BIOSOCIAL ISSUES AS A COMPONENT OF BIOLOGY EDUCATION

BY

NOMATHEMBA VIRGINIA MAGI (Neé NKOSI)

BSc (Unisa); UED.,BEd (Unizul); MEd (Oregon).

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Promoter: Dr S.A. Naicker

Co-promoter: Dr T. Isaac

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DECLARATION

I declare that this research study: *BIOSOCIAL ISSUES AS A COMPONENT OF BIOLOGY EDUCATION* is my own work both in conception and execution, and that all the sources that have been used or quoted have been indicated and acknowledged by means of complete references.

Signed: ______________________

Nomathemba V. Magi

ACKNOWLEDGEMENTS

In South Africa, there are relatively few writers who are focusing their attention on science education issues that are intended to improve the lot of the African community. Some of these writers have been very vocal about the need for science taught in schools and at universities to be made more relevant towards the society within which it operates. It is perhaps from such a standpoint and motivation that this inquiry has developed and brought together individuals who have been prepared to take time to read and reflect about some of these matters. Thus, a few of the people mentioned in this acknowledgement have in some significant way contributed in the design, conceptualisation, examination and bringing to reality some of the the ideas expressed in this document.

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It would be a serious oversight, on my part, to forget to express my appreciation of the late Dr TK Moodley's encouragement in taking up the basic ideas of this project, which were then unfamiliar to South African science educationists.

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Nomathemba Virginia Magi (Neé Nkosi)
Faculty of Education
University of Zululand
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This piece of work is dedicated in its wholeness to my parents: My late-father Mfanuzakudlani Benjamin, and my mother Phikhona Minah Nkosi. Their belief in me and constant encouragement to go that extra mile in achieving my desired goals has a power of strength that has carried me through my early life.

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ABSTRACT

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This study was designed to investigate the extent to which the biology teachers and student teachers are aware and understand biology-related problems that affect the African communities in the Natal north-coastal region. The basis of the research is modelled on the premise that because biology-related problems such as health, shortage of food and water resources, population explosion, pollution are prevalent in South Africa, biology teachers may well be teaching about ways of coping with these problems. In essence the aims of the study are to:

(1) Identify the most important biology-related social problems that impinge on life in the African community, the extent to which they are understood, and the sources of information used by teachers and student-teachers to obtain information about biosocial issues.

(2) Establish whether biosocial issues form a constituent part of the current biology curriculum at senior secondary school level, and to identify important biology-related issues that should be included in the biology curriculum.

The procedure used surveys from two separate sample populations practising biology teachers (N=99) and student teachers (N=93 who were at final year of their Secondary Teachers Diploma. Data were computer-analyzed using frequencies and percentages, ranking and cross tabulations.

The study is broadly structured around nine chapters. The first chapter gives an overall orientation to the study and further elucidation of methodology is in Chapter 5. Chapter 2 specifically treats the impact of African education on biology education in South Africa. Chapters 3 and 4 discuss the conceptual sources and relationships which exist between science, technology, society and the relevance of biology education in the African communities of South Africa. Chapters 6, 7 and 8 deal with empirical data in the form of field survey responses, analysis and interpretation. The overall summary of the study, its implications and conclusions are presented in Chapter 9.

The major conclusions of the study are: First, that biology teachers and student-teachers identified the most important biology-related problems in the north-coastal region of Natal as food and water resources, health and diseases, energy resources and nature conservation. Secondly, that whereas most teachers and student-teachers indicated that they were knowledgeable about these problems, the nature of their understanding was mostly a narrow and factual view of the concepts which neglected the social perspective.

Thirdly, both teachers and student-teachers rely heavily on the schools and textbooks as sources of information. However evidence from an analysis of biology syllabuses used in secondary schools indicates that there is over-emphasis of factual knowledge and little reference to the application of that knowledge to life situations. As a result, textbooks which are closely modelled along the dictates of syllabuses, have little or no worthwhile information on biosocial issues. Fourthly, that to make the biology curriculum relevant to the needs and interest of the African community, biosocial issues that were identified as important should be incorporated in the biology curriculum.

The study has important implications for the goals of biology education, the selection of biology content offered in schools, and the involvement of teachers in curriculum development. In the north coastal region of Natal, biology education does not contribute to better understanding of one's environment that could lead to the solution of problems and improving the quality of life in the community. Involvement of teachers in the selection of biology content which is viewed as important for fulfilling community needs and interests should be considered because teachers know and can articulate the aspirations of their local communities.

CHAPTER 1

ORIENTATION OF THE STUDY

1.1 INTRODUCTION

Changes in society as well as in science and technology have forced a re-examination of school science curricula that are given to the majority of children whose lives depend on science and technology. A re-examination of the goals of science education and curricula have resulted in a call for reform in science education made by a number of prominent natural science educators and natural science education associations in South Africa and elsewhere. The need for this reform arises from the perceived disjuncture between school science and the realities of a scientifically and technologically oriented society. Science curricula that are currently used by pupils have been criticised for the narrow focus on academic, theoretical content that excludes personal, societal and career goals of students.

The call for reform in natural science education arises from the need to reveal natural science as a human activity by emphasising the relationships that exist between natural science, technology and society. The generally accepted viewpoint among advocates of this new orientation in science education is that natural science and its handmaiden, science-based technology, are major agents of social change. As such, the aspect of natural science to be considered important is the knowledge that will be useful and relevant to the solution of societal problems. Bernal (1946:152) arguing about the interdependence of natural science and society, states:

> Society influences, inspires and directs science quite as much as science transforms society.

Indeed, over the years natural science has been responsible for improving the quality of life in modern societies. The vast majority of citizens experience science in the context of technological innovations, such as radios, trains and so on. It is this influence of science in modern society that has brought about the demand on science education to provide enough understanding of the place of science in society. An education about the knowledge, applications, skills, and values relative to science and technology can make the public collaborate intelligently with those engaged in scientific pursuits, and be able to criticise or appreciate the effects of science and technology on human life.

It is through this concern that science educators have come to recognise and accept that what is required is a school science curriculum which relates more closely to the material and social aspects of ordinary life than it did in the past. Although we are still very much in the dark as to what the ideal curriculum for science should be, it is clear that schooling in science should be able to contribute to the personal development of students and the general quality of their lives. One of the values of teaching science is to help pupils use scientific principles to deal with their real societal problems. The human applications of scientific knowledge are as much part of science as its theories are (Bernal, 1946: 156).

1.2 BACKGROUND TO THE PROBLEM

Until recently, the work of most scientists has been divorced from the resultant social implications. This isolation was actually fostered and celebrated in the ethos of 'pure science' undertaken 'for its own sake'(Ziman 1984:180). As a result, school science was taught as a body of knowledge to sharpen the faculty of reasoning and to prepare the few who will engage in scientific pursuits at the expense of the social implications.

The demand for a balanced science curriculum in secondary schools for 'relevant science', which would bring the whole of science teaching in touch with everyday experience, was first made at the beginning of this century. The 1918 Thomson Report from the United Kingdom, stated that science would be a humanising influence if its 'human interest' was developed side-by-side with its 'material and mechanical aspects' (Newton 1986:457). The argument presented by the Thomson Report was the following: as science, like other subjects, illustrated the perennial problems of the human situation, it should be presented in ways which showed how its applications influence the patterns of modern life and social organisation.

In the United Kingdom, the 1961 Policy Statement of the Association for Science Education (ASE) revived the 'humanised science teaching' theme when it restated the main idea of the Thomson Report of 1918 by stating that:

> science should be recognised -- and taught -- as a major human activity which explores the realm of human experience, maps it methodically but also imaginatively, and, by disciplined speculation, creates a coherent system of knowledge. (Kerr 1966: 301)

In addition, the 1961 ASE Policy Statement also stated that the science curriculum should include 'the effect of science and technology'(Newton 1986:458). Other documents, policy statements and publications made by the Association for Science Education (ASE) between 1971 and 1984, The Royal Society (1985), National Science Teachers Association (NSTA) (1964, 1970) and the National Assessment of Educational Progress (NAEP) (1973 , 1977 , 1979) served to popularise the theme of Science-Technology-Society in the United Kingdom and the United States of America.

Arguments to show how societal conditions influence transformations in both the aims of science teaching and the organisation of aims in curricula and instruction have been supported by several writers in the United Kingdom and the United States of America (Bernal 1946; Kerr 1966; Ravetz 1971; Bybee 1977; Hurd 1980, 1982; Ziman 1980, 1984; Yager 1982b, 1984). Studies that have highlighted the state of science teaching in schools and the lack of understanding about science-related social issues by the general public, in both the above mentioned countries, have been undertaken by the National Assessment of Educational Progress (1973 -1979); Shen (1975); Hickman (1982); Prewitt (1982, 1983); Lucas (1983); Miller (1983); Chavis, Stucky and Wandersman (1983); and Miller (1986). Except for the report of the working committee on the Teaching of Science and Mathematics (HSRC, 1981b) studies of this nature are rare in South Africa.

World problems such as hunger and food resources, diseases and health, water resources, war technology, and so on, which are considered appropriate for inclusion in socially relevant science curricula, have been identified by a few researchers in the United States of America such as Rosenthal (1983); Bybee and Mau (1986); Bybee and Najafi (1986); and Garrard (1986). Many of the problems mentioned above are of a biological nature. Research studies in the United States that evaluate the extent to which high school biology textbooks address social issues have found that little attention is devoted to issues such as food resources, population growth, human health, etc. Studies of this nature have been pioneered by Boschmann *et al*, (1978); Levin and Lindbeck (1979) and Rosenthal (1984); and Hamm and Adams (1989).

Although the phrase 'education for relevance' has been popular i developing countries for decades, only a few writers have calle for school science programmes which would be relevant to th needs, interests and culture of the majority of the people in society (Nyerere 1969; Moodley 1974; Kelly 1980; Brophy and Dudley 1984; Knamiller 1984; Coombs 1985; and Pouris 1989). These writers have called for relevant science curricula in developing countries that incorporate technology education, issue-based studies and environmental education. It is envisaged that such curricula will not only produce scientists and technicians but will also promote scientific literacy and critical thinking amongst the whole population. A few research studies on issue-based topics and school projects showing how local issues can be incorporated into formal science syllabuses in some of the developing countries, are beginning to emerge.

Increasing pressure for reform in South African education, particularly African education, has been expressed for the last sixteen years. Criticism by the private business sector and the African community has been levelled at the 'academic' nature of schooling and its failure to adequately prepare school children for employment and living in the modern technological world. The relevance of education, particularly science education, to the needs, interest and culture of the African community in South Africa has also been questioned by many educators and science educationists (HSRC 1981a; Hartshorne 1985; Pouris 1989; NEPI 1992). Research studies that have identified problems in the epistemology of science, the learning process in the classroom as well as the assessment of science education in South Africa, include those by Moodley (1980), Degenaar (1982), Vakalisa (1984), Muller (1987), Levy (1989) and Isaac (1990). Most of these studies have focused on practical work in historically-White and historically-Indian Schools.

The only study that has attempted to address African issues is that of Vakalisa (1984). However. Vakalisa's study is on the teaching of ecology to senior secondary pupils. Notwithstanding these studies, there is a scarcity of research studies that address personal and community needs which are related to the science curriculum.

A research attempt that views biology as linked to the Science-Technology-Society field, and also adopts a philosophical and conceptual approach, is that of Adolph (1985). The study argues that biology as a subject can assist pupils to orientate themselves in the human world. The study tends to argue broadly about the concept 'human world' which is considered to cover 'biotic reality' and the 'education reality'. These concepts are explained in such a way that they do not necessarily show a viable interrelationship between currently taught biological content and existing social issues in a South African situation. The argument therefore, does not identify specific aspects of biological content and concepts which are both relevant and seen by local communities as being important and valuable for pupils to have. One of the fundamental goals of this study is to address some of the biology-related social issues which are presently not considered in the present biology curriculum.

1.3 PRESENTATION OF THE PROBLEM

This research study has been motivated by the following factors:

(a) The biological knowledge that is taught in African schools does not relate to these children's life experiences and society's needs.

(b) Some long-standing values, beliefs and ethical judgements often derived from religious or customary traditions need to be analysed in the context of underlying concepts of biology. Knowledge and understanding of biology-related issues will help pupils to appreciate the value of the scientific enterprise and to challenge and/or understand the long-standing values, beliefs and ethical judgements.

(c) There is a growing danger of society becoming divided into two opposing camps: a minority having some knowledge and understanding of natural science and the related social issues, and a majority that feels science is too difficult to understand and is not their concern.

(d) Situations often arise where biology teachers are expected to explain biosocial issues which are of a personal and social nature to pupils. The lack of well-planned themes on biosocial issues in the syllabus and an appropriate teaching approach often results in unplanned and vague discussions on these issues. Both the evasions as well as the vague explanations deprive the pupils of an opportunity to appreciate the importance of science in their day to day life.

1.3.1 Objectives of the Study

The basic aim of the study is to determine the extent to which biosocial issues affecting the African community are understood and transmitted by Biology teachers to pupils in such a way that biology education is made relevant to the lives of the pupils and to the needs of the community. Complementary to this aim, the main objectives of this research project are five-fold:

(1) to identify the biology-related social problems that affect the African community,

(2) to determine the extent of awareness and understanding of biology-related social issues amongst biology teachers and student-teachers in African secondary schools,

(3) to establish whether the identified biology-related problems form a constituent part of the current biology curriculum at senior secondary school level,

(4) to identify the sources of information biology teachers and student-teachers use to obtain information about biosocial issues, and

(5) to indicate, specifically, the biosocial content that could be included in the biology curriculum.

1.3.2 Significance of the Study

The primary significance of this study revolves around the identification and selection of appropriate content which should be included in the Biology curriculum so that pupils are exposed to the various biosocial issues. It is visualised that this content will provide a kind of education that will help pupils and citizens comprehend biology-related issues which impinge on their lives. It is anticipated that this study will also provide researched information about the biology teachers' perception of what ought to be taught in senior secondary classes. These teachers are particularly important in this research effort for two reasons. Firstly, the majority of these teachers are from the African community so they are aware of their community's needs and aspirations. Secondly, teachers form a link between the pupils and knowledge, skills, values and attitudes regarded as important in biology education.

This research project will also attempt to contribute information to the emerging theme of Science, Technology and Society which has as its objective, the teaching of natural science for the benefit of society, and not for its own sake. The study assumes importance when one considers that the currently used knowledge approach in curriculum design is being criticised for its lack of focus on topical problems or issues in this country. The shortage of scientifically and technologically trained manpower and the scientifically illiterate citizens is a direct concomitant of the present curriculum (Pouris 1989). It is hoped that findings resulting from this study will provide an indication of what may be needed to develop and implement a biology curriculum that includes biology-related social issues such as health, energy shortages, careers in biology, etc.

1.3.3 Delimitation

This study will be limited geographically to African secondary schools and colleges of education in the north-coastal region of Natal. This area stretches from Ubombo in the north to Durban-Umlazi in the south, a distance of approximately 400 kilometres (see Figures 1.1 and 1.2 on pages 12 and 13). The study area has African secondary schools under two departments, the Department of Education and Culture (KwaZulu) and the Department of Education and Training (historically-White areas). The inspectorial circuits from which schools in the study were selected are also shown in Figure 1.1. Within this north-coastal region of Natal are colleges of education and universities from which data were collected from student-teachers.

The problem considered in this study will be restricted to standards 8, 9 and 10 biology teachers. This investigation was also limited to student-teachers who were in their final year of training to become biology teachers at senior secondary schools. Teachers are a particularly important aspect in this research effort because they are among the several agents of change.

