Professional	48
Practical	4
Human rights	4

It would seem that most of the lecturers considered Curriculum 2005/OBE to be an important INSET need of the teachers in the district. This was not unexpected as the new curriculum has not featured adequately in the college programme. For teachers in the district, training in Curriculum 2005/OBE has been sporadic and inadequate. It would, therefore, seem that Curriculum 2005/OBE would have to be an essential part of any INSET activity in the district.

Interestingly, only 4% of the lecturers considered practical and human rights as important INSET needs of teachers in the district. It would seem that the lecturers have down played the importance of these aspects of INSET. One may be inclined to think that the lecturers' perception of INSET is that of a continuation of the PRESET activity that they are used to and perhaps consider developments in practical and human rights as something beyond the scope of INSET.

4.4 PHYSICAL FACILITIES OF THE COLLEGE

In the view of the rector, the college has adequate physical facilities to support an in-service teacher education. He had this to say: 'The facilities we have at this college are meant for the proper training of teachers. The curriculum we had did not match the facilities we have. Now that we are changing to an educators' development centre, it is only then that we can develop our teachers accordingly using the facilities available here.' The vice-rector seems to have a similar opinion that the college has the physical infrastructure to cope with the demands of an INSET institution. As the inventory of the college shows, the college does not have residential accommodation except for a single three-bedroom guesthouse (See appendix D for the inventory of the college facilities).

It was found from records obtained from the district office that as at 29 April 1999, there were 67 primary and 39 secondary schools in the district. There were also 756 primary and 448 secondary school teachers (Source: Audit form - District summary, 29 April, 1999). These are about the numbers of schools and teachers that the college resources are supposed to cater for at the INSET.

4.5 HUMAN RESOURCES OF THE COLLEGE

4.5.1 Staff qualifications

The rector of the college believes that the college has qualified personnel to offer in-service activities for teachers. Table 2 shows the qualifications of the staff at the college. The rector however, laments the dependency and laziness of some of the staff members. In his view, the college staffing system will have to change in order to meet the needs of the EDC. He states, 'If we move to in-service education, the college has got to recruit suitable staff members - not that people who are inside should go on with it. I don't encourage that.'

Table 2

Qualifications of lecturers of the college (n=31)

Type of qualification	Number of lecturers
Master of Education (MEd) degree	4
Bachelor of Education (BEd) degree	6
Honours degree with teachers' certificate	2
Bachelors degree with teachers' certificate	15
Bachelors degree without teachers' qualification	1
4-year teachers' diploma	2
3-year teachers' diploma	1

The vice-rector also believes that the college has qualified staff to provide INSET courses. He concedes, however, that not all the present lecturers may qualify to teach INSET courses. His main problem was rather about the poor image the local community and the teachers have about the lecturers of the college. He thinks that the image problem would be the main obstacle to the present staff being accepted as facilitators at the EDC. The other problem, he fears, is the competition the college will have to face against other INSET providers in the district. Prominent INSET providers in the district were found to be the University of Port Elizabeth (UPE) and Azalia College. The vice-rector thinks that they have better image with the community.

In the view of Mrs Norton, INSET providers should support each other rather than to compete among themselves. She also believes that credibility problems of an INSET institution could be solved if accredited courses are included in its programmes. She suggests that a reputable university such as Rhodes University could be found to accredit such certificates. On the question of staff qualifications, Mrs Norton advises that it is very important that the staff should aim at having at least a master's degree in education. She says, 'The MEd I did has made such a difference to me. It changed me totally. I'm far

more of a reflective practitioner and I've just found it invaluable. And I can see the lack in the people that I work with. So yes, I'll recommend that everybody upgrades.'

4.5.2 Lecturers' perceptions of their roles at an INSET centre

Out of the 27 respondents, 4 of them (15%) were not sure what their roles would be at an INSET centre. The roles that the other respondents perceive for themselves are: To teach or lecture or provide workshops for teachers (44%), introduce new teaching approaches to teachers (15%), help teachers to apply OBE in their classrooms (7%), develop learning material (7%), develop curriculum (4%), provide media support for teachers (4%), to be agents of change (4%), research (4%), administration (4%). The rector perceives his role as the head of the institution who will do the planning and take his planning to the stake-holders. He has a vision of an administration supported by a governing council. Such a governing council, in his opinion, must be composed of mostly representatives of teacher organisations. These findings are interesting but I would be hesitant to speculate on them. I would think that a follow-up probe would be necessary to investigate why the lecturers provided the particular responses.

4.5.3 Competence of staff members

Among the 27 lecturers who participated in the study, 23 of them (85%) think that they have the competence to teach at an INSET institution. Two lecturers (8%) think that they cannot teach at an INSET institution, and the 2 others (8%) are not sure. All the lecturers, however, think that they would need some support of a kind to be able to perform their tasks more effectively at the EDC. The support they would need are the following: further qualifications (26%), workshops from more knowledgeable people (93%), material resources (74%), teamwork (8%), programmes from elsewhere (4%), and incentives (4%). Twenty of the lecturers (74%) think that they can design their own INSET programmes. Six of them (22%) think that they cannot, and one person (4%) is not sure. The data reveal interesting findings. For example, if 93% of the lecturers would need workshops from more knowledgeable people, one would doubt the sincerity of the 85% of the lecturers who responded that they think they have the competence to teach at an

INSET institution. Since the lecturers gave these responses through questionnaires, it was not possible to make further probes. A similar study in future may consider a design of a questionnaire that would probe the lecturers' responses.

4.5.4 Teaching strategies that the lecturers would use at the EDC.

The teaching strategies that the lecturers intend to use at the INSET are the following: Group-work and co-operative learning, projects, workshops, practical work, research, problem solving, and lecturing. Only 3 lecturers are not sure of the strategies they would use. Twenty-one of the lecturers said that they are confident in the use of the teaching strategies they named but three of them are not.

4.5.5 Assessment strategies that lecturers would use at the EDC

With respect to assessment, the lecturers intend to use the following strategies at the in-service education of teachers: Portfolios, journals, written reports, projects, presentations, self-assessment, peer assessment, school visits, feedback from schools, attitudes, questionnaires, tests, and examinations. Only one lecturer was not sure of the assessment strategies he or she would use for INSET. These anticipated strategies seem to suggest a shift away from the current assessment practices of the college. Currently the college assesses its students mainly by written assignments, tests and examinations.

On the question of how lecturers would find out if teachers put what they learn at the INSET into practice in their schools, the following responses were obtained from 21 lecturers: School visits, examination of teachers' portfolios, examination of teachers' journals, pupils' achievements, action research, and responses from the Department of Education. Six lecturers were not sure of the strategies they would use.

4.5.6 Lecturers' knowledge about constructivism as a new philosophy to learning

Only 12 (44%) out of the 27 participating lecturers reported that they are familiar with 'constructivism' as a philosophy of learning. Out of that number that claims to have knowledge about constructivism, ten of them claim to use constructivist strategies always

or sometimes. Four of those who claim to use constructivist strategies could, however, not name any constructivist strategies used in their teaching. All the 12 respondents who claim to be familiar with constructivism, would use constructivist strategies to teach in-service courses. However, only seven of them rate the constructivist learning approach highly. On the question of what may inhibit the respondents from using the constructivist approach to teach at the college, the responses were: 'poor response and attitude of students', 'student preference for rote learning', 'because others are not using it', 'lack of resources'. Three respondents were not sure.

Only one participant consistently indicated that he or she would not be able to teach at an INSET institution, was not familiar with constructivism, was not sure of the teaching strategies to use at an INSET institution, and was not sure of the assessment strategies to use at the INSET. The other participant who indicated that he or she would not be able to teach at an INSET institution also reported that he or she was not sure of the assessment strategies to use at the INSET. He or she would use lecturing as a teaching approach at the INSET.

Twenty-three out of the twenty-seven respondents (85%) believe that they can support teachers to implement Curriculum 2005 and OBE in their classrooms. The respondents, however, indicated that they would need help themselves to be able to support the teachers more effectively. The nature of help that the lecturers think they would need are: further specialist training, material resources, literature sources, and incentives. Only four of the respondents (17%) think that they would not need any help.

The rector of the college rates constructivism, as an approach to learning and teaching, highly. He would recommend it as an approach that should be used to teach at the INSET level. He states: 'it is a good way of teaching whereby a student will make research. You know, if you are involved in your training you get proud and then what you have learnt, you don't forget because you are involved. So it is that way of teaching that you have an

excellent product.' He thinks that lecturers of the college do not use the constructivist approach to teaching because they are probably not familiar with it.

4.5.7 How lecturers obtain information on new developments in teaching and learning

The participating lecturers reported that they keep abreast with new developments in teaching and learning through further education, textbooks, workshops and courses, the Internet, journals, research, and the media (television and newspapers). Table 3 shows the percentages of respondents who use the different sources. Even though 33% of the respondents indicated that they undertake further studies, the rector thinks that the lecturers have not responded well to his advice for such undertaking.

Table 3

How lecturers keep abreast with new development in teaching and learning expressed as percentage of lecturers (n=27)

Sources of information	Percentage of lecturers
Workshops and courses	89
Journals	55
Further education	33
Textbooks	15
The internet	7
Research	4
Television and newspapers	4

4.6 VIEWS ON THE POTENTIAL OF THE COLLEGE TO BECOME AN INSET INSTITUTION

4.6.1 A research finding

A study conducted in 1999 by the Department of Education (Eastern Cape) found that the college did not satisfy the conditions to join the higher education sector. Rather, the study found the college to be a possible in-service institution for teachers.

4.6.2 The rector's view

In the view of the rector, the college is not ready to take up the challenge of in-service teacher education. He put it as follows: "It is not ready in the sense that it has been said by word of mouth that we are going to be a teachers' development centre but we have not been told how to plan. And if you submit your planning to the department, they normally say there is a task team responsible for that. We don't know what the task team will come up with. That is the problem. We are just waiting for the coming of that messiah." On the other hand, he believes that the college has successfully managed such transformations before and is in a position to manage this one as well. He seems, however, to contradict himself when he says that the past experiences of the college would not be relevant to inform its future.

4.6.3 The vice-rector's view

The vice-rector seems to have a different view from that of the rector. He believes that the college has strong points to become an INSET institution. He gave five reasons. They were:

(a) The need for most teachers in the district to have a fourth year of study.

(b) The wide catchments area of clients that the college has.

(c) The availability of physical facilities for undertaking in-service activities for teachers.

(d) The availability of qualified staff.

(e) The college already offers upgrading courses and so has the INSET experience.

A problem that the vice-rector raises is that the community does not seem to have the sense of ownership of the college. This, he fears, could make the local teachers apathetic towards the in-service institution. Already, as he says, the community seems to be happy that the college is closing down.

4.6.4 Views of lecturers

Twenty-two out of the twenty-seven participating lecturers (81%) believe that the college is capable of undertaking INSET activities. Only four of them (15%) think that the college is not capable of becoming an in-service institution. One of the respondents (4%) was not sure. Those who think that the college was capable of becoming an INSET institution gave the following reasons:

(a) The college already offers upgrading programmes and therefore has the experience.

(b) The lecturers are qualified and experienced.

(c) The college has the necessary infrastructure.

(d) The location of the college is proximal to most of the schools.

It seems that most of the respondents share similar views with the vice-rector. Those who think that the college is not capable of becoming an INSET institution gave two main reasons:

(a) No preparation has been made so far.

(b) Lecturers are not fully equipped to undertake in-service activities.

CHAPTER FIVE
DISCUSSION AND CONCLUSION

The purpose of this study was to investigate the capacity of a college of education to offer in-service teacher education. In chapter one, I gave an overview of the problems about South African teacher education and the need for in-service education for the teaching corps. In chapter two, I conducted a survey of the literature on the concept of in-service teacher education (INSET). The survey focused on INSET models from a historical perspective. It also discussed the possible mode of INSET in the Eastern Cape province for the future. Chapter three described the research methodology. It included the research context and the design. The research context described the background of the study. The research design indicated the purpose of the research, research question, the philosophy underlying the design, participants, and the data collection methods. Chapter four reports the research findings. In this chapter (five), I intend to discuss the findings from the research endeavour and draw some conclusions. The discussion is based on the aspects of the college that were investigated.

5.1 PHYSICAL INFRASTRUCTURE OF THE COLLEGE

It emerged from the data that the participants of the study generally believed that the college has the physical infrastructure to support in-service teacher education. It would seem, however, that the lack of residential accommodation would make courses running for more than one day problematic. As has been outlined in the recommendations of the departmental workshop on INSET (Department of Education, Eastern Cape, 2000), an Education Development Centre (EDC) should have residential accommodation for its clients. Being a rural area without a well-developed transportation system, it does not seem that teachers would be able to commute from their homes to attend courses punctually. This is against the backdrop of the participants' view that the college is located in a proximal position to the schools. Grobler and Steyl (2000) found that lack of reliable public transport system makes regular and punctual attendance to INSET courses difficult and slows down the process of professionalisation.

Authors seem to favour the school-focused model of INSET. This would imply that lecturers would have to provide both contact courses and school visits. That would imply the accessibility of transport to the lecturers. Presently, the college has only two vehicles (see appendix D). It would seem that lecturers would not be able to visit the schools adequately unless they are prepared to use their own vehicles for the school visits. Experience shows that lecturers do not normally use their vehicles for college business.

5.2 HUMAN RESOURCES

5.2.1 Staff complement of the EDC

Currently, the college has 31 lecturers 11 of whom are due to leave on redeployment. The data shows that there are 106 schools and 1 204 teachers in the district to be catered for by the EDC. With these numbers of schools and teachers in the district, it would appear that the lecturers would have their hands full if they are to provide effective INSET to the teachers.

5.2.2 Staff qualifications

The inventory of the qualifications of the lecturers shows that only four of them hold master's degrees in education (see table 2). There was no evidence that many of them were pursuing master's degrees. In fact, only two of the lecturers were pursuing master's degrees in education at the time that this research was being conducted. If the recommendation of Mrs Norton (see appendix C) is taken into account, it could mean that only four of the lecturers would be qualified enough to teach at the EDC. It could be argued that although holding a master's qualification would not be a guarantee that one would be able to teach effectively at the INSET level, a master's degree ensures improvement on one's theoretical understanding of education. Lecturers without master's qualifications are more likely to be handicapped in their teaching at the EDC.