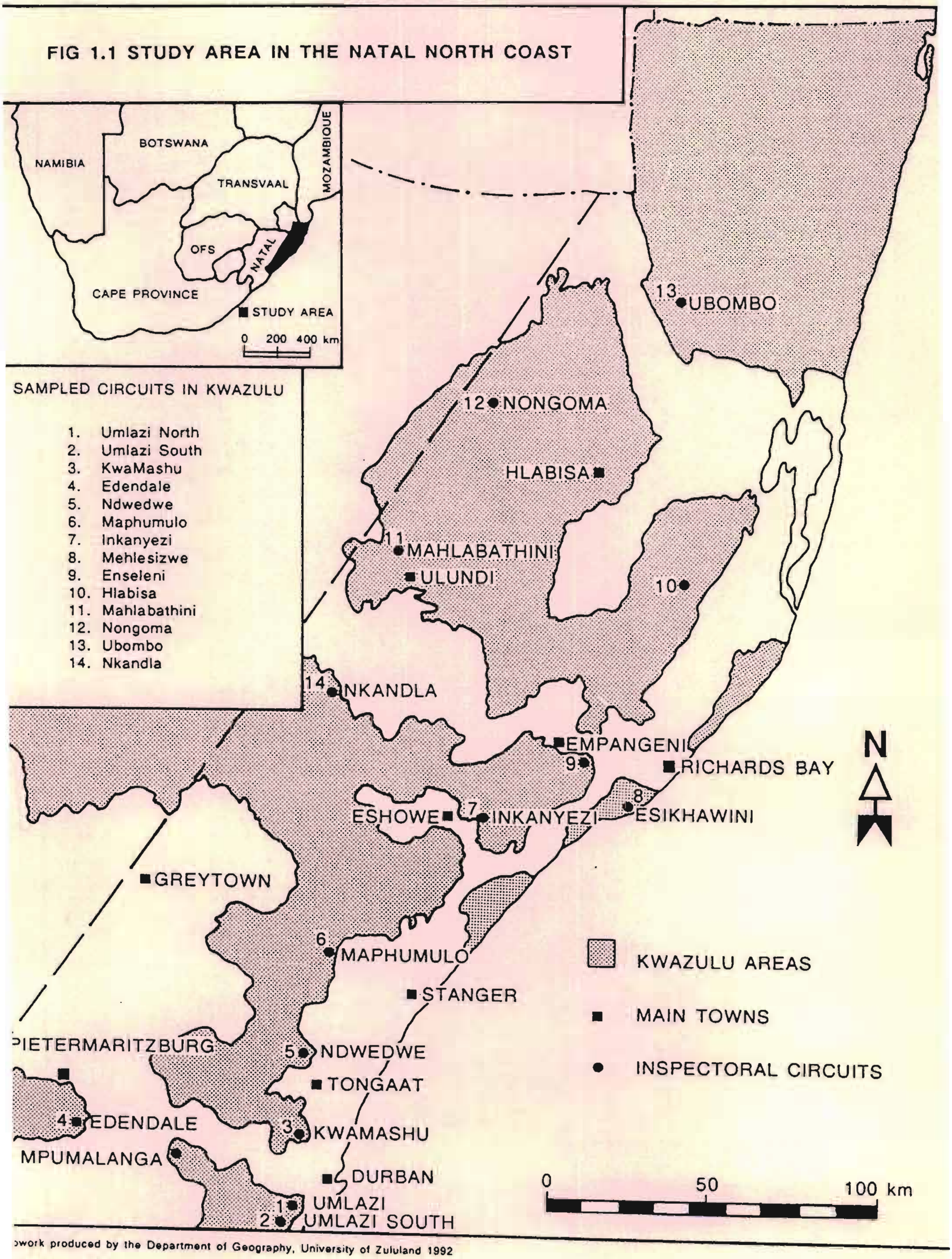


FIG 1.1 STUDY AREA IN THE NATAL NORTH COAST
NAMIBIA
BOTSWANA
TRANSVAAL
MOZAMBIQUE
OFS
NATAL
CAPE PROVINCE
STUDY AREA
0 200 400 km
SAMPLED CIRCUITS IN KWAZULU
1. Umlazi North
2. Umlazi South
3. KwaMashu
4. Edendale
5. Ndwedwe
6. Maphumulo
7. Inkanyezi
8. Mehlesizwe
9. Enseleni
10. Hlabisa
11. Mahlabathini
12. Nongoma
13. Ubombo
14. Nkandla
13 UBOMBO
12 NONGOMA
HLABISA
11 MAHLABATHINI
ULUNDI
10
14 NKANDLA
EMPANGENI
9
RICHARDS BAY
ESHOWE
7 INKANYEZI
8 ESIKHAWINI
GREYTOWN
6 MAPHUMULO
STANGER
PIETERMARITZBURG
5 NDWEDWE
TONGAAT
4 EDENDALE
3 KWAMASHU
MPUMALANGA
DURBAN
1 UMLAZI
2 UMLAZI SOUTH
N
KWAZULU AREAS
MAIN TOWNS
INSPECTORAL CIRCUITS
0 50 100 km
work produced by the Department of Geography, University of Zululand 1992

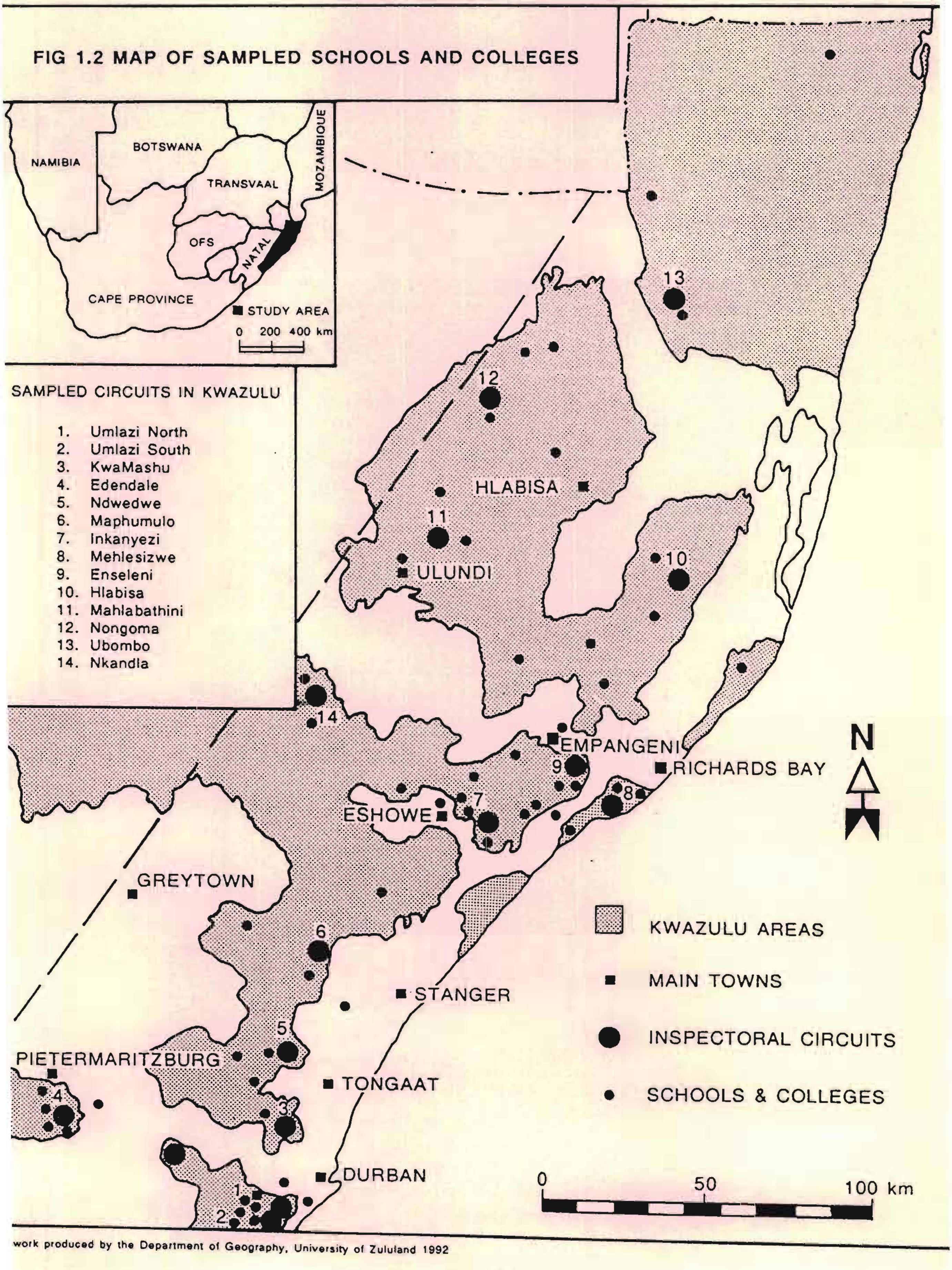


FIG 1.2 MAP OF SAMPLED SCHOOLS AND COLLEGES
NAMIBIA
BOTSWANA
TRANSVAAL
MOZAMBIQUE
OFS
NATAL
CAPE PROVINCE
STUDY AREA
0 200 400 km
SAMPLED CIRCUITS IN KWAZULU
1. Umlazi North
2. Umlazi South
3. KwaMashu
4. Edendale
5. Ndwedwe
6. Maphumulo
7. Inkanyezi
8. Mehlesizwe
9. Enseleni
10. Hlabisa
11. Mahlabathini
12. Nongoma
13. Ubombo
14. Nkandla
HLABISA
ULUNDI
EMPANGENI
RICHARDS BAY
ESHOWE
GREYTOWN
STANGER
PIETERMARITZBURG
TONGAAT
DURBAN
N
KWAZULU AREAS
MAIN TOWNS
INSPECTORAL CIRCUITS
SCHOOLS & COLLEGES
0
50
100 km
work produced by the Department of Geography, University of Zululand 1992

It is the teachers who translate curricular aims into objectives, and within certain constraints, it is they who decide what and how they will teach. According to Selmes (1974:325-326) the pace and fervour of new curricula projects in the 1960-1980 decades, and the cumulative dissatisfactions with what is taught and how it is taught have been determined by teachers. In support, Hart and Robottom (1990: 583) contend that participation of teachers in curriculum development should be encouraged.

1.3.4 Limitations

The research project is limited by the lack of homogeneity of the sample. Biology teachers in African schools have varying qualifications ranging from Matriculation with a two-year teaching diploma to a Bachelor of Science (BSc) degree with a University Education Diploma (UED) or Bachelor of Paedagogics (BPaed in Science) degree with UED. It is also common to find teachers of this subject who have a standard 8 qualification and a primary teachers' certificate or teachers who are professionally unqualified but have either a standard 8 or 10 academic certificate. Another apparent limitation could be the acute shortage of qualified biology teachers, particularly in African senior secondary schools. However, this limitation does not seriously detract from the aims of the study because education alone is not an independent factor in determining an individual's perception of biosocial issues.

Other limiting factors have been those associated with the following:

(a) The limited number of schools visited due to the shortage of funds. Vast distances would have to be travelled between sampled schools and a lot of funds would have been taken up by this exercise.

(b) The scarcity of primary and secondary resource materials on biosocial issues in this country. This shortage of sources will make this study rely more on research findings and books from other countries rather than South African materials.

1.4 ASSUMPTIONS

Some of the assumptions of this study revolve around biosocial issues, curriculum development, and the social relevance of biology education. The following positions are assumed:

(a) Individuals are constantly required to make decisions and value-judgements on social issues which are biology-related throughout their lives. Therefore, teachers from the African community will have opinions about the topical issues or problems within their communities.

(b) Findings of this study will assist in planning and developing a biology curriculum which includes biosocial issues. Such a curriculum could reveal the relevance of biology education to community needs and problems.

(c) African teachers need to be involved in issues of curriculum development because they are one of several agents of change in society. The involvement of teachers in the curriculum process has, up to now, been limited to merely implementing a curriculum in which they had had no say.

(d) There is a need for an informed citizenry to deal responsibly with science and technology-related issues.

(e) The subjects are sufficiently motivated to respond to the research instrument sincerely and to the best of their ability.

(f) There will be consensus sought on the definition of terms used in the research instrument.

1.5 DEFINITION OF CONCEPTS

The important concepts associated with the present study will be explained and set in the contexts in which they are embedded. Unless there is an obvious contradiction in usage, the following operational definitions will be used.

1.5.1 Biosocial Issues/Problems

A **social issue** has been defined by Rosenthal (1985) as a matter that has been or is disputed by society or is yet to be decided by society. On the other hand, a **problem** is a perplexing question or situation that calls for a practical solution. Although the two concepts differ, a relationship can be discerned in that while a social issue could represent a division of opinion, ethical disagreements, or clashes of ideas and beliefs, it may also be a problem that needs a solution. In view of this relationship, the terms **issues** and **problems** will be used interchangeably and synonymously in this study.

The term **biology** is generally defined as the study of life focused on the nature of living things (including ourselves) and the relationships between their form, functioning and environment. Kelly (1980:22) asserts that the concept "biology" includes biochemical, physiological and anatomical aspects on the one hand, and on the other, behavioural, ecological and cultural dimensions. This view of biology is endorsed by Hurd (1980) when he states that a study of human biology should blend biological patterns with cultural patterns to provide a holistic view of human beings both in nature and in a social context.

The term **biosocial** is used to describe biology courses, particularly in human biology, where attempts to integrate a social dimension have been made. The term **biosocial** is not synonymous with social implications. Kelly (1980:25) defines a **biosocial** phenomenon as :

> .... one which has roots in the physical make-up of an organism but which is expressed in a social context. The study of it brings biology - particularly human biology - into

liaison with aspects of sociology, psychology and anthropology.

In this study Kelly's definition is adopted as an operational definition. This definition brings out the blending of biological and cultural patterns referred to earlier in Hurd's view of biology. Such a link between biology and the realities of life will assist in presenting a holistic view of biology education. Problems and issues that concern us today such as, food supplies, health, over-population and others can be understood and resolved through a unified biology/social interface. Concepts which emphasise the practical and human welfare aspect of biology and used synonymously with biosocial issues/problems are **social biology, applied biology and biology and human welfare**.

1.5.2. Biology Education

The concepts **biology education** and **education in biological science** are used synonymously and interchangeably to denote the study of living species as a part of nature. In this regard, biology education is viewed as an activity of man, not only in interpreting nature, but also in making it possible for people to appreciate the worthiness of the scientific enterprise, and to use it both in attacking contemporary problems as well as in designing the future (Moodley 1981:5). The above perception of biology education is applicable to this study because it involves a new synthesis of biology that encompasses the links and interrelationships of human biology, technology, society and human values.

1.5.3 Scientific Literacy

Scientific literacy refers to the kind of scientific and technical knowledge that can be immediately put to use to help solve practical problems in society (Lucas 1983:2). In this study the concept is also used to refer to the ability to solve practical scientific and technological problems, and to participate in decisions about these problems or issues. Literacy in the knowledge of the most basic human needs, such as health, food and water resources, is required.

1.5.4 Curriculum

The concept **curriculum** has presented educationists with difficulties. In attempting to define "curriculum" for particular purposes, writers have often emphasised some specific features over others. Schubert (1986:26-38) perceives this concept as having different elements, i.e curriculum as content, as a programme of planned activities, as intended learning outcomes, as cultural reproduction, as experience, as discrete concepts to be mastered and as an agenda for social reconstruction. This study aligns itself with the manner in which Schubert views the concept of curriculum, in that a biology curriculum that includes human affairs as its central focus, tends to be problem-centred. In addition, it is also desirable that the curriculum ought to be multifaceted and relevant to any local community. In this regard the curriculum becomes a point at which knowledge, the interrelationships between teachers and learners, the economy, political and social structures of society, intersect and interact (Kirk 1989:43).

1.5.5. African

For the purposes of clearer meaning and interpretation, the concept of **African** in this study will refer to the negroid people in South Africa as distinguishable from Whites, Coloureds and Indians.

1.6 STRUCTURE OF THE THESIS

The broad structure of this thesis is arranged in such a manner that it considers two types of data sources. The first includes conceptual sources which are discussed in Chapters 2, 3, 4 and 5. These chapters discuss existing relationships between science, technology and society, the aims of science education, perspectives on African education in South Africa and the biology curriculum. The second type of data considered is derived from the field survey instruments and methods, and these are found in Chapters 6, 7 and 8. By way of a conclusion, an integration of both conceptual and empirical materials is given in Chapter 9.

More specifically, Chapter 2 gives a historical review of the impact of apartheid policies on African education, and science education in particular. These policies are those conceived and administered by various organs of the South African government. Special emphasis is placed on how the political, financial, legislative and administrative strategies were used to structure and control education, particularly science education, for Africans in South Africa.

Chapter 3 discusses the nature of science education and the relationships between science, technology and society.

Chapter 4 describes the development of biology as a school subject from the 1900 to the present. The focus of this discussion is on how pressures from outside the school initiated reform in biology curricula in Western and developing countries.

Chapter 5 examines different approaches that have been adopted in curriculum development, particularly in biology curriculum development. In this chapter there is also a further examination of the criteria used in selecting curriculum content and the role of teachers as valuable contributors to curriculum development.

In Chapter 6 the field research methodology is presented stating in detail the methods used in designing the research instrument, and collecting and analysing data.

In Chapter 7 the data collected is considered for analysis. The acquired data are mainly presented in tables and graphs, and some similarities and differences are highlighted for special mention.

Chapter 8 gives a further analysis of data, as well as an interpretation of some main aspects of both the conceptual and empirical data.