5.2.3 Competence of the staff

A good majority of the respondents (85%) seem to believe that they are capable of teaching at the INSET level. Interestingly, many of them (44%) appear to have a view of

their roles at the EDC to be no different from their roles at the PRESET institution. Forty-four per cent of the respondents indicated their roles at the EDC to be teaching or lecturing. It was also evident that majority of the respondents (56%) were not familiar with 'constructivism' as an approach to teaching and learning. Even a third of those who claimed to be familiar with 'constructivism' (4 out of 12) could not name any 'constructivist' strategies used in their teaching. This suggests that their claim of knowledge about 'constructivism' could be doubtful. The implication is that their approach to teaching at the INSET institution would still be by 'behaviourism' that they are used to. The evidence seems to support the rector's view that the lecturers do not use constructivist strategies in their teaching because they do not have an adequate understanding of constructivism. The rector did not seem to have confidence in most of the lecturers' competence and ability to teach at the EDC.

The vision of Eastern Cape Department of Education (DoE) seems to assign a variety of functions to the proposed EDCs (see section 2.6.5). One of the functions is educator and curriculum services. An urgent need of teachers today, it seems, is the implementation of Curriculum 2005 and Outcomes-Based Education (OBE) in their classrooms. The apparent lack of understanding of constructivism and Curriculum 2005 and OBE, would seem to hamper the effectiveness of the lecturers at the EDC.

The DoE also expects the EDCs to provide specialised education services to its clients. There was no evidence from the data gathered that the lecturers would be able to provide specialised education services to teachers. Only one respondent indicated that he or she would be able to provide media resources and development services. The rector was also confident that the college has the personnel to offer management and administrative development services. It would seem that the rector has the four lecturers that hold master's degrees in mind to offer the management and administrative courses at the EDC. It seems also that the college is in a position to offer computer literacy courses to teachers. The college has three lecturers who offer computer literacy courses to its current students.

The DoE proposes that the EDCs should use several different modes of delivery of in-service courses. Although the respondents named several different modes of delivery that they would use at the INSET, they have not used those modes of delivery in their teaching at the PRESET level. It seems doubtful if they are proficient in the use of the modes of delivery that they named.

The DoE also proposes that programmes offered at the EDCs should lead either toward accreditation or certification. This view seems to be upheld by Mrs Norton as an experienced INSET provider. Already, the college has a relationship with Rhodes University (Grahamstown) for such accreditation of its courses. It would seem that the college might not have difficulty to continue that relationship with the university.

The DoE again proposes that the INSET courses should provide their practitioners with the necessary action research skills. As Davidoff and Robinson (1992:12) and Luckett (1996:14) argue, participatory action research (PAR) is the most appropriate method of improving professional practice. There was, however, no evidence from the data that the lecturers of the college have action research skills to impart to its clients. In fact, only one respondent indicated that he or she would use action research as one of his assessment strategies at the EDC.

5.3 CONCLUSION

The findings from this research seem to indicate that Tishala College of Education has strong points on some issues but weak on others on its capacity to become an INSET institution.

On the issue of physical infrastructure, the college appears to have a lot of facilities to support in-service teacher education. As Grobler and Steyl (2000) found, the availability of modern technology and infrastructure can enhance in-service education projects. On the other hand, the lack of residential accommodation for participants would seem to

make contact courses running for longer than one day, problematic. Transport facilities also seem to be inadequate to enable the lecturers to make the necessary visits to schools.

The human resources of the college also appear to be limited in some ways to adequately provide in-service education to teachers in the district. In the first place, the number of lecturers at the college appears to be too small to adequately cater for the school-focused INSET that is envisaged. Secondly, the qualifications of most of the lecturers would not seem to give them the necessary background knowledge and confidence to adequately support teachers at the INSET level. Thirdly, the competence of most of the lecturers as in-service providers seems doubtful. Even though most of them claimed that they would be able to teach at the INSET institution, it would seem that it would be a whole new story when it comes to the actual delivery. Evidence from the data does not seem to support their claim of competence. A significant percentage of them did not have knowledge about 'constructivism' that currently seems to be a popular philosophy in education. Again, there was no evidence that the lecturers would be able to employ the action research approach to improve the teaching of their clients. As Luckett (1996:7) argues, 'in staff development, one should not simply hand out bundles of educational theory and teaching tips which can then be applied unreflectively to specific teaching practices.' The particular cases that confront professionals are often 'not in the book' (p.8). Teachers should be given the opportunity to reflect on their practice. The apparent lack of these modern ideas on education in the lecturers is likely to hamper their effectiveness as teacher-developers. Fourthly, it was reported that the lecturers of the college lack credibility with the local community and the teachers they are supposed to serve. If that is the case, the success of the college as an INSET institution could be in jeopardy. Educational experience seems to indicate that trust between the educator and the educated cannot be over-emphasised.

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APPENDIX A

QUESTIONNAIRE FOR LECTURERS

Make ticks or fill in your responses in the spaces provided

1. Your gender: Male ( ) Female ( )

2. Teaching experience (in years):

1 - 5 ( )
6 - 10 ( )
11 - 15 ( )
16 - 20 ( )
21 or more ( )

3. Number of years as teacher educator:

1 - 5 ( )
6 - 10 ( )
11 - 15 ( )
16 - 20 ( )
21 or more ( )

4. Department(s) that you belong to at the College:

Languages ( )
Education ( )
Practical subjects ( )
Natural sciences ( )
Social sciences ( )
Professional studies ( )
Mathematics ( )

5. Your position at the College:

Administrator ( )
Administrator & lecturer ( )
Lecturer ( )

6. The College is going through a period of transformation.

i. Are you happy with the transformation process? Yes ( ) No ( )

ii. If you are unhappy with the process, please comment on it:_____

_____

_____

_____

7. What direction would you have wished for the college?

Higher Education and Training sector ( )
Pre-service teacher education ( )
In-service teacher education ( )
Other (please specify) .....

8. Do you feel confident to teach at an in-service teacher education centre?

Yes ( ) No ( )

9. What teaching strategies do you presently use to teach the pre-service student teachers? (You may tick more than one):

Lecturing ( )
Group work ( )
Projects ( )
Co-operative learning ( )
Hands-on practical activities ( )
Other (please specify) .....

10. Do you think that your teaching strategies help your students to learn adequately? Yes ( ) No ( )

11. How do you assess your students? (You may tick more than one):

Tests & exams ( )
Written assignments ( )
Portfolios ( )
Journals ( )
Self assessment ( )
Peer assessment ( )
Other (please specify) .....

12. To what extent do your assessment practices give you an indication of the abilities of your students?

Very well ( )
Moderately ( )
Not much ( )

13. The **College assesses its students mainly through tests and exams. What other effective ways do you think the college could assess the students?**

_____
_____
_____

14. The Minister of Education does not seem too happy with the quality of teachers the colleges have produced. What factors do you think could account for the 'poor' quality of teachers educated at this College?

_____

_____

_____

15. The Minister of Education suggests that teachers should be 'retrained'.
i. Do you think that this College is in a position to take up the challenge of in-service teacher-education? Yes ( ) No ( )

ii. Please give reasons for your response:

_____

_____

iii. What do you perceive your task to be at an in-service teacher education centre?

_____

_____

_____

iv. What in-service education do you think that the teachers need? (You may tick more than one):

Academic ( )
Didactic ( )
Curriculum 2005/OBE ( )
Professional ( )
Other (please state) .....

16. Do you think that you have the competence to take on the new role of in-service teacher-educator? Yes ( ) No ( )

17. What do you think that you may need to be able to perform your task as an in-service teacher-educator more effectively?

Further qualification(s) ( )
Workshops from external sources ( )
Material resources ( )
Other (please specify) .....

18. Are you in a position to design your own programmes for in-service teacher education? Yes ( ) No ( )

19. What teaching strategies do you intend to use for the in-service teaching activities? _____

_____

_____

20. Are you confident in the use of those teaching strategies? Yes ( ) No ( )

21. How do you intend to assess the teachers who may attend the in-service courses to determine the success of your programmes?

_____

_____

22. How do you intend to find out if teachers put what they learn at the in-service courses to practice in their classrooms?

_____

_____

23. Are you familiar with *constructivism* as a philosophy of learning? Yes ( ) No ( )

24. Do you presently use *constructivist* strategies in your teaching?
Always ( ) Sometimes ( ) Never ( )

25. If your response to the above question is 'yes', please state the strategies that you use: _____

_____

26. Would you want to use *constructivist* learning strategies in the in-service teacher education programmes? Yes ( ) No ( )

27. How do you rate the *constructivist* approaches to learning as compared to the traditional (behaviourist) approaches?
Highly ( ) Averagely ( ) Lowly ( )

28. What may inhibit you from using *constructivist* strategies to teach at this college?

_____

29. How do you keep abreast with new developments in teaching and learning?
Further education ( )
Workshops & courses ( )
Internet ( )
Journals ( )
Other (please specify) .....

30. Are you in a position to support teachers on how to implement Curriculum 2005/OBE in the classroom? Yes ( ) No ( )

31. Describe the nature of help that you may need to be able to support teachers on how to implement Curriculum 2005/OBE in the classroom:

_____

_____

APPENDIX B

INTERVIEW WITH THE RECTOR OF THE COLLEGE ON 8 MAY 2000

Question (Q): Sir, this college has in its history undergone a number of changes. As far as I can remember it started as a Training school, then it came to PTC, then to PTD and STD and so on. Later on it became affiliated to Rhodes University. This shows some of the changes the college has gone through. How have the changes been managed?
Response (R): Eh, the question is not clear. Managed in what way?

Q: Okay, has the college been able to cope well with all those changes?
R: Yea. So far there have been no problems. There have been no problems because we just stick to the requirements like the staff requirements for the diploma courses that were introduced, we had to change the staff. Those that did not qualify had to be taken to places where they qualified to teach. Yea, and then we had to recruit students who qualify - who had the entrance qualifications for the diploma courses.

Q: So it means that there have not been any serious problems as far those changes are concerned.
R: Not so far really. No serious problems. In fact for a start the only problem I can mention it was difficult to get students who qualified for the diploma courses when we started it in 1989. Yea, most students could not qualify to the extent that we had to take students who had passed four matric subjects with the hope that during the course of their study, they would be writing the outstanding subjects. That was the only difficulty we had. Then in 1990 we had to stick to the requirements and we had a number of students who qualified. But there were also a number of those who did not qualify and they wanted entrance. So they forced their way in because there was that political upheaval in the country so they forced themselves in. They had to be admitted. That year, we were supposed to admit only one hundred students but we were forced to admit six hundred. Those students had a problem and when they were inside, some of them could not even finish up the course. They 'collapsed' on the way because they did not qualify to be here. They did not have the right ticket for the plane they were boarding.

Q: The Minister of Education seems to be concerned with the quality of teachers in the field. How did the situation you have just described impact on the quality of teachers we produced?
R: Very much. I am telling you those are the people who are going to destroy the education of our children.

Q: But now the college is transforming possibly into an in-service teacher education centre where we shall be providing support for such kind of teachers. Are you happy with that kind of transformation for the college? I suppose that you probably had wished that we joined the Higher Education sector?

R: Yeah, I'm happy about it as long as it is done by knowledgeable people. The planning should be correct. But as far as I can see, the planning has taken a wrong step.

Q: The planning on whose part?
R: On the part of the department. The officials of the department are planning what they do not know.

Q: So do you have any regrets that the college is going that direction?
R: No, I don't have regrets. My only concern is the planning. If the planning can be correct and done by people who know it. It should be given to the people who are going to the spadework. The lecturers of the college are the people who should be given the latitude to plan not the department to plan for us.

Q: So how do you compare that with going to the Higher Education sector that we were fighting so hard for? Wouldn't you have preferred the college going to the Higher Education sector?
R: No. Most of our staff members are lazy to serve under the Higher Education sector. I'm sorry to say that. They could not make it.

Q: But do you think that they will be able to make it in the in-service teacher education?
R: If we move to in-service education, the college has got to recruit suitable staff members; not that people who are inside should go on with it. I don't encourage that.

Q: But currently some lecturers have been identified for redeployment and some to remain. Now, do you find those who are supposed to remain capable of running the in-service courses?
R: No, no. I tell you the redeployment was meant for all colleges before this idea of becoming Education Development Centre came. So the staffing system of this college is going to change in order to meet the needs of the Education Development Centre.

Q: So is the lecturing staff aware of this?
R: I don't know. I won't say they are aware but they should be expecting it surely. We won't be able to tell them until such time as we get something in black and white from the department. If the department is expecting to use the staff that is inside here, well they are going to miss the goal.

Q: What do you really find deficient about the current staff?
R: Well the in-service sector needs manpower that will be able to drive themselves and not to be driven. That is the problem.

Q: And in terms of qualifications?
R: In terms of qualifications, it seems it is just a few that do not qualify but qualifications without ability do not count. You see, I normally say in my management system, I always use a system whereby I categorise the staff members. At any place of work we've got

staff members who do not have the ability to work and do not have knowledge of work. There are such people. Such people do not qualify to serve in the Education Development Centre. We have number two, staff members who are able to work but are unwilling. You see they have got the ability but they are lazy. So such people because of the ability they have, they can be motivated but they don't qualify because they are lazy. Number three, there is another category of the people who are willing to work but do not have the ability. They are willing to work but they don't have the knowledge. In such cases again you can motivate the side that is lacking. People who are needed are in this last category - those that are willing and are able. Those are the people who can serve.

Q: So at this stage have you identified those people?
R: *Hayi*, I can identify a few.

Q: So if the department called upon you now to say give the names of those you think can serve in the Teacher Development Centre, you think you can readily give out such names?
R: I will definitely speak the truth and I won't deny it (Laughter).

Q: You have been encouraging the staff to upgrade their qualifications and competences. You have said this many times at staff meetings. What has been the response?
R: The response has been poor.

Q: What could be the reason for the poor response?
R: I don't know whether it is lack of money for registration because we have taken our children to expensive schools or it lack of interest. I don't know but the response has been poor.

Q: Let us go back to the Teachers' Development Centre. What kind of administration do you anticipate there? How will it be administered because I don't know if it will continue as we have it now - governing council, rectorate, Heads of Department, and so on. How do you anticipate the administration to be like?
R: We should be having a governing council surely but not composed of the members we have now. Because we are going to serve the educators, we've got to have mostly the teacher organizations involved in the governing of a college of that nature so that the college can have people that is required and known by the teacher organizations.