Chapter 9 presents a summary, conclusion and implications of the present research study for science teacher-educators, curriculum developers, educational policy-makers and planners.

1.7 CONCLUSION

In setting up a research orientation and design, it is usually desirable to have the problem well defined and structured, and its procedure well mapped out. This chapter has attempted to do that.

In the chapters that follow, the stated problem receives detailed discussion. Issues of concern include: relationships between biology education and society; the range of literature and philosophy in science education; the perceptions of teachers and student-teachers studied; and the related curriculum design initiatives. All these issues have to be considered in the context of the science-technology-society paradigm. In order to clarify this paradigm in the context of the South African scene, it is imperative to briefly review the impact of apartheid on science education in Africans schools. The next chapter devotes itself to this history.

CHAPTER 2

THE IMPACT OF EDUCATION FOR AFRICANS ON SCIENCE EDUCATION IN SOUTH AFRICA

2.1 INTRODUCTION

One of the most interesting things about the teaching of scienc is that it will inevitably flourish if the national educatic policies are designed to promote it. The differentiate education system in South Africa has had varied impacts on tł different racial groups. Over the years the education fc Africans has had a profoundly negative impact on the teaching aı advancement of science. The argument presented in this chapt focuses on the relationship of science and society and how t aims of teaching science in schools should change according society's needs. In order to understand the critical realiti of science education in African schools, it is important that c first has a grasp of the educational system in which the schools are entrenched.

This background information will, firstly, throw some light the present crisis in the education of Africans, and particula the crisis in science education, which is discussed in following chapters. Secondly, the information will attempt examine the role of the African community in making decisi about education for their children. The level of participat in curriculum decisions by the African community, in particul is significant for this investigation. This is because the investigation is focused on how the biology curriculum is constructed in terms of the relevant needs of this community.

It is important to note that the aspects chosen for discussion will be discussed briefly and in relation to science education. The main sections for discussion in this chapter are: the general background of segregated and apartheid education; education issues impacting on biology education; and the contemporary reform initiatives.

2.2 THE SEGREGATED AND APARTHEID SYSTEM OF EDUCATION

South Africa is a country in which ideologies have divided people along racial and social class lines. The emphasis on differences in race and social class has been an integral part of the country's history since the arrival of Whites in 1652. The education system has been largely used to create unequal educational and unequal developmental opportunities among people of different racial groups, that is, the Africans, Indians, Coloureds and Whites. The major social class divisions in South Africa relate to the rich and the poor, as well as the educated and the uneducated.

These segregationist or apartheid practices have resulted in people seeing themselves primarily in racial and ethnic terms such as White, Indian, Coloureds, Zulu, Sotho, Xhosa and so

Cross and Chisholm (1990:44) maintain that the construction of segregated and apartheid schooling structures has helped tc naturalise an abnormal racial and ethnic consciousness. The foundations of segregated schooling began to emerge in the 1800s when provincial governments started establishing and financinç the school system for White children at the expense of schoolin for all other children. For instance, when free primary educatio for all White children was introduced, no free education fo African children was introduced at the same time. It was left t the missionaries, whose interest was to spread Christianity, t provide education to those Africans who accepted Christianity In general, the quality of education under missionaries was nc good because of their limited funds and lack of experience i educational matters. As a result only a small number of Africa children, whose parents could afford to pay the school fees, ha access to education. Only mission schools, therefore, afford educational opportunities for Africans when provincia governments showed no interest in the education of Africans.

The philosophy of racially segregated schooling also affect what was taught in African schools as far back as the 1800s. Ma Whites had biased and negative views regarding the behaviour Africans upon their acquiring a western type of education. The negative views ranged from ideas that educated Africans cou develop 'habits of idleness' or behaviour that is 'above h station'; to fears that educating Africans would 'endanger t position of the White working class' (Hartshorne 1992:24). As result, the primary school curriculum was made to devote more time to manual labour and less to reading and writing English or Dutch, together with the teaching of the Christian doctrine. The curriculum in the secondary and teacher training institutions also included Christian values, practical work and technical or industrial training. It should be understood that the teaching of science to Africans in this period was inconceivable. The manua and industrial training offered in African schools did no prepare pupils for taking up skilled work. Christie (1992:80 cites a pertinent complaint by DDT Jabavu arguing that:

> In our (African) schools 'manual labour' consists of sweeping yards, repairing roads, cracking stones and so on, and is done by boys only.... the boys grow to hate all manual work as humiliating.

Consequently, manual work was viewed by Africans as of n educative value. Concern over a school curriculum which seeme to promote White economic, political and social interests wa sometimes expressed by African parents by their preventing the children from attending school. The negative influence of th idea of 'manual training' has made Africans not want to aspi for a more practically oriented training in science a technology. Indeed, to this day the number of African studen in technikons and faculties of science at universities continu to be relatively low. This has created a heritage of inequali and discrimination that still affects the schooling of Africa to date.

The foundations of segregation and racialism in African education became firmly established with the ascension to power of the Nationalist government in 1948 and the legalisation of apartheid education in 1952. The policy of apartheid was entrenched through the passing of a series of laws, aimed at safeguarding White economic and political interests, rather than satisfying the needs of the African people and their children. The laws on education were formulated in such a way as to restrict Africans from improving their capacity to lay claim to jobs in the ope market. Cross and Chisholm (1990:45) suggest that the desire o the mining magnates to reduce labour costs and secure a high rat of profit was pursued through a policy of racial division o labour into occupations with different functions, income an status. Consequently Whites were granted elite status whil Africans were retained as a cheap labour force. These racia divisions were made possible, amongst other factors, b manipulating the education curriculum.

Education has been viewed by the Nationalist government as pa of an overall plan for developing South Africa in such a way th political domination by the white ruling class would perpetuated. As a result, the government appointed the Eisel Commission in 1949 to investigate African education in order recommend effective ways of 'reforming' African educati (Christie and Collins 1984:160). The recommendations of th commission led to the passing of the infamous Bantu Education Act of 1953. This act served to lay stress on the role of the government in controlling education for Africans.

In relation to the present study, the Bantu Education Act was aimed at, *inter alia*, the following outcomes (Kallaway 1987:38):

(a) To ensure that the educational experience of the Africans remained at a traditional cultural level. This would eliminate any hopes of Africans competing fo: social and political rights on a par with Whites. Thi aim has made African education stagnate and encourage the pursuit of less modern science and technolog techniques.

(b) To authorise and identify the state as the main funde of education for South Africa's indigenous peoples The impact of this design was to control education b controlling the finances. African education was give less subsidy per pupil as compared to other groups This disparity has brought much suffering to Africa education and to science in particular.

(c) To adapt schooling and to make it relevant to tl employment and work opportunities in the context South Africa's segregated labour market. The result this aim has been the restructuring of the scho curriculum to be compatible with the segregat employment practices. This has made African education to be less career oriented and less focused on science in particular.

It can be seen from the issues listed above that the Bantu Education Act was aimed mainly at entrenching White privileges and preventing access to opportunities; enforcing a tight control on the social and economic development of the Africans; anc increasing the number of unskilled and semiskilled workers. It is worth noting that whereas the Bantu Education Act was described as an education restructuring act, in essence it was a socio-economic and political statement. Its effects have ha wide-ranging implications on the various aspects of Africa social and educational life.

2.3 <u>EDUCATION ISSUES IMPACTING ON SCIENCE EDUCATION</u>

There are many educational issues that have been affected by th 1953 South African government's restructuring of Africa education. This section will only discuss the main issu relevant to this study such as: control and administration education; financing of education; enrolment of pupils; teacher qualifications; policies regarding the curriculum; the scien curriculum; and science teaching programmes.

2.3.1 Control and administration of education

In setting up the aims of Bantu Education the Nationalist government did not intend to fail in executing these aims. Therefore, to achieve these goals the government instituted two major safeguards. First, the control and administration of African education was placed under a White minister of education and White personnel were responsible for every aspect related to African education. The aim of this move can be seen in the words of Hendrik Verwoerd as minister of Bantu Education, when he stated:

> When I have control over native education, I will reform it so that natives will be taught from childhood that equality with Europeans is not for them.
>
> (Christie 1992:12)

The quotation above clearly reveals that the Nationalis government never intended that Africans should have a say in th education of their children. The exclusion of Africans in th control and administration of their own education has remaine enforced since then. This quotation also emphasises th deliberate creation of unequal educational opportunities amongs the races that has prevailed up to now. This tight control ove the development of Africans has had far-reaching implications fc science education, in particular, and the availability c scientifically and technologically trained manpower in Sout Africa.

The policy of apartheid education was maintained through centralisation of all aspects of education relating to Africans. Centralisation of matters such as policy making, planning, organisation, co-ordination, curriculum process, and financing ensured uniform management and control of African education in all four provinces. Centralisation also ensured tight control over the development of Africans towards a desired end, that is, class and racial segregation, as well as the inequality of educational opportunities, working skills and life opportunities.

A further fragmentation of African life was evidenced in 1968 when the control of education was decentralised and transferred to ten departments of education according to the ten ethnically divided 'homelands'. The Department of Bantu Education, presently known as the Department of Education and Training, retained control of African education within areas designated for Whites in South Africa. Thus the provision of education for Africans in South Africa has, since 1968, continued to be controlled and administered by eleven different education departments as shown in Table 2.1. These departments exclude those allocated for Whites, Indians and Coloureds.

The fragmentation of African education was unacceptable an detested by the majority of Africans. Some of the reasons fo this were the low per capita expenditure on education in th 'homelands', a high pupil/teacher ratio compared to schools i

White designated areas, the problems of administration and co-ordination caused by difficulties in communication due to the geographic position and rural nature of the 'homelands'.

TABLE 2.1 VARIOUS DEPARTMENTS OF EDUCATION FOR AFRICANS IN SOUTH AFRICA

DEPARTMENT	ETHNIC GROUP
Education and Training (DET)	Africans in Areas Designated 'White'
Education (Republic of Bophuthatswana)	Tswana
Education (Republic of Ciskei)	Xhosa
Education (Republic of Transkei)	Xhosa
Education (Republic of Venda)	Venda
Education (Gazankulu)	Tsonga
Education and Culture (KaNgwane)	Swazi
Education and Culture (KwaNdebele)	Ndebele
Education and Culture (KwaZulu)	Zulu
Education (Lebowa)	Pedi
Education (QwaQwa)	Sotho

For science education, the above problems were more severe with the acute shortage of qualified and experienced teachers and the virtual non-existence of laboratories and equipment. Consequently, the teaching of science is poor and dominated by rote learning, resulting in a high failure rate in science subjects.

2.3.2 Financing of African Education

The disproportionate allocation of funds for education on the basis of race, by the government of South Africa has lead to markedly different resources received by each education sector. Disparity can be seen in the numerous and well-resourced White schools when compared to the few and poorly-resourced African schools. The per capita expenditure on education for the different racial groups, shown in Table 2.2, illustrates the disparity in funding. It must be noted that the figures for African education include expenditure in the homelands. The per capita expenditure in the homelands is much lower than the per capita expenditure for African schools in the White designated areas.

TABLE 2.2 STATE PER CAPITA EXPENDITURE ON SCHOOL PUPILS BY RACE

YEAR	AFRICAN		COLOURED		INDIAN		WHITE
	a	b	a	b	a	b	
1953-54	R 17,00	13%	R 40,00	31%	R 40,00	31%	R 128,00
1969-70	25,31	5%	94,41	20%	124,40	27%	461,00
1979-80	91,29	8%	234,00	20%	389,66	33%	1169,00
1983-84	234,45	14%	569,11	34%	1088,00	66%	1654,00
1988-89	764,73	25%	1359,78	44%	2227,01	72%	3082,00
1989-90	930,00	25%	1983,00	53%	2659,00	71%	3739,00
1990-91	1194,00	29%	N/A	-	3109,00	70%	4103,00
1991-92	1248,00	28%	2701,00	61%	N/A	-	4448,00

N/A - not available
a = Expenditure. b = Proportion of White expenditure.
(Source: Cooper *et al*, 1990:795; Christie 1992:108; Cooper *et al*, 1992:195 and Cooper *et al*, 1993:588)

It can be seen from Table 2.2, that from 1953 to 1980, the amount spent on the education for the African child was been less than one-tenth of what was spent on the White child. In the decade after 1980 the per capita expenditure on education for Africans improved from 8 percent to 25 percent of the White expenditure. However, in spite of the diminishing disparity, African education is still lagging far behind all the other population groups.

The effects of poor and restricted funding for African education resulted in appalling conditions in African schools. Some of the problems experienced in schools have been inadequate classroom accommodation and large classes. The problems of large classes affect science education through the inability of teachers to pay attention to problems experienced by individual pupils, to provide laboratory materials to all pupils and to carry out demonstrations effectively. Difficulties experienced by children in learning science may lead to a high 'drop out' rate from school and a high failure rate in matric examinations compared to pupils of other races. Table 2.3 summarises the matriculation results of the four population groups in 1991.

TABLE 2.3 MATRICULATION EXAMINATION RESULTS: 1991

CANDIDATES		PASSES		MATRICULATION EXEMPTION	
	Number	Number	Proportion	Number	Proportion
African	280 918	114 695	41%	30 289	11%
Coloured	22 405	18 557	83%	4 911	22%
Indian	14 258	13 558	95%	7 062	50%
White	65 933	63 504	96%	27 356	42%
Total	383 514	210 314	55%	69 618	33%

(Source: Cooper *et al*, 1993:606)

An analysis of the results in Table 2.3 indicates that there was a very low proportion of Africans who passed matriculation in 1991. Only 11% of African pupils obtained a pass acceptable for entrance into a tertiary institution for further studies.

The number of pupils who passed science subjects and mathematics was even lower. This crisis continues to be grave as reflected in the pass rate of the African matriculation physical science (19%) and biology (13%) results in 1990. During the same year some 247 000 candidates wrote the matriculation examinations and only 36 percent passed (NEPI 1992:16).

The lack of different facilities such as libraries, school equipment, science laboratories and apparatus have also affected the quality of science teaching and learning in African schools. Further evidence of the effect of unequal funding is the quality of teacher education received by African teachers. For instance, well-equipped colleges of education for Whites produce well-trained science teachers when compared with colleges of education for Africans. The latter have ill-equipped laboratories and equipment and this makes it impossible to foster a teaching approach that encourages an acquisition of discovery and problem-solving skills.

Another result of poor funding in African schools by the government, was that parents had to shoulder the heavy burden of education costs. Parents were required to carry the cost of buildings on the 'Rand-for-Rand' system of financing the school infrastructure. In addition, parents were required to contribute towards the employment of additional teachers to handle the ever increasing number of pupils. Parents were also obliged to pay school fees and to provide books and stationery for their children. The huge cost of schooling to African parents, the majority of whom work in the lowest paid sector of the economy, was a contributing factor for the high rate of school drop-outs or the failure of parents to send their children to school. All the hardships described above that were experienced by Africans through unequal financing of education, contributed to the crisis in education that culminated in school boycotts between 1976 and 1985.

2.3.3 Enrolment and overcrowding

In spite of restrictions imposed by apartheid education, a steady growth in the number of African children attending schools has been seen. The value of education and the desire of parents to send their children to school, so as to get better jobs or professions, has led to the increase in the number of students enrolling for primary and secondary school classes. Overcrowding actually ensued when the various state organs failed to finance and match the increasing school-going population among the Africans. Consequently, the increase of student enrolment and overcrowding in African schools became a serious problem while other population groups had no such problems. Comparative overcrowding in schools is reflected in Table 2.4 in terms of the pupil/classroom ratio.

The high ratios in African schools shown in Table 2.4 indicate how numerous problems involving the shortage of teaching staff, facilities and laboratories were reinforced.

TABLE 2.4 PUPIL/CLASSROOM RATIOS IN SOUTH AFRICA: 1960 & 1990

POPULATION GROUPS	1960 PRIMARY	1990 PRIMARY	1960 SECONDARY	1990 SECONDARY
African	55:1	51:1	45:1	41:1
Coloured	29:1	26:1	25:1	23:1
Indian	32:1	29:1	29:1	27:1
White	18:1	18:1*	17:1	16:1*

* = Figures for 1988 were used since figures for 1990 were not available. Figures in 1988 showed a 16:1 ratio.
(Source: Cooper *et al*, 1992:206)

The ratios also point to severe pressure on the teachers who have had to deal with over-populated classes. Figures for most 'homelands' are comparatively higher. For instance, the pupil/classroom ratio in 1991 at secondary schools in KwaZulu was 51:1, while in KaNgwane and Lebowa it was 59:1 (Cooper *et al*, 1993:606). To cope with the large numbers of pupils and the lack of classroom accommodation, a double-session system was introduced. This is a system where one teacher teaches two separate groups (of 50 pupils each) daily; one in the morning and the other in the afternoon (Hartshorne 1992:38). The reduced hours of learning inherent in this system have also contributed to the inferior quality of education, particularly in science education. For instance, there is no time for discovery learning or practical work carried out by pupils themselves in the science classes.

In addition, the underqualified and unqualified teachers employed to cope with the increasing number of school children are faced with inadequate knowledge of science and a lack of confidence in the teaching of science. It is inevitable that most pupils resort to rote learning of scientific knowledge, have little understanding of science and develop a dislike of science as a subject at an early stage. Consequently, the number of African pupils who take science subjects at secondary school level and at tertiary level has remained very low.

Lastly, overcrowding and lack of classroom accommodation has resulted in a large number of children dropping out of school (Hartshorne 1991:58-59). Another reason associated with this attrition is that over-worked teachers are unable to give individual attention to pupils with basic learning problems. The wastage in human potential and the increased illiteracy amongst Africans stands as an indictment of the existing pattern of inequality which is central to the policy of apartheid.

2.3.4 Teacher qualifications

When Bantu Education was introduced in 1953, there were few well qualified African teachers compared to a large number of underqualified and unqualified teachers. Table 2.5 shows qualifications of teachers between 1960 and 1989. Some interesting facts reflected in this table include:

(a) The number of unqualified teachers increased progressively from the 1970s. This trend has been a cause for concern in African schools, particularly in rural areas and for the teaching of science and mathematics.

(b) There is a marked improvement in the number of professionally qualified teachers with Senior Certificate or matriculation.

TABLE 2.5: QUALIFICATIONS OF AFRICAN TEACHERS : 1960-91

	1970		1980		1989		1991	
	NUMBER	%	NUMBER	%	NUMBER	%	NUMBER	%
UNQUALIFIED PROFESSIONAL	7643	20	12019	16	22665	18	23513	11
QUALIFIED PROFESSIONAL WITH STD 6			9152	12	3570	3	15033	7
STD 8	25807*	68	40571	55	23936	19	22948	11
MATRIC AND DIPLOMA	4067	11	11736	16	71500	56	131376	64
DEGREE	545	1	1126	2	5891	5	12165	6

* No distinction was made in official statistics between standards 6 and 8.
(Source: Hartshorne 1992:261 and Cooper *et al*, 1993:610)

(c) The number of teachers who were professionally qualified and with Standards 6 and 8 certificates improved markedly by 1970. Because of the shortage of qualified teachers for secondary schools, many of the teachers employed were required to teach at this level, even though they were not prepared for it in their training.

The shortage of adequately trained science teachers, particularly in biology and general science, can be seen in Table 2.6 (on page 40). The high percentage of teachers who have no post-secondary training in biology and general science, when compared to other subjects, is another cause for concern. This means that almost half of the biology teachers at secondary schools are not adequately qualified to teach at secondary school level.

The work of unqualified science teachers is also impeded by factors such as the inadequate supply of physical and teaching resources (for example, textbooks and equipment), their inability to cope with secondary school work and the pressure from pupils to pass examinations.

TABLE 2.6: LEVEL OF TRAINING OF TEACHERS IN SECONDARY SCHOOLS ACCORDING TO SUBJECT - 1990

SUBJECT	NO POST-MATRIC OR TERTIARY EDUCATION	ONE/TWO YEARS' POST-MATRIC TERTIARY EDUCATION	MORE THAN TWO YEARS POST-MATRIC OR TERTIARY EDUCATION
Accounting	25%	32%	43%
Afrikaans	27%	26%	47%
Biology	49%	18%	33%
English	23%	34%	43%
Gen.Science	66%	17%	17%
Geography	32%	27%	41%
History	29%	26%	45%
Mathematics	26%	35%	39%
Music	33%	20%	47%

(Source: Department of National Education 1992:60)

Many of these teachers are forced to adopt teaching styles which were not science oriented, such as note-taking, rote-memorising of class notes or textbook facts and using authoritarian discipline. Pupils are allowed little or no time for active participation, group work, discussion or asking of questions.

For science subjects, laboratory work and experimentation is not done, even in those schools which have laboratories (NEPI 1992:4). These styles of teaching which emphasise expository teaching with little regard for understanding or the development of independent creative thinking, bring into question the quality and relevance of education in African schools.

2.3.5 Development of the Science Curriculum

In terms of past educational practices, as discussed earlier, education for each population group has been an "own affair", a system which is aimed at preserving the cultural values and the identity of each group. The general policy for formal, informal and non-formal education is determined by the Minister of National Education after consultation with all the ministers of education responsible for each population group, the statutory councils and the advisory committees. Therefore, the general policy in respect of curriculum development for all population groups is determined in this way.

Once the general policy has been adopted, ministers of education responsible for different population groups execute general policy and provide education for their specific population groups. It is important to realise that although education of Africans is an own affair which takes into consideration the "cultural and value framework" of Africans (Department of National Education 1992:3), the membership of all committees and bodies who determine the curriculum is generally drawn from the

White community. For example, the biology syllabuses ar determined by the Subject Committee whose members are mainl Whites and are unknown to African teachers. The absence of large number of Africans representing their communities whe these syllabuses are formulated, suggest that syllabuses whic are used in African schools are designed with White pupils an White schools in mind.

The revision of biology syllabuses which occurred in 1964, 197 and in 1985, also by non-Africans, has not taken into account th enormous problems experienced in African education. The proces of syllabus revision did not accommodate problems such as th shortage of qualified teachers, the lack of facilities such a laboratories and apparatus, the cultural background of Africa children, the needs and aspirations of the African community an the South African society as a whole. The lack of participatic of Africans, the private sector and all parties interested i education matters has partly contributed to the escalating crisi in science education in South Africa. Participation of African in the education of their children through curriculum developmen and the criteria used to select biology content are centra issues of this research study.

Apart from the domination of the curriculum development proces by the White members of the community, the science syllabuse have been criticised for their various shortcomings. Some of th shortcomings in biology syllabuses are: overcrowded content tha leaves little time for practical work; syllabuses are too content-oriented and pay little attention to discovering and problem solving; and there is less emphasis on the relationship of science, technology and society (HSRC 1981b:49,88). These structural problems of the biology syllabuses influence the design of school textbooks and other teaching materials which tend to be built around prescribed syllabuses. As a result textbooks are heavily loaded with biology facts and information. This state of affairs has encouraged teachers in African schools to adopt a content-based approach in order to cover the prescribed content within limited time.

Teachers are also compelled to adopt a teaching style characterised by verbal exposition as a result of factors that have been discussed in the above sub-sections. Some of the factors are: high teacher-pupil ratio, lack of laboratories and other resources, underqualification of teachers or situations where qualified teachers are called upon to teach biology which is a subject outside their area of expertise. This situation has contributed to passive listening and rote learning of biology facts by pupils for the purpose of regurgitation during examinations. Examinations further reinforce memorisation of facts because practical work and the application of knowledge is not assessed. Therefore, the learning of biology which emphasises problem solving and application of knowledge, as well as an understanding of the link between biology, technology and society is seldom encountered in African schools.

2.4 CONTEMPORARY REFORM INITIATIVES

The problems in African education that have been discussed above, that is, control and administration, unequal allocation of finance and resources, the explosion in the number of pupils without proper classroom accommodation, and the suspect quality and relevance of education has generated frustration and anger in the African community. Other problems are the high failure rate in matriculation examinations particularly in science subjects, the high drop out rate of school children, and rising unemployment due to inadequate career opportunities. This frustration and anger sparked the riots and school boycotts which started in 1976 and have contunued to date. The riots and school boycotts could be regarded as the watershed that persuaded the government and other groups like the private sector to begin to address the question of African education.

2.4.1 Government Initiatives

The government decided to appoint the Human Sciences Research Council (HSRC) to investigate education in South Africa. This committee, headed by De Lange, produced various major recommendations. Those that are more pertinent to this study include the following (HSRC 1981a: 134; HSRC 1981b: 92-94):

(a) The syllabuses should be short enough to allow adequate time for relevant practical experience.

(b) The syllabus should constantly emphasise the relationshi between science, technology and society.

(c) The syllabuses prescribed for a subject at various levels i schools and at universities and other places of post-schoo tuition should be carefully co-ordinated so that eac successive course provides development, rather than a unnecessary repetition of material contained in precedin courses. Syllabuses in various subjects should be wel co-ordinated and integrated.

(d) A much wider spectrum of people should be involved in th discussion than those who have been involved in syllabu revision in the past. The aims of the syllabus and th criteria for the selection of content should be clearl identified.

The above mentioned recommendations indicated the new direction which science education in South Africa should take. Thes recommendations focus on the following: syllabus content whic emphasises the relationship of science, technology and society the co-ordination and integration of biology knowledge with othe disciplines; the participation of the wider community i curriculum development; the aims of science education and th criteria for the selection of content. An in-depth discussio of all these issues will not be done here because they are deal with in Chapter 3, Chapter 4, Chapter 5 and in various othe places throughout this study.

Although an in-depth discussion of teacher education is outsid the scope of this investigation, the De Lange Commission' specific recommendations in respect of the availability, trainin and service conditions of science teachers are nevertheles relevant to this study. Pre-training and continuing training c teachers to improve the academic qualifications of underqualifie teachers in science and mathematics, was suggested. Revision c teacher education syllabuses, greater emphasis on methodology an practical training in teaching science at primary and secondar school level and the provision of opportunities for professiona growth of individual teachers were some of the recommendation (HSRC 1981b: 100-105). These recommendations are important fo this study because they relate directly to the effective teachin of science, the role of teachers in the selection of relevan content and their participation in curriculum development.

In spite of many weaknesses (time constraints, inadequat representation in number and the political standpoint o Africans), the De Lange Report highlighted the crisis i African education. Its central message was the equality o access to educational opportunities, financial allocations an community participation in educational decisions. This would hav gone a long way in addressing some of the education problems fo Africans. However, it is unfortunate that the government did no adopt and address the fundamental issues that were highlighted b the De Lange Report when it was published in 1981. As a resul apartheid education continued and renewed protest and resistanc in education is still present to date.

Since 1990 the South African government has tried to address th education crisis in South Africa by publishing several document that focus on reform in education. The proposed reforms aim a removing a racially-based and the highly fragmented system o education in this country. Some of the documents include the Education Renewal Strategy: Discussion Document (ERS)" which wa published by the Department of National Education in June 1991 Some of the major proposals in the ERS discussion document were that race should not feature in the structure and provision o education, that one central education authority with regiona departments should be established, and that curriculum changes i the formal school system should be towards meeting the economi and manpower needs of the country (Cooper *et al*, 1993:576).

In November 1991 another document, "A Curriculum Model fo Education In South Africa: Discussion Document" (CUMSA) wa published by the Committee of Heads of Education Departments This document contained information on proposals regarding model for a broad curriculum for pre-tertiary education in Sout Africa. Proposals from this document suggest greater emphasis o vocational or career education within the secondary school syste after standards 5 and 7. The shift in emphasis from academic o general education towards vocational or career education i noticeable through the introduction of new subjects such a technology, economic education and arts education from the junic primary school phase. The document also includes specifi proposals on compulsory schooling, the twelve year educatic structure divided into four phases and the subjects offered t pupils in each phase.

The government initiatives that have been discussed above hav not, however, been implemented yet so the policy of aparthei education remains in place. A lot of criticism from a wide rang of organisations and the community has been directed toward these government initiatives. A major criticism of both the ER and CUMSA documents is the unilateral restructuring of th curriculum by the government. The implications are that th process of restructuring the school curriculum will lac legitimacy and relevance through lack of representation by al interested parties in the process. There has been insufficien participation of teachers and other players from the Africa community. Other issues include the "top-down" approach wher the curriculum process has been dominated by a White educatio department, the emphasis on the curriculum is to content-oriented and there is no integration of subjects such a technology with science or other subjects. Lastly, there i great emphasis on vocational or career education and a neglect o a recognition that education is for life and for improving th quality of life of all citizens.

2.4.2 Independent Initiatives

After the 1976 riots and school boycotts educational pressur groups have been actively involved in initiating changes an formulating their own policy proposals for an alternativ education system. These groups included business and worke organisations, universities, non-governmental educational grour and parent-teacher-student organisations. The vital role playe by these groups in the struggle against apartheid education ca be seen in terms of hundreds of projects which have arisen in th last decade to service the needs of the disadvantaged Africans.

Projects to improve the quality of African education hav concentrated on two areas: direct contact with secondary schoo pupils, particularly in mathematics and science subjects and i the in-service education of teachers. The private sector responding to the perceived needs for trained manpower an pressures for African advancement in commerce and industry, spen considerable sums of money on a wide variety of short-ter educational programmes. Some programmes were directed a improving the examination results in mathematics, physica science and biology while other programmes emphasised technica education. For example, in Natal, short-term programmes devise to assist standards 9 and 10 biology, physical science an mathematics pupils are provided by the Universities o Durban-Westville, Natal and Zululand.

The concern for long-term strategies that could improve th quality of African education led to a greater focus on supportin teachers in the classroom and providing effective and innovativ approaches to the in-service education of teachers. Th proliferation of privately funded in-service education programme can be illustrated by the fact that in 1985 there were 5 in-service education projects run by non-governmenta organisations. Many of these projects were concerned wit improving science and mathematics teaching and curriculu development. For example, an important role in in-servic education of science and mathematics teachers in Natal is playe by projects such as the Urban Foundation's Primary Scienc Project, Science Education Project (SEP), Teacher Opportunit Programmes (TOPS), Centre for the Advancement of Science an Maths Education (CASME) based at the University of Natal Institute for Education and Human Development based at th University of Zululand, Science Curriculum Initiative in Sout Africa (SCISA) at the University of Durban-Westville, Associatio for Science Teacher Educators (ASTE) and many others.

The strong contribution towards improved classroom practice restoring self-confidence and self-image of the teachers an pupils, and the quality and relevance of content and method i African schools is a direct result of the projects discusse above. However, since the determination of policy and th control of key educational resources remain with the governmen the influence of all these independent initiatives will rema decentralised and economically inefficient.

2.5 CONCLUSION

It is worth noting that for more than a century the state African education in South Africa has been and continues to be disarray. The present crisis in education is likely to contin until issues such as the unequal allocation of financi resources, the quality of schooling, the competence of teache and a curriculum relevant to the needs of individuals and t society are dealt with. The debate on reform and reconstructi of the whole education system which started in 1991 is, howeve a promising sign.

Evidence of the commitment by the government to bring about bro structural changes is seen in the ERS and the CUMSA document published in 1991. However, the success of the proposed chang depends on acceptance by all the people interested in educati such as the parents, teachers, community leaders, busine people, churches, worker organisations and the pupils themselve In fact, the participation of all the above-named groups in t reconstruction process is crucial for the acceptance of the n education dispensation by the majority of South Africans.

CHAPTER 3

SCIENCE EDUCATION AND SOCIETY: THE CHANGING AIMS

3.1 INTRODUCTION

For nearly a century and a half, natural science has been considered one of the essential subjects to be included in school curricula. However, the reasons for teaching natural science in schools, and the content which is considered suitable for teaching school children, has changed considerably within the same time span. Uzzell (1986:155-161) is of the opinion that changes in the content of school science have been influenced by various reports, projects and policy statements such as the Science For All Report of 1916, the Nuffield Secondary Science Project of 1970, the 1961 and 1981 Policy Statements of the Association for Science Education and several others. Hodson and Prophet (1986:166) reiterate the same idea when they argue that the content of science in schools is socially constructed as it reflects particular choices of different interest groups at different times in history.

Over the years, definitions or statements about science education have overemphasised the instruction of established scientific facts, the development of reasoning skills and a clearer understanding of how scientists search for knowledge. These statements excluded the everyday application of science and the relationships that exist between natural science, technology and society. Consequently, school science curricula have tended to emphasise the teaching of established scientific knowledge and science processes or skills while neglecting the application of science and technology to the needs of society and community development.

In the early 1980s there was widespread recognition that science and technology education are essential contributors to national development. Questions on the relevance of science education to perceived social problems initiated the need to redefine the goals of science education. Recent developments seem to suggest that the reformulation of goals will not only include understanding of scientific knowledge and skills, but the technological and environmental context of science teaching as well.

Currently, there is a debate amongst science educators over the definition of science education which is stimulated by the issue of locating science-technology-society topics within the discipline. One view identifies the development of reasoning as the fundamental purpose of science education while the other view is centred almost exclusively on the social context of science education.