Q: So what will be the role of a rector in a T.D.C.?
R: No, the head of this institution has got to be there to see that everything is being run accordingly, planning. When the head plans he will take his planning to the stakeholders.

Q: So how do you expect him to exercise control?
R: Eh according to the policy that will be set - the college policy that will be set, yeah.

Q: Is the policy going to come from within or outside?
R: I really do not know at this stage.

Q: But which one would you prefer?
R: The policy should come from within but I don't know whether the government or the department is going to do that.

Q: Now we are saying that the teachers are of poor quality. We seem to agree on that but if that is so, what kind of re-training do they need?
R: In the first place all the teachers have to be re-trained in South Africa because the training that was given to black teachers was of poor quality. We are now talking of OBE. Everybody should have the ability to teach the OBE. So that is the main retraining we need. And we need to re-train our science teachers to teach science accordingly and not according to the way they were trained.

Q: In that case the retraining should be in what direction? I am thinking of whether it should be academic training or didactic training? What kind of area will they need help?
R: It is both academic and didactic because they lack academic training. During the PTC period when we were training PTC teachers, teachers could be taught methods of teaching only putting aside the academic work. Now those teachers could teach what they do not know because they were specialising in methods only. Right now there is this OBE. OBE is method. We need to teach everybody OBE so it is both academic and method. That is the re-training that should take place.

Q: I read your article in the 1993 edition of the College magazine. It was on 'Process Approach'. It seems that you have faith in the process approach?
R: It is a good way of teaching whereby a student will make a research. You know, if you are involved in your training, you get proud and what you have learned, you don't forget because you are involved in it. It is that way of teaching you have an excellent product. I'm telling you because they make research themselves and you discuss the research with them.

Q: Is the approach being used by lecturers of this college as far as you know? Have the lecturers been using the method?
R: I have been encouraging it but I don't think that it has been used.

Q: So for this teacher development activity, would you recommend it?
R: That is where the method should be used. Yea because these are adults. Most teachers you know, though they are teachers, they were never involved in research which is wrong. It is time that they do the research work.

Q: I see this 'process approach' to have some relationship with curriculum 2005 that is said to be based on the philosophy of constructivism.
R: Exactly, creativity.

Q: Presently, since the lecturers don't seem to have been using that approach, do you think that it is a question of competence or what?
R: They don't know it. You see, we say we are going to have a course here on effective management and that course our teaching methods will be the process approach. A student will be given a topic to make a research on that topic and then bring it to the class in a form of a seminar and then we discuss it.

Q: But these teachers their contact with the in-service centre will be short and so how can it be done?
R: It won't be short in the sense that we will attend forth nightly - once a forth night. This forth night one group is making a research, they come with their work then we discuss it in the class, next forth night another again and so on.

Q: Supposing that the department says that some of the lecturers here should remain and carry on with the teacher-development activities, seeing that they don't appear to be competent, what support would you recommend for them to be able to carry out their duties effectively?
R: You know sometimes you can take a horse to the river but you cannot force it to drink. That is why I was saying it to them that self-development is the best.

Q: You commented on the quality of the students who came to college but what comment do you have about the curriculum we have been operating as having contributed to the poor quality of the teachers.
R: As I said to you at the beginning that we need to retrain them more especially the black teachers. They are the people who had poor training because they were trained to teach a very low standard of education that was set then. Now education is equal for all today so emphasis should be put on black teachers. Like you see when we run these courses here, most of the white teachers volunteer to do it because they were trained in those fields. You find our black teachers folding their arms because they know nothing.

Q: What about the way in which we assessed the students? Do you think that it had something to do with our products?
R: Yeah, it also had effect because we used to have big number of students. You can't assess a big number of students properly. We should have few students and make a follow up and the assessment should be continuous from first year to the final year. Not only for the short period.

Q: So because of the size we were not able to do it effectively?
R: Yeah.

Q: But I think we were mostly basing our assessment on exams and tests. Do you think that was enough?
R: No! No! If we look at the white teachers, they used to have few students at colleges so that they could train them properly and assessment was continuous.

Q: May be I will want to ask about the last thing. It is about our facilities. I know that this college has got a lot of facilities but now we are changing direction into a T.D.C. Do you consider our present facilities to be enough to meet our needs?
R: The facilities we have at this college are meant for the proper training of teachers. The facilities we have did not match the type of curriculum we had. Facilities are more advanced than the curriculum we had. Now changing to a T.D.C. then it is only now that we can develop our teachers accordingly using the facilities available here.

Q: But this new approach requires a lot of resources like stationery and so on. How do you hope to fund it?
R: The department has got to provide it. It is an in-service training.

Q: So do you hope that funding will come?
R: You can't plan without finance. Now that they have planned this, they should be having funds for it otherwise it is poor planning.

Q: But supposing they plan that poorly and you are left with no funding from the department, how do you hope to carry on?
R: Well, I won't be able because funders, that is outside funders, do not provide for in-service training. That is solely the baby of the department. That is the problem.

Q: I think we can conclude now if you can share with me the lessons you have learned that will inform our activities in future?
R: I don't get your question.

Q: What I mean is that we have run this college as a pre-service teacher institution and now we are changing into a T.D.C. May be we don't want to have a situation where we will be accused of having produced poor quality teachers anymore. What experiences of our past can we draw from so that we don't make such mistakes again?
R: Yeah, it will be difficult to match the past experiences because we are not continuing providing pre-service training. We are changing to in-service to a new thing that needs a completely new planning - different planning.

Q: In your opinion is the college ready to take up the challenge of in-service teacher education?
R: I don't think that it is ready. It is not ready.

Q: What is missing?
R: It is not ready in the sense that it has been said by word of mouth that we are going to be a T.D.C. but we have not been told how to plan and if you submit your planning to the department they normally say there is a task team responsible for that. We don't know what the task team will come up with. That is the problem. We are just waiting for the coming of the messiah.

APPENDIX C

INTERVIEW WITH MRS NORTON. 11 OCTOBER 2000

Question (Q): One thing that I wanted to know is the policy on INSET in the Eastern Cape. Is there any set policy that guides in-service education in the province?
Response (R): It must be the norms and standards for teacher education. I know that at the East London teacher centre they a very tied up with OBE training and that was one of the reasons that I left because you couldn't plan your INSET with teachers because you wouldn't know when the government would call you to go out and train. All your programmes just fall away. So they've had quite a bad time in trying to get on with teacher education in the sense that we used to do. You know in-service - going through content, doing experiments, introducing teachers to new teaching methods that kind of thing has sort of fallen away while they have to do the training that has been handed down from national. So I think I'll say yes, definitely our guide is the norms and standards because if you don't achieve those for educators - developing the roles and competences for teachers then why are you doing it?

Q: Who are their clients?
R: Well you see they will now service the whole of central region. They are the central region teachers' centre. What we did when I was there, I looked after what we called the Somerset programme - looking after schools have got the little Somerset micro-science kit. Quite a lot of schools have got that kit and big companies put monies in it and put these into the schools. But they don't fall up with service and if you go back a few years later you find the kits sitting on the shelves because the teachers don't know how to use them. So what we did was, we called up subject advisers, in fact we called a provincial meeting to divide the province up to decide who was going to look after what. In the central region, we had me here at All Saints, Katy at the teachers' centre and Makela who is the one and only subject adviser for science for the whole of central region. It's ridiculous. And we sort of split the central region up into three. I look after this part, Katy for East London and Mdantsane, and Makela will look after Peddie and Alice. But I have to incorporate those into King Williams Town because Katy hasn't got a vehicle. When Katy and I were at Hlaziya, we developed over 100 interactive teaching aids for teachers of biology from grade 7 and grade 8 upwards. And we get together two or three times a year and run workshops. Those we run weekly quite happily. Teachers would come to them and we would go round but we don't have the time to do it.

Q: Did it include primary and secondary teachers?
R: Yes, at Hlaziya we had primary and secondary and so at teachers' centre they've got primary and secondary but I worked in the secondary. I did a little bit of research down in grade7 at about 1994 when the RDP document came out. We looked to see that that education was going to be co-operative learning, dododo, so we started straight away with the workshops in group work and designing worksheets and things like that. That hasn't gone on.

Q: Did the teaching materials you were using include the SEP materials?
R: It was different. We both worked with SEP but we were trainers. We weren't going up to the schools. It was more of a consultant thing. I didn't get involved as Katy did. Gill was part of SEP as well.

Q: Do you know if SEP is still in operation?
R: No. It's not in operation. One of the guys, Sipho, who used to work with SEP is now working with me as an independent and he does a lot workshops for me that I can't do with the Somerset project.

Q: These workshops, do you visit the schools or you call the teachers to a centre? How do you do it?
R: It used to be both. Let me tell you about three different kinds that All Saints does. I'll tell you about the Somerset one and I'll tell about the accredited courses that we are doing. And that is as far as I know in the central region is being done by these three centres. Let me start with the Somerset one. Those workshops, we just send a message out to the schools to come to Hlaziya. When the teachers come, they decide the area of work they want - physics, chemistry, or biology. We have got the kits there and then we let them do the experiments. We can talk around them, we look at the underlying content, the basic problems there with conceptual understanding then we can work with that as well. Then the teachers go back. We ought to visit their schools but there are too many of them and too few of us. If that project will have to grow, we've got to have more workers though we used to visit them twice a term. And then run another one at All Saints for this half of the region. So that is the model. It is literally we have the teachers coming and they dictate what they want to do. Similarly, with the teaching aid one, the teachers will come, they will tell us what they want to make and we got everything ready for them and they make the teaching aids they want and then we talk about how to use them and the ideas in the classroom and that kind of thing. So that was a sort of low-key in-service. What All Saints is doing is a project. They work in partnership with schools around King Williams Town. The staff here produce matric level resource materials and the schools pay thirty rand per student per year for six subjects. They print the materials here and the schools pick them up and take them away to the schools. Then once a month they have a forum meeting and the teachers come, not all of them of course, and there is a sort of a general meeting deciding on things like are we going to have a common trial exams paper or June exams or whatever it is. And then they break up into the subjects. In the subjects each person here facilitates that workshop and obviously they do it according to the needs the teachers at the workshop express. That is only once a month and lasts for about an hour so you can't do an awful lot. If there are queries that the teachers have then they can talk on one-to-one basis. They also run computer courses and the teachers can come here and do computer literacy course.

Then, what I was doing apart from the Somerset thing, I felt that with my experience we know that a one-off workshop doesn't work. And if you try a two-day workshop, some teachers will come on the first day and others will come on the second day. So if you are really not getting anywhere, you need to plan quite carefully. So I spoke with people at

Rhodes and I got permission to run certificated workshops and courses. I designed three but I've finished two. They have got to do with laboratory management. I want teachers to be able to know the equipment that are in the laboratory, how to look after them, how to manage your laboratory, how to identify unknown chemicals if they have lost their labels, how to look after live animals, how to prepare in advance for your biology lessons, make sure the plants are ready, you are not rushing around to find things. All that kind of classroom management and then if there was any underpinning knowledge that was lacking, that would slot in there. So the first one I did was in chemistry - how to manage your chemistry lab. Looking after glassware and those kinds of things. That was a whole 60 notional hour course. They came to me for 30 hours and I have 30 hours work in the classroom. Assignments handed in showed they've been working in the classroom and school visits. I went to the schools and looked up their science room. My first assignment was to sort it out and that was such a learning curve for most of them. They enjoyed it and that has been very successful. I've had problems with analytical chemistry because a few of the chemicals you need in order to identify certain metals are not found in schools and they are very expensive. So it's not easy. We can identify acids, we can identify carbonates and that kind of thing and some of the metals we can do. I had 7 people who stuck out on the course because if they missed out once, I wasn't happy because you have to come on the whole course to get your certificate.

Q: So when were they attending?
R: They came on Saturdays so that I can have a four-hour slot. If I needed a two-hour slot, then I have them in the afternoon 3 to 5 and then in the school holidays we did 2 to 3 days in a roll and they quite enjoyed that because you got into the thing of teaching and learning.

Q: Would you say that the certification that was attached was the motivating factor?
R: Absolutely! I think it was the motivating factor because it is a 60 notional hour thing and at the moment, they are going to get a certificate of attendance but we are hoping that we can register these short learnerships on the NQF and get them 6 SAQA credits and eventually if these teachers can build up by doing … we've done the chemistry one, we've done the biology one, I've got to work on the physics but there is no time this year. That is going to start next year so teachers who have got the competences in managing those kinds of things could perhaps put those towards credits for perhaps a BEd. It might be an option they could take – management.

Q: Do the teachers who come for these courses have degrees?
R: Em, some do. One or two of them do. Some of them don't. One person said to me this was such a valuable thing because it gave him the opportunity to leave teaching and get a work in the lab he wanted to and he had some idea on how to manage a lab. I thought that was interesting although that was not my aim. My aim is to improve teaching in schools and not to get people ticket to get out of teaching. But anyway that was good to know. Yes, the biology lady had a degree in biochemistry but because she came from a

disadvantaged school, she didn't have all the ideas that we put into little booklet and ideas to make it fun in teaching.

Q: So who controls the East London teacher centre and All Saints? Is there any body that controls them or they are independent?
R: The two are independent of each other. The East London teachers' centre is a government body so they are under the department of education. We are an NGO but we believe in partnership. You can't have two people doing the same thing. It doesn't make sense. That is why I am saying that if your college became an INSET, we would like to a partnership between everybody who is doing INSET sharing materials, perhaps even sharing facilities. If you needed a biology workshop run, then there is this sort of give and take. You can go and run it up there or come and run it here.

Q: This was going to be one of my questions but it seems that you have answered it. I was going to ask about competition between INSET providers but you say you would go for partnership rather than competition. I was going to ask about your personal opinion on how you think INSET should be conducted in this province?
R: (*Laughter*) I do believe that we need to let each other know what we are doing so that we advertise each other's courses and the teachers get the benefit of it. Obviously for an NGO, it is important that we make money and now I charge for those courses. Those teachers pay bucks before they come on them. I also raise funds and the teachers who come on my science and biology courses were from schools that have got the Somerset kit. I started with those schools because I had money from the sponsors who had put the kits in the schools and they gave me extra money to run these workshops. And then I charged the teachers because they are going to get certificates from it. I charged them half of what I would charge those from a non-Somerset school to come. And they are prepared to come because they get the certificate and I think the Rhodes university link is quite important too. People seem to perceive Rhodes as being quite a good university so that has been helpful.