The aim of this chapter is to discuss the changing aims of science education and the emphasis placed on the role of science in society. The chapter will also examine how this change in emphasis will necessitate reform in the science curriculum offered in schools. In an attempt to clarify the relationship between science education and societal issues, this chapter will discuss the following aspects: Education in a Cultural Context; The Aims of Science Education; Science, Technology and Society.

3.2 EDUCATION IN A CULTURAL CONTEXT

Chapter 2 has revealed that education, particularly African education in South Africa, is under criticism. It is not simply that the education system has failed to create more state schools for African children, but also that the education offered is not relevant to African children's needs. The question which educationists in this country must answer is: what preparation should be given to the youth to enable them to become independent thinkers of society and, accordingly, enable them to lead valuable and satisfying lives.

We live in a society which is largely dependent on scientific culture for its material welfare, but we are generally ignorant of the ideas, plans, discoveries and perspectives on which science is based. Culture is the sum total of all material and non-material achievements produced by a people in the process of adjustment to an environment. According to Coombs (1985:244) culture includes a society's system of values, ideology and social codes of behaviour; its productive technologies and modes of consumption; its religious dogmas, myths, and taboos; its social structure, political system, and decision-making processes.

According to Coombs (1985:244) the identity and survival of any culture is maintained, to a large degree, by language and education. The main task of education in all societies has always been to conserve and protect an inherited culture and transmit it to each new generation. The aim of education is, therefore, twofold: first, to perpetuate the functioning of the society and second, to prepare the individual to lead a meaningful adult life within that society.

Despite the traditional aim of education to preserve culture, there has been widespread cultural transfers and infusions in many countries in recent times. The cultural transfers and infusions have been followed by changes in the nature of work and life-style, changes in old values and social codes of behaviour, and changes in educational institutions including emphasis on curricula. Cultural changes in most societies have been fuelled by the following factors : the spread of modern science; the spread of technology and mass media products and the related rapid growth of international trade. The impact of cultural changes has drawn world-wide attention to the improvement of science education. The general demand is not only for producing more scientists and technologists, but also to assist all individual members of society to adapt and function in a world that has become progressively influenced by science and technology.

The development of new areas of knowledge and technology, and the changes in the structure of society have focused attention on relevant or appropriate science education which meets the needs of a particular society. When one decides what the "needs of society" (Jonathan 1986:136), are, Jonathan warns of the apparent simplicity with which people conceive of those needs. She argues that talk of the "needs of society" may be appropriate where goals are basic and universally shared, but will have little meaning in a complex society which is pluralist in values and stratified in terms of social status, rewards and power. Jonathan (1986) concludes by stating that the aim of educatior therefore, should be to prepare the young not just to cope witł life, but to understand and critically evaluate the circumstances they inherit. This view is shared by Freire when he asserts:

> education...should enable men to discuss courageously the problems of their context - and to intervene in that context; it should warn men of dangers of the time and offer them confidence and the strength to confront those dangers instead of surrendering their sense of self through submission to the decisions of others.
> (Freire 1976:33)

The type of education described by Jonathan and Freire, is no only concerned with the development of rational powers but als regards personal and societal development as being important. I South Africa where society is complex and beset with a number o disparities (such as geographic, socio-economic and educational) an appropriate science education which confronts issues such a population growth, hunger and malnutrition, health and environment, and food and energy resources is of vital importance.

3.3 SCIENCE, TECHNOLOGY AND SOCIETY

There are numerous versions of what science is or what counts as scientific. The diversity of conceptions of science can be seen as a testimony to the widespread influence and penetration of ideas about science found in many different areas of life. Indeed, conventional definitions of science tend to emphasise different features, depending upon which perspective it is being viewed from.

3.3.1 Different Aspects of Science

Ziman (1984:1-2) describes four aspects of science.

(a) Knowledge Aspect: science is defined as a body of knowledge regarding natural phenomena. This accumulated knowledge has been acquired by research and is organised into coherent theoretical schemes and laws.

(b) Methodological Aspect: science is viewed as a procedure used by scientists to obtain information about the natural world. Elements of this procedure such as observation, experimentation and theorising are considered special and objective. This view leads to science being perceived as value-free and non-subjective.

(c) Instrumental Aspect: emphasis is placed on science as a means of solving problems in the society. The deliberate planning of scientific research on particular topics, with the expectation of arriving at results with preconceived applications, is characteristic of this view. According to this view, science becomes directly involved with technology and society when it is applied to the solution of technical or practical problems of individuals or groups of people.

(d) Vocational Aspect: science consists of a series of discoveries of science made by people with a gift for research. Science education therefore, is largely preparation or training for particular scientific or technological careers.

The above-mentioned definitions of science are complementary. However, earlier writers such as Kuhn (1970) and Popper (1972) have tended to see these aspects of science in isolation. Some of these writers have also overlooked the role of science in society or the importance of biosocial issues in science. In truth, a model of science as considered and proposed in this research study is one which should reveal science as encompassing broader aspects of life and existence. In other words, science is a body of organised knowledge produced by research, it is means of solving societal problems, a distinct profession and i employs characteristic methods to obtain reliable informatio about the natural world.

According to Ravetz (1971:405) scientific knowledge is a product of social endeavour. He further argues that science can only be understood if it is treated as a social institution, both within its own sphere of activity and in its relationships with the world at large. This viewpoint expresses what this research study is all about. In addition, Ziman (1980:58) concurs with these notions when he states that the production of scientific knowledge is not simply a matter of experimenting and theorising by individuals: it is a social process in which critical interactions between scientists, and resultant communal acts of validation play a vital part. These views confirm that the construction of scientific theories and concepts is often influenced by cultural ideas and assumptions of scientists. Furthermore, the direction of scientific research is in part determined by the goals of scientific institutions, and those of the political and economic institutions which support them (Verhoog 1985:102).

3.3.2 Science as Part of Culture

The claim that science is an integral and important part of the general culture is often traced back to the influential lecture by Snow (1959) entitled *The Two Cultures*. In his lecture Snow (1959) observes that scientists do not read creative literature, and that literary people do not understand the basic ideas of science. He decries the existence of a chasm or cultural divide between the scientific and humanistic communities. Snow (1959) then goes on to plead for the blending of the disciplines of science and humanities in the general education of citizens.

Prior to the 1960s, sociologists excluded science from their investigations of how specialised bodies of knowledge were influenced by the social and cultural contexts in which they were produced. It is now generally agreed amongst sociologists that scientists have access to two main cultural reservoirs: one provided by the scientific community and the other provided by the wider society. Let us briefly consider some of the operative values of these two communities.

To the scientific community, science has its own set of values which guide scientific research. These values are familiar to scientists and become part of their disciplinary repertoire. Aikenhead (1985:55-56) refers to one set of discipline-centred values, such as, 'objectivity' as constitutive values. The other set of values which includes ethical, ideological and cultural aspects is known as contextual values. Aikenhead (1985:56) asserts that contextual values affect scientific and technological enterprises by influencing:

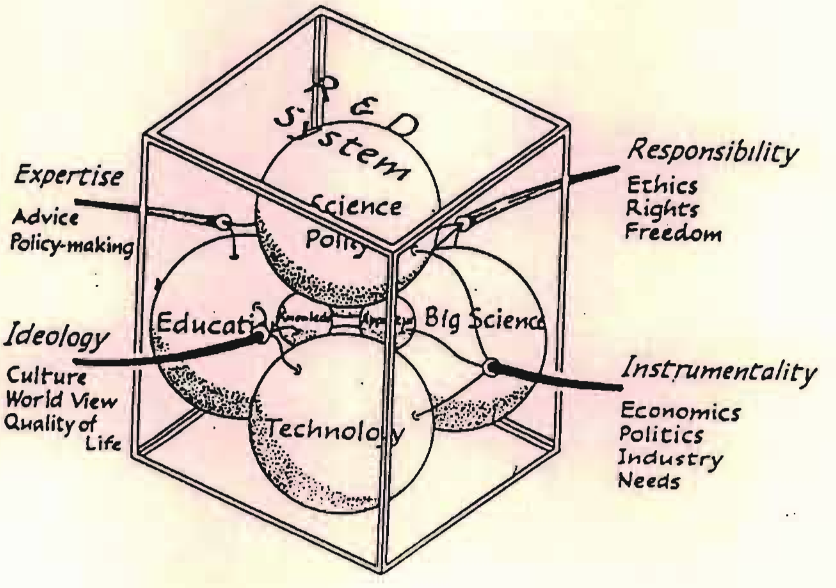
(a) the field of research to be funded,
(b) the research methodologies which may conflict with ethical values, and
(c) the policy decisions over the technological implementation of science.

The status of scientific knowledge as an objective entity is challenged by Kelly's theory of Personal Constructs (1955). This theory expounds the view that knowledge is the product of the interaction of individual minds with their experiences, resulting in a highly personal system of interpretations and rationalisation. Writers such as Woolf (1964); Young (1974); Solomon (1987) and Driver (1988) reject the distinction between academic knowledge and common-sense knowledge made by philosophers such as Karl Popper. They argue that all science knowledge, personal and public, is socially constructed. Driver (1988:137) maintains that the significant view from a constructivist perspective is that scientific theories are seen as provisional and fallible. Theory-making and -testing is a dynamic human enterprise which takes place within the socially defined community and the institutions of science.

Within the wider society in the contemporary period, science is regarded as the means by which all societal problems are to be solved. Scientific research has been seen as a programme of action that yields results to cure disease, improve crop yields, halt population growth and so on. Social scientists such as Ben-David (1971:169); Mulkay (1979:97) and Ziman (1980:103) observe that the proposal that human conditions should be ameliorated by the applications of science, is not as neutral as it is made out to be. External factors such as the social, political and technical conditions in the wider society have a considerable influence on scientific development.

In addition, the funding of scientific research and the decision to include research findings in social and public policies in many countries is essentially a political process (McInerney 1982). It is for these reasons that Mulkay (1979:119) concludes that the scientific knowledge, that is, its concepts, empirical findings and modes of interpretation cannot be divorced from the social and cultural context from which it is produced. For example, in many capitalist countries scientific research is undertaken, and encouraged by industrial companies, for the sake of advancing the profit motive rather than general human welfare.

FIGURE 3.1 SCIENCE IN ITS SOCIAL CONTEXT



Source: Ziman (1980: 107)

Ziman (1980) is one of the few scientists who has produced a model which knits together a number of threads connected with science in its social context (see Figure 3.1). The model illustrates the fact that the research and development system should be presented with reference to its constituent elements and their interactions, such as, science and ideology, science and human needs, the value of scientific expertise, social responsibility in science and others. Adoption of such a model in science education could reveal the real nature of science, that is, science as a human activity. Ziman's model is considered to be a suitable framework within which scientists and science teachers can work with the knowledge that for any issue that is raised, the response of the whole system must be taken into consideration.

Support for a science model with biosocial and humanistic approaches, like the one advocated by Ziman (1980), has been seen in the work of writers like Bybee (1977, 1987a); Hurd (1980); and Rosenthal (1983). This is so because the model attempts to knit together elements of the natural sciences and society such as science policy, science education, social issues, and research in science and technology. The present study argues for an integration of all elements, as presented in the model above, for developing a relevant science curriculum in South Africa.

3.3.3. Science and Technology

The distinction between science and technology is vague. Knowledge of both areas is drawn from the same archives, experiments are done with similar instruments by people with the same educational background and the same expert skills. The task, therefore, of distinguishing between academic science and technology is dull and tiresome. According to Hurd (1980:7) science and technology are symbiotic : while technology needs scientific knowledge to thrive, technology gives back to science a rich reward in new instruments, new techniques and new powers.

Technology has been broadly defined by Lowrance (1986:33), as the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity. According to this definition, technology is perceived as the technical activity of a human culture, be it modern science-based technology or practical techniques/crafts which have their origins in the mists of antiquity.

Scientific and technological knowledge systems tend to overlap more and more. While the objective of science is to create an organised body of knowledge as a resource, science-based technology is essentially instrumental in its valuation of knowledge. A more recent definition of technology, by Lowrance (1986:33), is that it is systematised practical knowledge based on experimentation and/or scientific theory, which enhances the capacity of society to produce goods and services and which is embodied in productive skills, organisation, or machinery. Ziman (1984:121) concurs when he states that science and technology together constitute a major social institution based upon the systematic generation, accumulation and utilisation of knowledge.

In the eyes of the public the role of science in society is inseparable from the role of technology. Science and technology are viewed simply as two aspects of one indivisible activity. They are both valued by society for their instrumental function. As a result, the demands made on science and technology are of a practical nature and range over a wide spectrum: from meeting basic human needs for food, shelter and health to providing war weapons and profitable investments for the power structures of society. Ziman's views (1984:140) of societal demands which "science and technology" is expected to solve, is grouped as follows:

- Meeting basic human needs, in the form of food, shelter and health.
- Making war, or otherwise serving the purposes of the nation-state.
- Making profits for competitive industry, through technological innovation.
- Improving the quality of life, by eliminating human drudgery and environmental pollution.
- Solving social problems, such as over-population and economic underdevelopment.

It becomes clear then, that modern society relies heavily on science and on technology for its advancement. Man's ability to actively mediate and modify his environment is rooted in what science and technology can and cannot accomplish (McInerney 1982). Our philosophy and actions as science educators, therefore, must reflect a humanistic and society-responsive approach to teaching and practising science. Our classroom reality in propagating scientific teaching and procedure must be one which is bound to make our children more interested in science. Furthermore, children must find science to be more functional in society from their early years of education.

3.4 THE AIMS OF SCIENCE EDUCATION

Science education as a component of educational studies shares the directives common to all social institutions, which is, providing for the needs and continued development of individuals, as well as fulfilling the requirements and aspirations of a democratic society (Bybee 1987a:672). Science in the 1990s could benefit as a discipline by taking a critical look at whether science programmes offered in South Africa fulfil the needs and provide for the continuous development of individuals. Clearly there are many ways in which cultures and social life are now influenced by knowledge and applications from the sciences. The aim of relevant science education should be to assist people to have a sense of control over their lives and to gain confidence in applying scientific knowledge to solve societal problems.

In view of the sparse application of science to real life issues, changes in the national curriculum policies for science have to be introduced. These changes have already been instituted in several Western countries, such as the United Kingdom, the United States of America and Canada (Watts and Gilbert 1989: 76). The instituted changes rest on the four assumptions.

1. Scientific literacy and competence for all, and scientific expertise for some, is beneficial to the individual, particular groups, the economy, democracy and the development of science.
2. All science is teachable to all pupils and all science is learnable by all pupils.
3. School systems can deliver and manage such science teaching and learning if the human and physical resources can be made available.
4. The cost of science education can be met by the state.

In recent years the thrust in science education for the secondary school level has been directed towards achieving a balanced science curriculum. This implies that science educators seek to cover all aspects of learning such as knowledge, methodology, instrumentation and vocational training for all children. If this principle of 'science for all' is adopted by many countries, scientific literacy which has been described by Simpson and Anderson (1981:6) as the central goal of science education, could be promoted. "Scientific literacy" is broadly defined by Shen (1975:45) as an acquaintance with science, technology and medicine, popularised to various degrees through information in the mass media and education in and out of schools.

Shen (1975:45) asserts that scientific literacy can be divided into the following three categories:

(a) Practical Science Literacy which enables an individual to cope with the basic problems of survival: it is concerned, therefore, with matters such as shelter, water and food supplies, diet health and child rearing.

(b) Civic Scientific Literacy which enables a citizen to contribute to debates about science-related issues which have a direct bearing on the nature of the society in question. For example, matters of pollution and waste disposal in society.

(c) Cultural Scientific Literacy which is concerned with the recognition and appreciation of the 'cathedrals of science': science as a majestic achievement of the human intellect and spirit.

Shen's analysis forces us to take a careful look at the content of science curricula offered in schools, the relevance of science programmes to everyday events or societal problems, and how well the science programmes provide a framework for future informal learning. It becomes clear that the presentation of science knowledge, skills and understanding should occur within a personal and social context. The inclusion of science-related social problems in curricula will focus attention on the use of social and related contexts or perspectives in science education, an aspect that has been neglected in the past. It is worth noting that relatively little attention has been paid to the use of social and related contexts in the South African science education curricula. In African schools, science teaching is still a mere reiteration of content, irrespective of its utility for the large majority of students. Yet, problems like the shortage of technologically-oriented manpower, the increased health and disease problems, teenage pregnancy, drug abuse and alcoholism are common concerns in our society.

In contradistinction to what is happening in South Africa, some Western countries, for example the United Kingdom, have re-formulated their scientific literacy principles (refer to Shen 1975) to specific goals in a formal education setting. Some of these aims for science education have been spelled out by *The Royal Society*, which is the foremost scientific society in the United Kingdom. The aims are as follows (Royal Society 1985:17):

(a) To develop the processes of scientific thinking in the context of a broad education - observing, pattern seeking, explaining, experimenting, communicating, applying;

(b) To acquire a range of mental and manual skills through direct involvement in scientific activities;

(c) To acquire some knowledge and understanding, through systematic study of the body of knowledge called 'science'; and

(d) To understand the nature of an advanced technological society, the interaction between science and society and the contribution science has made, and can make, to the cultural heritage.

The above-mentioned goals of science education have been repeated by many science educators and policy makers in the United States of America (Ravetz 1971; Ziman 1980; Hurd 1980; Hofstein and Yager 1982, 1984; Nellist and Nicholl 1986; Uzzell 1986; Bybee 1987a). These goals of science are now generally accepted in science education circles in Western countries as a guideline for developing new science curricula. Examples of new curricula, based on new aims, are the Science in Society (Lewis 1981); the Technical and Vocational Educational Initiative (TVEI) and the Science in a Social Context (SISCON) in the United Kingdom .

In South Africa science educators are only beginning to enter the debate on the crisis in science education (Pouris 1989, SCISA 1989). Very few science educators have begun to express the need to teach science in such a way that all four goals, stated earlier, can be realised. There is still a significant gap between talking about the crisis in science education and re-formulating aims and curricula that will meet the needs of the South African society. This study is an attempt to fill part of this gap by investigating some of the issues that can be included in the development of biology curricula which are relevant to the needs of the society.

3.5 CONCLUSION

Science educators have the responsibility of preparing both the professional scientists who will propose solutions to contemporary problems as well as the scientifically literate citizens. In the past, science educators focused on the preparation of scientists because they emphasised the content and process dimensions of teaching science at the expense of other dimensions.

The call for a redefinition of goals of science education made in the 1980s, and the demand for an education that is relevant to societal needs has forced science educators to take a closer look at the nature of science. The result is that science should be viewed as a human activity intended to improve man's knowledge of his operational environment. Therefore, an understanding of science in its external relations with society and technology will broaden the scope of objectives in teaching. Widening the range of objectives in science teaching will assist in changing the aims of science education and the development of curricula which are relevant to perceived needs of society.

CHAPTER 4

PRESENT STATUS OF BIOLOGY EDUCATION

4.1 INTRODUCTION

Education has a long history of reform resulting from changes in society. This history of reform reveals periods of major changes and the circumstances that produced those changes. In the developed and the developing countries, phenomena such as industrialisation, urbanisation, immigration and the increased number of pupils entering schools at all levels have had enormous impact on changes in the school curriculum. In addition, development of new areas of knowledge and of technology have also influenced decision-makers to continuously scrutinise and revise their existing education programmes. The process of development, evaluation and implementation of the school curriculum, therefore, is an on-going process rooted in the dynamic nature of society.

Fewer subjects in the school curriculum have drawn greater world-wide attention over the past twenty five years than science has. The hope that science would contribute to economic prosperity and social advancement of most countries has been responsible for this attention. However, the inability of science education to provide the required manpower and social progress in many countries has led to a general outcry regarding the status of science education. The pressure to improve science education has come not only from scientists, but also from political and business leaders, farmers, military strategists, parents as well as from the education system itself. Coombs (1985:246) believes that the pressure to change the science curriculum is not solely to produce more scientists and technologists, but it is also to produce a new generation of citizens who are better prepared to function in a world that is influenced by science and technology.

The focus of this chapter, therefore, is to review the dominant trends which have attempted to bring about changes in the teaching and learning of school biology in Western and developing countries. Trends in the reform of the biology curriculum from 1960 to date will be reviewed. Special attention will also be paid to biology education in African schools in South Africa. This review will help us understand the existing position of biology education in African schools. It is hoped that this review may also provide information on whether changes in biology teaching are necessary or not.

Finally, this chapter will also review some issues and problems currently faced by South African society and to see the extent to which the current biology curriculum addresses them. The review of social issues and problems is important in revealing the needs of the communities or people for which the biology curriculum has been designed or developed. The need for a closer link between what is taught in school and the problems and issues of the community has been emphasised by Rugumayo. He maintains that:

> a community does not become aware of the importance of biological education unless the training given to individuals places emphasis on the primacy of the social function of biology education (Rugumayo 1980:8).

In this chapter, Rugumayo's argument is the central theme around which the review is based.

4.2 SENIOR SECONDARY SCHOOL BIOLOGY CURRICULUM

To address the subject of senior secondary school curriculum more effectively, a review of the status of the biology curriculum from the early years to the present is necessary. This approach will help to show whether the biology curriculum has been influenced by politicians, scientists or societal issues which affect the lives of ordinary citizens. This discussion also looks at advancements in other countries, such as the United States of America and the United Kingdom, with the view of showing how developments in biology curriculum of those countries have influenced the biology curriculum in South Africa.

4.2.1 The Early Years

The idea of a general biology course was introduced to the United States of America by Thomas Huxley in 1876. Huxley's textbook "*A Course of Practical Instruction in Elementary Biology*" was based on the notion that biology as "the study of living bodies is really one discipline, which is divided into zoology and botany simply as a matter of convenience" (Rosenthal & Bybee 1988:346).

By 1900 several schools in the United States of America were teaching a course on general biology which included botany, zoology and physiology. Due to a lack of a suitable model for an integrated biology course the first high school textbooks and courses were modelled on college curricula, that is, they were organised into units of botany, zoology and human physiology.

During the first quarter of the 20th century, enrolment in schools increased and biology became a popular subject in both high schools and colleges. A number of factors, such as the industrial expansion from 1910 to 1920, the rising wealth which freed children from labour, and the increased length of compulsory schooling may have contributed to the increased public awareness of science in the United States of America (Rosenthal & Bybee 1988:346). This increased awareness of the role of science in people's lives led to a dissatisfaction, expressed from different quarters, concerning the academic nature of high school biology and its irrelevance to life. Educators in the United States responded by attempting to make biology an integrated course suitable for the majority of students. Consequently a shift in emphasis from a strong academic to a practical course, that is, from biology for its own sake to biology for functional purposes, is reflected in the titles of some textbooks published at the turn of this century (Rosenthal & Bybee 1988:346). These include *Applied Biology* by Bigelow &

Bigelow (1911); *Practical Biology* by Smallwood, Reveley & Bailey (1916); *Civic Biology* by Hodge & Dawson (1918) and *Biology and Human Welfare* by Peabody & Hunt (1924).

This attempt to make biology an integrated course which is relevant to the lives of the majority of students had, however, limited effect on the biology curriculum offered at that time. The efforts to make biology reflect a human aspect drew strong criticism from many scientists and educators. Their criticism revolved around the orientation of secondary school biology: should it be a science of life or a science for living (Rosenthal & Bybee 1988:346). This debate has continued to date not only in the United States of America but also in South Africa. Rosenthal and Bybee (1988:346) believe that secondary school biology has remained academic and that many courses and textbooks in the United States are still divided into botany, zoology and human physiology. The influence exerted by American textbooks and developments in biology curricula can be seen in the South African biology curricula and their respective textbooks.

The campaign to introduce biology in the school curriculum came much later in the United Kingdom. The publication in 1916 of the pamphlet *Science for All*, by the Association of Public School Masters, started a campaign which sought to "bring the whole of science teaching into closer touch with everyday experience" (Kerr 1966:304). Until then, physics and chemistry monopolised the school time-table. However, not much progress was made until after the 1936 publication of *The Teaching of General Science* by The Science Masters' Association. This publication campaigned for general science to be a suitable course of study which would draw from the common experiences of children but not exclude any of the fundamental special sciences: physics, chemistry, botany and zoology (Kerr 1966:304).

The determinants of the increase in popularity of general science, by then a course in the United Kingdom which included aspects of physics, chemistry, botany and zoology, are similar to those which existed in the United States of America. The increase in the number of pupils entering secondary school level, and the need for science teaching which suited many children, were major factors. By the 1940s and early 1950s general science became a popular science subject that was offered to the majority of pupils in most secondary schools. However, by 1960 most schools had reverted to teaching separate sciences at secondary school level. One reason for the decline of support for general science was that pupils who wished to follow careers in science or technology were inadequately prepared by a course in general science. Therefore, the change in the science curriculum offered at school was determined by people in higher education as well as by economic and industrial forces.

During this period it was not only the arrangement of content into separate sections which was problematic as it lacked an integrated presentation of science knowledge, but the methods used in teaching general science. The heuristic approach in teaching science recommended by Armstrong as early as 1898, did not flourish in schools in the United States of America nor in the United Kingdom. Pupils were not treated as discoverers of knowledge but were viewed as being ignorant of facts. As a result, pupils were generally listening, reading and memorising rather than being engaged in active inquiry (Stoneman 1974:268).

Bernal (1946:150) confirmed this state of affairs for the United Kingdom when he stated that as science teaching spread, the dominant method of "imparting necessary information and standard techniques" had grown out of the need to provide training for science specialists. In other words, the methods used in teaching encouraged memorisation of facts without understanding or the application of knowledge to societal problems. He further suggested that in order to avoid the practice of simply handing out information that is so "out of relation with life as to become meaningless and impossible to remember" (Bernal 1946:150), education in science should serve two purposes:

1. To provide enough understanding of the place of science in society to enable the great majority that will not be actively engaged in scientific pursuits to collaborate intelligently with those who are, and to be able to criticise or appreciate the effects of science in society.

2. To give a practical understanding of scientific method, sufficient to be applicable to the problems which the citizen has to face in his individual and social life.

It should be noted that the above stated objectives for teaching science were neglected not only in the United States, and in most Western countries but also in the entire developing world from the 1940s to date. There are three reasons why Bernal's objectives for teaching science are important for this study. First, the recognition that most students who take science, in especially biology, do not become scientists is one of the arguments made by this study. The study, therefore, argues for biology content teaching methods that provides all pupils with appropriate knowledge and skills to function in a South Africa dominated by science and technology. Secondly, the relationship of science, technology and society which is emphasised in Bernal's argument is the central theme of this study. Thirdly, the argument above emphasises the idea that "society influences, inspires and directs science in as much as science transforms society" (Bernal 1946: 153). The idea that science continuously changes and is being revised to meet new knowledge and new needs from society is valuable knowledge for all children. This study argues for a reconstruction of the school biology curriculum which must keep pace with scientific advances, the effects of those advances on society and the needs of the African community. It is believed that such a curriculum will help pupils solve biology-related problems and understand the relevance of biology to their everyday lives.

4.2.2 The Age of Curriculum Reform

The discussion in the previous section show that personal and social goals were somewhat recognised in the early years of the development of the general science and biology curricula. However, as biology became more established as a standard course in secondary education these goals were less recognised in the curriculum of the 1950s. In most schools in the United Kingdom and the United States of America the biology textbook was used extensively and little or no laboratory work was done. The biology curriculum of the late 1950s was based on textbooks that presented biology as a body of information. This situation encouraged rote memorisation of a mass of facts and encouraged generalisations.

The launching of a satellite into space by the Soviets in 1957 was perceived, in other developed countries, as an indication of superiority in science and technology. The need for more scientists and technologists to increase growth in science knowledge and appropriate technologies inspired developments in science. This prompted major funding in the United States of America to support basic research in science and to improve science education. The National Science Foundation (NSF) and various other education projects supported by the Department of

Education and the National Institute of Education developed new curriculum programmes and materials for science education. The combination of the knowledge explosion in science and developments in learning theory also provided a stimulus for change. New science curricula were developed by teams of science experts and educators. Therefore, the years 1956 to 1975 became the golden years of science curricula innovations and reform in the United States of America.

In the case of biology education, the Biological Sciences Curriculum Study (BSCS) formed by the American Institute of Biological Sciences in 1959, was the most successful effort of all the national science curriculum efforts (Yager 1982a: 329). The BSCS biology materials were developed, field tested in schools and then disseminated. Yager (1982a: 329) maintains that over one-half of biology classrooms in the United States used the BSCS materials. The emphasis of the biology curriculum projects developed during this period was on both the structure of the biology discipline as well as the inquiry or scientific processes. The textbook provided activities for use in the classroom, worksheets for laboratory use, teaching strategies and directions for laboratory preparation for teachers as well as chapter examinations. The overemphasis on using textbooks encouraged more funds for in-service training or workshops to assist teachers in implementing these curriculum programmes.

The lack of change in classroom practice which was expected through the use of these new curriculum materials attracted criticisms regarding the effectiveness of these programmes. As a result, public funds used to support science curriculum development projects were reduced. This decline in support for further curriculum developments ushered in a period of assessing the impact of science curricula developed during the 1956-1970 period. The three major status studies funded by the NSF, according to Yager (1982a:330-331), were designed as follows:

(a). One study reviewed all the 1955-1975 research literature in the areas of science, mathematics and social studies education.

(b). A second study surveyed teachers, supervisors, administrators, and others to identify their perceptions of the K-12 (kindergarten to 12th grade) programmes in the science, mathematics and social studies education.

(c). The third study consisted of eleven case studies of school systems representing different sizes, emphases and geographic areas.

The crisis in science education exposed by these status studies was characterised by the narrow focus on academic preparation and the overemphasis on textbooks as the only means of presenting science. For instance, the results of the above-mentioned studies in biology revealed that nearly 90 percent of teachers used a textbook, page by page, 90 percent of the time (Yager 1992:906). Biology knowledge in textbooks excluded personal needs of students, current social issues and career goals. These studies also revealed that the teaching strategy was controlled by the textbook. The teachers tended to emphasise the textbook information with corresponding emphasis on terminology and definitions. The stated goal in textbooks, that is, teaching science as inquiry was rarely observed. When laboratories were used, the tendency was to demonstrate information already presented. Lastly, the curriculum projects of the period 1955-1975 were determined and written by scientists and curriculum developers and not by teachers.

The results from the three National Science Foundation (NSF) studies, discussed above, and the information gathered from the National Assessment of Education Progress (NAEP 1979) was later analysed and synthesised into Project Synthesis (Harms 1977). This project identified the major challenge for successful reform in curriculum development as that of redefining the fundamental goals for science education. Project Synthesis suggested four goals for a school science curriculum: science for meeting personal needs; science for resolving current social issues; science for assisting with career needs; and science for preparing for further study (Yager 1992:908). These goals not only serve to represent four distinct justifications for science in the school curriculum, but also provide a basis for evaluating a science curriculum.

The goals of science education discussed above have served to emphasise the need for change in science education. The direction for change suggested is that of emphasising the relationship of science, technology and society as the organisational core of the curriculum. This new direction could assist in giving science a context at a time when all countries depend on science and technology for advancement. Most countries are also experiencing global problems associated with science and technology.

To some extent, curriculum developments originating from the United States also created an atmosphere of change in the United Kingdom. In the United Kingdom the policy statements entitled *Science and Education* which appeared in 1957 and 1961 had a major influence on school science curricula. The aims of the *Science and Education* policy statements, namely, the understanding of principles in science and the discovery approach to practical work should be reflected in all science projects. While the discovery approach was good in emphasising active learning, Millar and Driver (1987:56) are critical of science educators who perceived this approach as the aim of science instruction. Millar and Driver believe that the challenge of science education is to develop a deeper understanding of the concepts and the purpose of science through using the discovery learning approach.

The Nuffield biology, chemistry and physics O-level were the first projects which appeared in the 1960s in Britain. In addition to learning materials, special examination papers based on specified objectives of the three Nuffield courses were introduced in schools. Miller (1986) believes that the most influential curricula in the United States were: the Biological Sciences Curriculum Study (BSCS), the Physical Sciences Study Committee (PSSC), the Chemical Bond Approach Project (CBA) and the Chemical Educational Materials Study (CHEMS).

The increase in the number of comprehensive schools in England and Wales, and classes of mixed ability children led to the development of combined science courses. The Nuffield Combined Science materials for the 11-13 age group and the Nuffield Secondary Science designed for 13-16 year olds were both published in 1970. Combined science was a response to an awareness of the need for a common course embracing all the sciences to show their interrelatedness.

The Association for Science Education (ASE) policy statement "Science and General Education" issued in 1971 took into account the increased complexity of school organisation and the growing use of mixed-ability classes. The statement argued that science teaching should "illustrate the effect of science on modern life and social organisation... Teachers choosing course materials should remember the children's needs, the relevance and social implications of topics" (Uzzell 1986:161). Various reports and publications by the ASE during this period arose partly from attempts to combat the worsening image of science. Therefore, a change can be seen in emphasis of the science projects towards integrated science with increasing reference to social and technological problems.