Q: Otherwise do you have funding from external sources?
R: All Saints has got capital which we have invested which allows us to keep going but we have to generate funding for our programmes. In the past we've been able to get overseas funding and support so we've been able to work for free. This year, we had to charge for the resources to the schools to cover the cost of printing and make a little bit of profit. We are having a huge think-tank in a couple of weeks' time to decide what we are going to do next year. We are doing too many things at the moment and we need to focus down and concentrate on a number of things. All have got to be self-sustaining but within that whatever I'm doing, I let the people at the teachers' centre know what I am doing so that they can let teachers know. I put up notices in their buildings and they put up notices in our buildings. In that way we work together. But that is as I say, that is from me. From the other programmes, there is not that. There are still a few who will come and use our stuff for free.

Q: I'll suppose that with you may go directly to the schools and tell the teachers what you are doing and then they may be encouraged by what you tell them to come. I wonder whether it is the same for the teachers' centre at East London?
R: You see, what we used to do at Hlaziya it would work now if they don't sit down for the government to come and tell them to go and do the training. We used to bring out a programme. A six-monthly programme is printed and went out to every school in the Ciskei. It was up in the staff room, it was up in the district offices and the teachers knew what programmes were on and in fact they were meant to come. In those days you would have to go but it is no longer the case. And so since I was at the teachers' centre we weren't able to do that. But what Kathy and I do, we'll both sit down and plan and if she can't do that, I try and find somebody else to come in and we'll try and put these up in the district offices. It is not as easy to get them out to the schools although with over 200 schools coming here to collect resources, I put fliers out and they go out that way to the schools. All Saints having that programme is very useful. If the teachers' centre needs messages out to the schools, they can send them out that way or we take them to the regional offices and they go into the district managers' pigeon holes and the district managers take them and distribute them to the schools so that we've that relationship going.

Q: But that is for the central region. Do you know if there are any such activities going on in other regions?
R: Eem, no. Well, there must be in Port Elizabeth with the teachers' centre there. One of the things we do here is to facilitate workshops on behalf of UPE in their teacher upgrading programmes which is a form of in-service which they are doing. The DE (diploma in education) and the bachelor of education undergraduate degree here and I know that they are also doing that at Queenstown. Interestingly, the teachers' centre also does that kind of facilitating for UPE.

Q: So you design your own curriculum sort of?
R: Yes.

Q: How do you come about that? How do you come to know the areas in which the teachers may need help?
R: What an experience with working with teachers. Every year we interview teachers, send out questionnaires and it is always the same things that come back so you get to know the areas to concentrate on. The certificate courses that I did was really from my perceptions of teachers inabilities in schools and sensing that they felt disempowered. They didn't know how to do it and so what I did was to put the programme together and took it around a number of schools and tested out the idea if they would be interested and they all said absolutely. So then I put in what I thought should go in and sent it back to the education department in Grahamstown (Rhodes). They looked at it and said yes go for it. So that is how I knew that I was on the right track and then from the evaluation that I get back from the teachers shows that that's fine, there is more actually could be done. I need about ten more people.

Q: When you meet the teachers, what teaching strategies do you use?
R: In any workshop that I do, and Kathy as well, we model OBE. We set outcomes. We have our programmes available for the teachers to look at them to be able to see what it is. When we use group work, for example, we stop and say now we are using this strategy. In our teaching, we tell the teachers about the strategy we are going to use and at the end, we talk about it with the teachers. So I'm trying to practice what I preach to show the teachers that it can work.

Q: So from your experience in in-service education would you want to recommend your model to any INSET? If say my college becomes an in-service institution, would you recommend this approach to us?
R: You must have certificated courses, I think, to make it worthwhile. I think once-off courses are fine but it is not going to make that impact. People go away and it doesn't change things in the classroom. I really believe that in order to make changes in the classroom teachers have got be committed and they've got to have assignments to do in the classroom and then they have got to come back and talk about them. It is only when you do something, think about what you are doing that you can begin to make a change. You know, the old method at Hlaziya of bringing teachers in for a day or going out and running a workshop at a school for a day is fun. It's lovely, you touch people but I'm not sure that it actually helps them to change. We are very difficult to change so I'll recommend that if you can link a university, I would recommend Rhodes. I really would. Well, Fort Hare would be fine.

Q: Already we have some links with Rhodes. They moderate our exams.
R: So that is good one to have there. I have noticed a thing about teachers during the term. They are too tired to do things. But times in the holidays, they enjoy it. We brought cakes and we had tea together. We made it fun but we worked jolly hard and they didn't seem to mind. Those who had to bring their children brought their children and had something to do at the back of the classroom. That way, I think, you encourage other people to see that science is fun.

Q: What I want to know now is the staff complement of an in-service institution. What kinds of qualifications and experience do they need to have to be able to do their work effectively?
R: First they've got be practicing teachers because unless you have experienced it you struggle. I found with my experience here because the staff here were all teachers beforehand. We got involved in rural science enrichment programmes so they started by going out to schools to help teachers. Now, they have revamped themselves into this teacher development centre. I can see the lack of educational philosophy and underpinning of learning philosophies. That kind of academic side is lacking. They go ahead just doing what they have always done because they were teachers and they don't know why they are doing it. I think it is very important that the staff should aim to have at least a master's degree in education. I think it is vital because I found that I did my B.Ed because I was bored. Doing a B.Ed opened my eyes. I did the M.Ed because I was working on a project and I thought I was going to do a research so why don't I do it. It has

made such a difference to me. It changed me totally. I am far more of a reflective practitioner and I have just found it invaluable and I can see the lack in the people that I work with. So yes, I will recommend that everybody upgrades. A lot of staff here are presently working on their master's.

Q: Do you have any links with the Imbewu project?
R: No.

Q: You have already told me about the OBE approach. What about Curriculum 2005? Do you have any training for teachers on it?
R: We started by looking at the specific outcomes and started by working at the matric level. It's not easy to say to them you've got to do it the OBE style because teachers perceptions is that it's a light years away before it gets to us. But what we have been pushing is the fact that there are critical outcomes that everybody should be achieving whether you are in school, university or whatever. So we try to show how teachers through their teaching can still achieve those outcomes and it will certainly ought to be working on the more OBE style of teaching. There is no longer this demonstration style. The students must do the work. But as I said, on the content side, teachers are geared towards the matric exams and forget about all other stuff. They teach all theory and at the end of that they tackle the practical side, which is totally the wrong way round. So there is a lot of work to do there but we certainly push the OBE style but not necessarily the process for Curriculum 2005.

Q: If I look at the number of schools that you have to deal with I wonder if you have enough staff to do the work.
R: No I can't use any of the staff here. It is only me. That is why I work with private consultants. This is only part of my job. Three quarters of my job is Rhodes University so I find it very difficult. I wish I could have a team of twenty and then we could make a difference.

Q: So in summary what would you consider to be the problems that you encounter as an INSET provider?
R: The problems are firstly communication with the teachers. We are not able to reach all teachers in the region. Secondly there is lack of continuity. Different teachers attend at different times. Resources and funding can also be a problem. Another problem is control. We don't have any control over the teachers on whether they attend courses or not. A teacher may book off to attend a course here but would end up somewhere else.

Q: Thank you very much. You have been of great help to me.
R: You are welcome.

APPENDIX D

INVENTORY OF THE COLLEGE FACILITIES

ITEM	QUANTITY	DESCRIPTION
Classrooms	15	40-seat capacity each
Art studio	1	Office and store rooms attached
Geography studio	1	Office and store room attached
Computer room	1	16 computers and 1 printer
Science laboratory	2	One biology and 1 physical science well equipped. Office and store room attached
Technology workshop	1	Office and store room attached
Staff offices	32	Furnished with tables, soft chairs and cupboards
Administration block	1	3 strong rooms, offices for rector, vice-rector, registrar, clerks, staff common room, kitchen
Lecture theatre	1	199-seat capacity
Assembly hall	1	1000-seat capacity with facilities for theatre and cinema
Guest house	1	3-bed rooms, lounge, kitchen, toilet and bathroom
Photo-copiers	4	Serviceable condition
Library	1	More than 2000 books, journals, magazines
Tuck shop	1	Kitchen attached
Football field	1	Dual-purpose for rugby and soccer
Tennis court	1	Good condition
Netball pitch	1	Good condition
Volleyball pitch	1	Good condition
Cricket training pitch	1	Good condition
Car ports	3	Capacity for about 90 cars
Intercom facility	1	Communicates to all classroom
Motor vehicles	2	One five-seater sedan, 1 nine-seater minibus
Micro-teaching room	1	100-seater capacity, audio-visual facility, office and store room attached

REFLECTION ON THE RESEARCH PROCESS

I feel a sense of fulfilment for having been able to produce research reports for the award of a master's degree. My primary motivation to undertake the research processes was to qualify for the award of a master's degree in education that would enable me to perform my duties as a teacher with greater confidence. The experience of undertaking the research activities has taken me a step further and I have now developed interest in doing research. This is not to say that the process was without difficulties but I perceived the difficulties as challenges rather than obstacles as I pursued my goal. As I reflect on the process, I can see how much I have 'grown' through the research journey.

The process started with the writing of a research proposal. The course work component of the degree programme had made it easier for me to choose the research topics as I could adapt my course work assignments for that purpose. The research methodology course that formed a component part of the course work was particularly helpful in determining my bearings in the research journey. It seems that I had initially taken a simplistic view of the whole research process. I thought that I could just 'polish' up my course work assignments to submit for examination. When I had to write five drafts of the research proposal before being accepted by the high degrees committee, I started to think differently. In fact, writing the research proposal was an important learning curve for me. That was the time I realised that every sentence written in a research report needed to be thought out carefully. The length of time it took me to produce an acceptable research proposal made me prepare myself for a long and bumpy road ahead. Indeed, every stage of the research endeavour was a learning process for me. Everyday I seemed to learn something new. If I were to repeat the research activity, I would surely do things differently because of the lessons and the enrichment I have gained from the process.

After writing the research proposal, I decided to start with the two empirical studies (projects two and three). I took this decision because I was working within certain time frames and I could not delay the empirical studies. The participants of the studies were going to be students and lecturers of the college where I worked as a lecturer and they could not be bothered later in the year. I had developed special interest in social

constructivism as a learning approach through the course work I undertook. As a result, I felt that I should conduct my research in that field. But it seems that starting with the empirical study on social constructivism was not the wisest decision I took. My perspectives on social constructivism and also on ecology that formed the basis of my study have changed since then. What I learned from the literature review (project one) for example would have impacted on my choice of ecological concepts used in the module and my approach to teaching them. I will also admit that my understanding of social constructivism has changed since I started the project. My interaction with the literature seems to have given me a better perspective of the constructivist approach to learning and teaching. A particular weakness I have identified with 'project two' is the quality of the learning module. Instead of designing my own module for the study, I could have employed a module that had been used by previous researchers. That I think would have given my work more credibility, after all I did not necessarily require a novel module to answer the research questions.

Data gathering was quite a difficult part of the research endeavour. My experience with projects 2 and 3 suggests that the frustrations of obtaining the required data can easily dissuade one from continuing with a research project altogether. The determination I had to complete my degree studies was the main factor the helped me not to abandon the research at the data-gathering phase. Project 2 entailed an implementation of a learning module with a group of students that involved the use of videos. I ordered some videos from the National Films Library, Pretoria ahead of time for the purpose. The videos did not arrive when I needed them. Upon enquiries, the videos had been dispatched to a wrong address. I became so upset that I fell ill. I had to reschedule my programme to await the arrival of the videos.

As part of the module implemented in project 2, the students were to undertake ecological field studies in both aquatic and terrestrial environments. I had gone every length to obtain materials needed for the fieldwork. Unfortunately, the period coincided with heavy rainfalls resulting in the flooding of the water bodies earmarked for the studies. I had to take the aquatic field studies out of my programme with the result that the students were denied an opportunity to experience the aquatic habitat with apparent negative impact on the findings of the research. I was further frustrated

by the terrestrial fieldwork being interrupted by rain. It was difficult to reschedule the fieldwork without interfering with the students' other programmes. I had to provide lunch for all 21 students involved in the study to motivate them to continue the fieldwork outside the college timetable. I need to mention here that the success of the data collection exercise was largely due to the co-operation I received from the students. At no stage did the students reject my request and I am grateful to them. They were always prepared to negotiate with me and make compromises. Without their co-operation, the whole project would have been in jeopardy.

Gathering data for project 3 was not any easier. My informants were mainly my colleagues at the work place. I thought I could take their co-operation for granted but to my dismay it turned out to be more difficult to obtain information from them than from external sources. Of course, there were those who readily responded to questionnaires and granted interviews but there were others who would not want to participate in the study at all or return questionnaires in time. It was such a disappointment to me but I reminded myself of what a literature source advised that inexperienced researchers would do well to avoid working in familiar environments.

In all the three projects I undertook, obtaining relevant literature was as difficult as integrating them into the reports. In certain instances my supervisor came to my rescue and I am very grateful to her. As a second language speaker, using English to express my ideas was not always easy. In fact, I wrote four drafts of my first report before it could meet the approval of my supervisor. However, I learned a lot from the first report and so I wrote fewer drafts in the two other reports. In any case, I elicited the assistance of a colleague who read through all my reports and offered suggestions. My supervisor in addition to discussing the ideas in the reports also pointed out the inaccuracies of language use in the report.

Doing three research projects seemed to require extra work from me. As I became anxious to meet the deadline for submission of the reports for examination, I regretted that I did not engage myself in a half thesis. However, the variety of projects I undertook gave me an opportunity to interact widely with literature sources and to engage in a variety of research methodology. Not only has my confidence as a science teacher been boosted, I have also developed interest in doing research. My ambition

now after undertaking this research journey is to undertake more research activities and to present a research report at a conference.

Research, as I have come to learn, demands time, commitment, thought, sacrifice, and money. The last two years during which I have been involved in the M.Ed. course and the research endeavour has taken a toll on my finances and alienated me from my friends. But the price, I dare to say, is worth the trouble. The 'growth' that I have attained as a result of undertaking the research activities gives me a real sense of fulfilment. If I read a research report now, I do not only interact with the content but I also appreciate the possible 'costs' of producing it.