The School Council Integrated Science Project (SCIS) published in 1973 was among the first projects designed to relate to pupils' needs. It combined biology, chemistry, physics as well as earth and social sciences. The intended group for the project was the 13-16 age group. There is considerable emphasis on 'relevance' in the context of application of science and technology and also the importance of science in society.

The trends in science curriculum development in the United States of America and the United Kingdom show similarities in many respects. The need for more scientists and technologists was the hallmark of the developments of science curricula in the 1960s in both countries. The narrow focus on academic science, the overemphasis of textbooks with little or no laboratory work done and the low relevancy of school science to personal, societal and career goals have been major problems of all curriculum projects developed in both these countries in 1960s and 1970s. Consequently, the need emphasised in the 1980s is that of scientifically and technologically educated citizens.

When some developing countries gained political independence from their colonial masters, most of the science curriculum materials developed during the 1960s and 1970s were exported to these countries. Unfortunately the exportation of these materials was done with little regard for the different sociopolitical and educational needs of those countries (Fensham 1988:2). For example, the BSCS from the United States and the Nuffield biology, chemistry and physics were used in developing countries with little or no changes in countries like Nigeria, Kenya, Botswana and others. Consequently, the aims of science education, the approaches to teaching and learning science and the syllabuses that were used in developing countries closely resembled those used in developed countries. For example, the West Indian Science Curriculum Innovation Project (WISCIP), as a clone of the Scottish Integrated Science materials and thus had identical aims and objectives and very little modification (Jegede 1988:400). In general, these syllabuses were predominantly academic, descriptive and knowledge-based with the main aim of preparing pupils for further studies in science (Lewin 1990:2).

Developing countries later entered a phase of adapting imported syllabuses when the implementation of unaltered foreign syllabuses became unsatisfactory. This was done by producing locally written textbooks which included local examples to illustrate science principles in the syllabus. However, the syllabuses still focused on basic principles of science, good thinking skills and the discovery approach emphasised in the curricula of the developed countries. Therefore, the locally written textbooks did not consider the relevance of science content to the needs of the country, the limited resources available, the cultural beliefs and customs that pupils bring to class (Knamiller 1984, Ogawa 1986, Twoli and Power 1989). The preparation teachers had in order to teach effectively was also neglected. The fact that these science curriculum programmes were not produced to fulfil specific aims or functions, and to suit particular circumstances of the developing countries, allowed learning to involve rote memorisation of strange concepts and processes which were rarely applied to the pressing problems of the pupils' environment.

4.2.3 **Biology Curriculum in the 1990s**

From the discussion above, it is apparent that the crisis in science education has now been experienced in both developed and developing countries. Many science educators acknowledge a need for change in the 1990s. The four goals suggested by Project Synthesis have become the starting point for seeking solutions for the current crisis in science education in the United States and elsewhere. The new direction suggested by these goals is toward the Science-Technology-Society (STS) movement discussed in Chapter 3. The major thrust of the STS movement is the presentation of school science knowledge, skills and understanding in a personal/social context (Bybee 1987a:679).

Discussion papers and research aimed at developing justification for the position of STS in science education have served to establish STS as a discipline. Some of the leading science educators who have published position papers and research projects on STS education in the United States of America include Bybee (1977, 1987b); Hurd *et al*, (1980); Hurd (1980, 1982); Yager (1981, 1982, 1986, 1992); Bybee and Kahle (1982); Hickman and Kahle (1982); Rosenthal (1984, 1985, 1988) and Roy (1985). Science educators that have taken the lead in arguing for the inclusion of STS in the science curriculum in the United Kingdom include Ravetz (1971, 1977); Lewis (1981); Layton (1986); Collins and Bodmer (1986) and Solomon (1987, 1988a, 1988b). Their influence in the United States of America and the United kingdom has resulted in the following effects.

(a) A generally recognised Science-Technology-Society movement that has stimulated debate in many countries including South Africa.

(b) Increasing awareness among teachers, through conferences and publications, about a new curriculum emphasis which addresses the relationship between science, technology and society.

(c) Undertaking research on the identification of global problems, such as hunger, population growth, health, air quality and other problems which affect life of the people in many countries. Research has also been focused on investigating the amount of STS issues in biology textbooks used in schools.

(d) Production of curriculum materials to enrich science courses which are currently offered in schools. Most of these materials have been aimed at enriching the science experience of young people in the age range of 14-16 years and 16-19 years. The curriculum units are generally short and provide a basis for the discussion of the issues arising from the beneficial and harmful aspects of the applications of science and technology (Hunt, 1988:409). Examples of curriculum projects of this kind in the United Kingdom are the Science in Society, Science and Technology in Society (SATIS) and the Science In a Social CONtext (SISCON).

Some of the current curriculum reform projects in the United States of America are the Project 2061, SS&C and STS.

The achievements discussed above have stimulated debate, research and attempts in curriculum development in many countries. However, there is agreement among science educators in the United States of America and in the United Kingdom that the STS movement has not yet succeeded in other areas. According to Waks and Barchi (1992: 82-83) there are three important areas where more work is needed in order to take the STS movement forward.

(a) Institutionalising STS instruction throughout the school system. Instruction in STS issues has so far been adopted by a small group of teachers and schools in order to enrich their compulsory science courses. This means that STS instruction has not infiltrated science education but it is still an 'add-on'.

(b) Developing an accepted curriculum model or framework that will guide the development of curriculum materials and the instructional approach to be taken in science classrooms.

(c) Generating guidelines for pre-service and in-service teacher education programmes. Preparation of teachers so that they acquire understanding of STS issues and how STS relates to other subjects.

Although there are still major areas to be worked at, it can be concluded from the above discussion that curriculum reform which encompasses STS issues represents a significant departure from the content-oriented science curriculum currently used in schools.

The STS movement has also marked a shift in the direction of science education which has influenced many developing countries. In these countries, the movement will provide a link between school science and the realities of life for the majority of pupils who will not be scientists. For example, the new Integrated Science syllabus for junior secondary schools in Botswana has already tried to address national interests and contemporary needs by topics such as: water for living, solar technology, and others (Nganunu, 1988:443).

Many developing countries such as Nigeria, inspired by the Science in Society and the SISCON courses from the United Kingdom, have started curriculum courses. In other countries a need for reform in science education is recognised and there is awareness among policy makers, industrialists, educators and others about STS issues and STS education.

4.3 BIOLOGY CURRICULUM IN AFRICAN SECONDARY SCHOOLS

In South Africa, science curriculum development has been less vigorous than in other countries. The policy of apartheid and the tight control exerted by the government on all aspects of education, is partly responsible for the lack of initiatives in curriculum development. Even the few local and regional initiatives started by non-governmental organisations have not influenced education nationally because of restrictions imposed by the numerous departments of education in this country.

Decisions on curriculum development or changes in the school curriculum are the responsibility of the central government as discussed in Chapter 2. The planned programme of teaching biology in African schools is set in the syllabuses produced by the Department of Education and Training. Each syllabus contains aims and objectives, the selected biology content and the number of school time-table periods to be devoted to each unit of biology content, the instructional approach and the information about the structure of the evaluation instrument at the end of each year.

Biology syllabuses which are currently used in African schools have been criticised for the following shortcomings:

(a) The aims of biology education are characterised by the outmoded view of science as an objective and value-free enterprise. The aims also emphasise the scientific method as the only method of arriving at scientific knowledge.

(b) The preamble to the syllabus listing the objectives and the approach to be followed is too brief. As an integral part of the syllabus a substantial elaboration on the objectives and the approach should have been embarked upon instead of just a single page.

(c) There is heavy emphasis on content details - fourteen pages as opposed to one page occupied by objectives.

(d) They are too prescriptive with respect to content details and the time to be spent on the prescribed content. For example, practical work is clearly cited and examples of organisms for observation are specified. This leaves no room for the teachers to be creative.

(e) Omission of important societal problems and issues such as AIDS, squatters, and other environmental problems.

(f) The examination system emphasises recall of factual knowledge while neglecting practical work and application of biology principles to real-life situations.

It can be seen that the main emphasis of prescribed syllabuses is the study of fundamental biological principles. It also appears that the production of syllabuses does not go hand in hand with other activities that are involved in curriculum development. For example, aspects like the provision of adequate physical resources and the development of educational materials or textbooks in schools are not planned by the same curriculum development committee. In addition, appropriate teacher education programmes, pre-service and in-service, for effective implementation of the syllabus are not given priority. Finally, changes in the curriculum are not supported by any research before these changes are implemented in schools. For example, the current biology syllabuses which were analysed in this study were revised and implemented without any research information on the relevance of the curriculum, the competence of teachers and the adequacy of the necessary physical resources.

4.4 THE NEED FOR CHANGE IN BIOLOGY EDUCATION

The increasing pressure for reform in education, especially African education in South Africa, has come mainly from the private sector, teachers, educationists, the African pupils and the African communities. According to Hartshorne (1985:148) the private business sector has been critical of the so-called 'academic' nature of schooling and its failure to prepare young people adequately for the modern technological world. In addition, the failure of the African education systems to provide the additional skilled manpower required for the maintenance and growth of the economy has also been criticised by the De Lange Report (HSRC 1981a) and Pouris (1989).

The retention and relevance of pluralistic education systems has been questioned by most South Africans, particularly by the African communities, who were no longer prepared to accept "inferior, segregated, discriminatory education systems being imposed upon them" (Hartshorne 1985:148). The schools unrest which started in Soweto on 16 June 1976 and spread across the country, has continued to be the most powerful challenge to African education systems. The outcry, then and now, demanded attention to be focused on the enormous inequalities suffered by the disadvantaged section of the South African society.

The vital recommendations with regard to the teaching of natural sciences and mathematics proposed by the De Lange Report in 1981, emphasised the need for reform in science education. Recommendations concerning the syllabuses for biology, physical science and mathematics are as follows (HSRC 1981b:88):

(a) The presentation of the concepts contained within the syllabuses for each phase of these subjects should be within the level of comprehension of the pupils concerned.

(b) The syllabuses should constantly emphasise the relationship between **science, technology and society.**

(c) The syllabuses should be short enough to allow adequate time for relevant practical experiments. To achieve this, consideration should be given to structuring syllabuses on a "core-plus-options" pattern.

(d) The syllabuses prescribed for a subject at various levels in schools and at universities and other places of post-school tuition should be carefully co-ordinated so that each successive course provides a development, rather than an unnecessary repetition of material contained in preceding courses. Syllabuses in various subjects should be well co-ordinated and integrated.

As far as curriculum development is concerned, the above cited committee recommended several procedures to be adopted for natural science and mathematics education in South Africa. As a first step in curriculum development, the committee recommended that:

> the overall aim, purpose and philosophy of a particular syllabus should be discussed at some length. The principal relevant characteristics of the target population of pupils for whom the syllabus is intended should also be identified. A much wider spectrum of people should be involved in the discussion than those who have been involved in syllabus revision in the past. The preliminary discussions will serve to identify clearly the aims of the syllabus and the criteria for the selection of content. (HSRC 1981b:94).

The need for change in biology education has also been highlighted by numerous societal problems and issues which require appropriate education for their solution. The South African public has, for the past three years, been increasingly aware of environmental problems through the mass media, that is, radio, television and newspapers. Social problems such as pollution, health and diseases, conservation, drug abuse, teenage pregnancy and land issues have dominated the media.

In Natal, contamination of water (rain, sea and rivers) by hormone herbicides has dominated the press since 1988. The hormone herbicide 2.4-D, a defoliant widely used by the forestry and sugar industries to control weeds, was found in 47% of the 117 rain samples collected at Mount Edgecombe (Natal) from August 1988 to March 1989 (Sunday Tribune, August 27, 1989). The article further stated that a report compiled by a monitoring team of the Department of Agriculture maintains that no place in Natal was free from contamination. The following figures were given:

TABLE 4.1 RAIN WATER CONTAMINATION IN NATAL

PLACE	RAIN WATER (%)
Felixton, near Richards Bay	89%
Umgababa, South Coast	50%
Nkwalini Valley, near Melmoth	100%
Pongola, North Coast	100%

SOURCE: Sunday Tribune, 27 August, 1989

Fears of water pollution in the Umgeni River catchment area which flows into the Inanda Dam have been expressed by Earthlife Natal, an environmental issues organisation (Sunday Tribune, August 27, 1989). These fears emerged from a discovery of approximately 3000 barrels of toxic waste buried a mere 150 metres from a borehole point and directly above the Umgeni River catchment area. The issue here is that biology education, at present, does not emphasise the effects of pollution on health and the action that can be taken to resolve it.

The high levels of toxin pesticide DDT and of polychlorinated biphenols (PCBs), the toxic product used in the manufacture of electric motors and neon lights, has been found to be a factor for the fatality rate of rare dolphins along the Natal coast (Weekly Mail, 21-27 Sept, 1990). The awareness of pollution in Natal has also been increased by an attempt to prevent the use of hormone herbicide formulations as weed killers made by the vegetable and fruit farmers in the area. The farmers claim that herbicide spray droplets travel in the air and are "scrubbed" out by rain resulting in crops being damaged, deformed or of inferior quality (Sunday Tribune, April 16, 1989).

In addition to the effect of herbicides on animals and crops, there is an increasing awareness and fear that these chemicals that people inhale on a daily basis may cause long-term health problems for a large percentage of the population in South Africa. Vomiting, fainting and sore chest are some of the problems experienced by inhabitants of an African settlement on the outskirts of Pietermaritzburg where toxic waste containing large quantities of lead were found (Sunday Tribune, July 23, 1989).

The levels of air pollution in areas such as Richards Bay (Natal), the Eastern Transvaal Highveld and the Vaal Triangle (Transvaal) is causing concern among residents in those areas and leaders in the field of health and environment. Reports indicate an increase in health problems of the upper respiratory area, including asthma and sinusitis, headaches and nausea, skin irritation, sore and itchy eyes, especially among children and older people (Sunday Tribune, June 18, 1989). Health related topics within the present biology curriculum are not included in the existing curriculum. Yet, the boundaries of health have expanded beyond the absence of disease model. Emerging trends conceptualise health as the ability to respond adaptively to environmental challenges, the capacity to realise personal goals and aspirations and to perform social roles (Garrard 1986:4).

TABLE 4.2 BIOLOGY THEMES AND RELATED PROBLEMS/ISSUES IN STANDARD 8-10 SYLLABUSES IN AFRICAN SCHOOLS

BIOLOGY SYLLABUS: MAIN SUBDIVISIONS	RELATED CURRENT PROBLEMS OR ISSUES IN AFRICAN SOCIETY
Food, Nutrition, Anatomy and Physiology of man	Hunger, Balanced diet, Health and Diseases.
Human reproduction	Teenage pregnancy, AIDS, Sex-abuse, Test-tube babies
Nervous and chemical co-ordination, Transport	Alcohol abuse, Health problem, Drug dependency
Ecology, Population dynamics	Conservation, Pollution, Health and Diseases, Over-Population.

Source: Adapted from Stoneman (1974: 272)

The description of some of the problems and issues confronting South Africans at present, is an attempt to reveal the serious nature of societal problems around us. Without exception, the societal problems discussed above are related to humans and to the quality of life. Biology, as a science of life, ought to play a role in assisting citizens to improve their quality of life and to inform them regarding decision-making about biology-related social issues and policies. Yet, if we look at the current biology syllabuses used by African pupils at standards 8 to 10, current social problems are not included in the syllabuses although biology topics/themes which can form a base for discussing these problems form part of the subject matter. Table 4.2 shows how the current problems facing the African community are related to the main subdivisions from standards 8 to 10 syllabuses. The evidence presented here, as well as the recommendations from the De Lange Report (HSRC 1981a), indicate that there is a need for a new orientation in biology curriculum.

4.5 CONCLUSION

This chapter has discussed how societal pressures were responsible for the introduction of biology as a subject in the school curriculum. Two points have emerged. Firstly, biology represents the first science course in the secondary school curriculum to be planned for the majority of students (Hurd

1980). Secondly, the calls to make biology relevant to the needs of the students were made as early as the 1920s but such a practical biology course has not been produced yet.

Until the late 1950s biology curricula were based on textbooks that represented science as a body of factual knowledge. Memorisation of biological facts and generalisations were major methods of learning and teaching. In the 1960s events in society, a knowledge explosion in science, and developments in learning theory combined to provide a stimulus for change. New curricula for use by classroom teachers were developed by teams of scientists and educators. The emphasis in the new curricula was on scientific processes and the nature of inquiry. Despite the curriculum development efforts of the 1960s and early 1970s, evidence from research studies indicate that little or no classroom practice actually changed as a result of exposure to these quality curriculum materials.

In the case of South Africa, curriculum development of the scale and level found in the United States and the United Kingdom is unknown. Evidence from the De Lange Report (HSRC 1981b) indicates that an overemphasis on the use of biology textbooks was the only means of presenting biology. The goals of teaching natural science in secondary schools have been criticised for their narrow focus on academic preparation that excludes personal, societal and career goals. Another important recommendation made by the De Lange Report was that a wider spectrum of people should be involved in the discussion of syllabus revision so as to "identify clearly the aims of the syllabus and the criteria for the selection of content" (HSRC 1981b:94).

A careful look at societal problems reported in the media reveals the following: health and diseases, famine, pollution, drug addiction, over-population, conservation and unemployment. Most of these problems are either directly or indirectly biology-related. It seems reasonable, therefore, to expect biology education to furnish students with appropriate biological knowledge to resolve these real-life problems and issues. Arguing about educational perspectives and curriculum imperatives for the teaching of biology in the 1980s and beyond Hurd (1980:7) made the following suggestions:

(a) that a pre-college biology course ought to be a preparation for planning a good life and conducting it properly, and

(b) the curriculum focus should be on providing access to knowledge and how to use it.

It appears that the reform process in science education, particularly in biology education, should be concerned with a re-assessment of goals, content selection based on perceived needs, and it should be collaborative and community-based.

CHAPTER 5

BIOLOGY CURRICULUM IN CONTEXT

5.1 INTRODUCTION

The analysis of the present state of biology education in Chapte 4 revealed numerous problems in the teaching and learning o biology at African schools in South Africa. Some of th problems arise from the purpose or goal of biology educatic which does not match the needs and aspirations of the Africa community and of the country as a whole. The current biolog curriculum tends to neglect the personal, social and career goal of African pupils. This neglect gives rise to questions abou the relevance of biology education. Evidence of the lack (relevance in science education, in general, has been revealed l the chronic shortage of scientifically and technological skilled manpower. Pouris (1989:4) argues that the crisis science education is also worsened by the large proportion (million) of South Africans of all races who are scientifical illiterate. The implication of this crisis is that there is need to reconstruct a biology curriculum which will relate personal, societal and career goals of African students in Sou Africa.

There is ample evidence, in Chapters 3 and 4, that the biolc curriculum offered in African schools has laid too much emphas on the 'products' of biology, that is, its laws, theories a knowledge, at the expense of 'processes' and 'context'. T redress this imbalance, an alternative approach to curriculu development is needed. The aim of this chapter is to investigat an alternative approach to curriculum development which present a balance between content, process and context of biolog education. Such an alternative approach is important because th central argument in this study is that biology education mus not only cultivate future scientists but also citizens who wil be well-informed and critically aware of the scientific activit and its implications in their lives.

It is also important for this study to search for alternati approaches which can help to answer the following question What principles should guide curriculum developers in selecti biology content for schools? What role should teachers play the curriculum process? These questions are important providing information about selection criteria that could be us in choosing biology content which could be relevant for t African community in South Africa, especially in the north coa region of Natal. Knowledge of the role that teachers play the curriculum process can assist in assessing the amount input they should give.

5.2 AN ALTERNATIVE APPROACH TO CURRICULUM DEVELOPMENT

A careful review at much of the literature on curricul development reveals an agreement on the fact that the curricul should be concerned with preparing the young for the society ir which they live. This preparation is done by providing knowledge and experiences that are considered worthwhile in that they enable learners to improve their quality of life (Moodley 1974:42; Steinhouse 1975:6; Schubert 1986:99). In addition Handler (1982:185) concurs with this view when he states that th curriculum is shaped by the culture of the society in which i operates because it is affected by its embedded social values social needs and social problems. It is therefore the view c this study that reform in the school biology curriculum shoul also address valued goals, social needs and social problems c Africans in South Africa.

The process of curriculum reform is complex and it involv numerous activities. These activities include formulation goals and objectives, developing teaching material instructional approaches and assessment instruments. The proce of reform should be viewed as a whole and should not emphasi some activities at the expense of others. For instanc curriculum development in this country has emphasised changes the content presented in syllabuses. The reform of the curre biology curriculum for African schools which is suggested in tl research study may, therefore, need to involve the following:

(a) Formulating goals and objectives of biology educat: that have a balance between process, content ; context, that is, goals and objectives should a focus on STS issues which impact on the lives of Africans as discussed in Chapter 4.

(b) Developing teaching content which, in addition to the structure of biology knowledge and the process of science, attends to problems of technology and the environment in the South African situation.

(c) Developing appropriate instructional approaches through which the above mentioned goals and objectives can be achieved.

(d) Developing appropriate assessment instruments which can assess where students are in relation to their growth as well as in relation to the goals and objectives of biology education.

(e) Generating guidelines for appropriate pre-service and in-service teacher education programmes so that teachers are able to effectively implement the biology curriculum which has an STS component.

In order to reconstruct the biology curriculum which has an STS component there will be a need to change from the traditional 'content' and 'process' approaches which have dominated curriculum development from the 1960s to date (see Chapter 4). The view that science teaching is the transmission of objective knowledge and that learning is the uncritical absorption of knowledge emphasised by the 'content' approach will need to be revised. A 'content' or knowledge-centred curriculum is underpinned by theories of knowledge. Typical of such theories is the argument that curriculum content should be formed around the concept of 'worthwhile activities' which were classified by Hirst in 1965 (Grundy 1987:34). These 'worthwhile activities' can be identified and categorised into certain 'forms of knowledge' based on four criteria as follows (Grundy 1987:34):

(a) the characteristic basic concepts,

(b) the characteristic structures by which these concepts are related,

(c) the characteristic ways in which knowledge statements are tested, and

(d) the characteristic techniques and skills for exploring experience and generating knowledge.

The above criteria which underlie the knowledge-centred approac to curriculum development, have encouraged rote memorisation (biology facts, concepts and principles. Millar and Drive (1987:37) have criticised the knowledge-oriented curriculum f encouraging teachers to 'transmit' and pupils to 'absorl knowledge. The presentation of scientific knowledge which divorced from context, is also criticised for failing to produ individuals who have a better grasp of the realities of life scientific and technologically oriented urban or rural areas South Africa.

Similarly, the 'process' approach which emphasises the teachi of scientific methods, processes, skills and attitudes associat with the way scientists work, has not been successful in creati an interest in and a better understanding of science. There is also little evidence, in Chapters 3 and 4, that inquiry teaching is practised in biology classrooms. As a result, in most biolog classes the major goal of teaching biology is still seen as th acquisition of knowledge. It is also widely accepted that th assumption underlying the 'process' approach that natural scienc is 'pure' and separate from all involvement with society an technology, is an illusion (Ravetz 1971:1). The effect c scientific purism has been criticised for limiting the range c scientific methods through which pupils become aware of hc scientific theories are tested and established (Wenham 1992:551) In addition, the significant feedback of ideas and informati from technology or 'applied' science to 'pure' science has n been emphasised in science education. Consequently, technolo and science are viewed as two separate activities which ha little connection with society.

If science education is to be relevant not only for those pupi who will use scientific knowledge and skills in their work, b also for those pupils whose lives will be significantly affect by scientific activity, then a balance is needed. A balar between content, process and context in science educatic particularly in biology education, needs to developed so that a pupils can benefit from science instruction.

An alternative approach which tends to represent this balai and underlies the current reform initiatives in sciei education, is the notion that knowledge is socially determined or constructed. The constructivist approach to curriculum development does not view the curriculum as a body of knowledge or skills to be transmitted. The curriculum is viewed as a series of learning tasks and strategies, materials and resources from which students construct their knowledge (Driver 1988:138). According to Benson (1989:330) the constructivists' perspective supports three arguments concerning knowledge creation and learning:

(a) humans do not passively encounter knowledge, but they are actively engaged in the process of constructing meaning and understanding of the world;

(b) knowledge of the world is actively constructed by an individual in a way that is coherent and relevant to that person; and

(c) knowledge is socially constructed and the context in which knowledge is created influences what is considered to be knowledge.

Constructivism as described above suggests that scientific knowledge and practice, like all knowledge, is a human construction. This view, therefore, tends to reject the idea that science knowledge is objective. It also rejects the assumption that empirical methods used to obtain science knowledge can be undertaken objectively without reference to an observer's way of seeing the world (Driver 1988:137). Indeed children learn new concepts through making continual reference their current knowledge and relating it to their experiences. Driver (1988:137) further asserts that making and testing theories is a dynamic human enterprise which takes place within the socially defined community and institutions of science. Commenting on the human character of science, Cheung and Taylor (1991) concur when they write:

> The objective, value-free character of science or other fields of knowledge creation was only a positivist's myth sustained by ignoring the myriads of subjective and value-based decisions that everyone involved in knowledge production must make. It is this constructive integration of thinking, feeling and acting that gives a distinctively human character to knowledge production. (Cheung and Taylor 1991:33)

The point made in the above quotation is that the influence of society on science, scientific research and scientific development must be acknowledged and incorporated during curriculum development. This social character of science shows us that observation, interpretation, and all the other science processes used in producing scientific knowledge, are influenced substantially by the existing knowledge, beliefs, values and attitudes that people hold. In addition, the purpose and content of the science curriculum should be considered in terms of what conceptions are of use to students outside the classroom.

One implication of constructivism is that learning depends on the context in which it occurs. Teaching children requires careful considerations of the social and cultural influences on their learning. The society oriented view of education provides a biology curriculum with a context which help pupils understand that biology is not divorced from real life both on the personal and societal level.

In the United Kingdom and the United States of America, curriculum projects which reflect the technology and society centred approach include the Science Society, Science and Technology in Society (SATIS), Science Technology Society, Science in a Social CONtext (SISCON) and others. However, these projects have not yet been adopted in every science classroom. In South Africa, the society-centred perspective has not yet been adopted or incorporated in the development of the biology curriculum. However, calls for a 'Science for All' curriculum have been made and many debates are taking place about how a Science and Technology Policy may be developed.

Each of the three approaches discussed above, that is, knowledge, process and context, have a significant contribution to make in curriculum development. However, none of these approaches can each be used as a complete justification for developing a biology curriculum to address the overemphasis of the teaching of biology theory in the present South African education system. In other words, the biology curriculum needs to be revamped. If the three approaches are combined, the society-centred perspective will provide a context for cognitive development of students and for the acquisition of knowledge in a biology curriculum. After all, schools should be concerned with preparing the young to cope with the situations they will encounter as adults.

Sjoberg and Imsen (1988:239) have highlighted the significance of context in curriculum development when they state that empirical evidence suggests that a lack of context may also be perceived as a particular context by pupils. Consequently, science will then be understood as something remote from real life both on the personal and the societal level. Following the discussion in Chapter 4, the understanding of biology as something unrelated to real life should not be encouraged considering the immense problems surrounding health issues and the pollution of the environment in South Africa.

5.3 SELECTION OF CURRICULAR CONTENT

In designing curricula, curriculum developers are always faced with the difficult problem of deciding which knowledge or subject topics to include in the curriculum and which to leave out. The decision on what content to include in the curriculum is based on the purpose or the goals of education. These decisions on curriculum development are also informed by the approach which should be adopted in designing a curriculum which will meet the needs and aspirations of individual learners and societal needs.

Traditionally, content has been treated as knowledge or subject matter to be acquired. Curricular content was, therefore, viewed as subject matter derived from the disciplines of knowledge. The criterion for selecting curricular content was the presentation of content in a form that would enable pupils to comprehend the structure of the discipline (Schubert 1986:218).

Knowledge-centred biology curricula has been met with general approval and reinforced by Schwab's (1964) ideas on the process of selecting curricular content. According to his views, the curriculum developer has to identify what he calls the 'structure of discipline' and then use it for selecting the curriculum content. Schwab (1964) views the 'structure of discipline' as covering three areas:

(a) accumulated knowledge in the discipline,

(b) a set of basic concepts used to describe a variety of phenomena within the boundaries of a discipline, and

(c) a set of basic methods of inquiry unique to the discipline and the rules used within the framework of the discipline.

The structural elements described above have been applied extensively in selecting content for biology curricula in the 1960s, for example, the Biological Sciences Curriculum Study (BSCS), and the biology curriculum currently offered in African schools. However, these criteria have been criticised for limiting content to the discipline of knowledge alone. The present study also does not adopt this position. The position assumes that personal experiences and activities of pupils, both in and out of school, do not influence what they learn in school

The contemporary position which views curriculum as learning activities and learning experiences as indicated in the previous section, views curricular content as a psychological construct in contrast to the subject matter to be learned (Schubert 1986:216). This position suggests that the structure of the discipline should not be the only criterion on which the selection of curricular content should be based. Schubert (1986: 217-223) has suggested the following eight criteria for selecting content societal needs, test of survival, structure of the discipline utility, political pressure, learner interest, democratic action and publisher decision.

The criteria described above have relevance to this researc study because this study advocates a biology curriculum whic addresses the needs and interests of pupils and society. Th biosocial issues which are suggested for incorporation into th curriculum by this research study, constitute necessary an useful information for better living and for making meaningfu decisions. The above selection criteria also show a balanc between content, process and context. This research study doe not, however, support selection criteria such as politica pressure and publisher decision. First, political pressure ha been used to control the current curriculum offered in Africa schools in such a way that the needs of the African people hav been ignored. While it is acknowledged that political pressur cannot be totally avoided, politicians should seek advice fro African educators who are in a better position to identify a appropriate curriculum content. Secondly, publisher decision or what should be taught excludes decisions from parents, teachers, private sector and others regarding what is best for the growth of children.

Another set of selection criteria which has relevance for this study has been suggested by Pring (1978). The principles o: content selection suggested by Pring (1978:141-142) also attemp to present a balanced and broad curriculum which include content, process and context:

(a) Social utility - knowledge that provides a necessar basis for surviving in a complex technological society.

(b) Social responsibility - knowledge that assists one t take charge, to be capable of rational conduct in democratic society.

(c) Common culture - preservation of a common background c values and meaning through a shared literary tradition.

(d) Personal satisfaction - subject matter that introduce pupils to activities that give considerable persona satisfaction and, in that sense, increased quality of life

(e) Cognitive concern - activities and knowledge tha extend the powers of the mind, that is, development c knowledge and understanding.

(f) Mental powers - knowledge that increases analytica thinking, ability to pursue an argument, to search fc evidence, to marshal and communicate ideas, to sift tl essential from the unessential.

(g) Parental and social pressure - subjects or knowledge in the curriculum should, in part, reflect parental wishes, that is, parents should have some choice regarding what children are taught.

Criteria which focus on contemporary social issues and the application of biological knowledge to solve those issues are needed, such as the pragmatic criteria presented by Lew (1977:34). These are:

(a) A basis for further education - where preference shoul be given to topics and issues that provide a wide basi and choice for further learning both in school an outside the school.

(b) Relevance to contemporary issues - involves selectin content that is important to society and that can b applicable both within the context of school life an in society.

(c) Cultural heritage - stressing that a curriculum shoul include some aspects of the cultural heritage or value activities of the community.

(d) Opportunity for multiple learning activities - incluc topics which lend themselves to various kinds c classroom and individual activities (multi-senso activities are preferable because they increase th motivation of learners).

It is evident, from the above discussion, that there are many principles that may be applied in the selection of curriculum content and thus any selection must be a compromise. Obviously, there is no single criterion for deciding on the content of school subjects, including biology. Different curriculum teams will use different criteria. In addition, there are many people who have a legitimate stake in choosing the content of school subjects such as subject associations, parents, teachers, employers, industrial organisations and the school pupils themselves. Therefore, decisions about what content should be offered in schools rest on many groups of people and their diverse influences.

However, in practice, there appears to be an overlap in the selection criteria. The argument presented above indicate that the selection criteria advocated by Schwab (1964); Lewy (1977) Pring (1978) and Schubert (1986) are derived from the needs o learners, societal needs and disciplines of knowledge. It i evident, therefore, that in designing school biology courses selection criteria that satisfy all three elements, that is societal needs, learners' needs and the structure of biology as discipline must be considered. In setting out criteria fc selecting biology content, it is also important to link the aim of science education with criteria. The strong influence of th major aims of science education, that is, knowledge, process ar context, can help cross-reference each of the aims with th criteria in structuring the choice of content.

The above discussion serves to highlight the challenge which will face curriculum developers in reconstructing biology education for South African children. The current position, discussed in Chapter 2, where the biology syllabus committee consisting of educationists and subject experts from predominantly one population group selects curriculum content and activities for African children, is unacceptable. The recognition that existing syllabuses are unsatisfactory has also been supported by the De Lange Report (HSRC 1981b). The report stated that the major problem was in the writing of syllabuses for African schools which is

> based mainly on research done and suggestions made by white education departments...The needs of the other education departments, the lack of facilities, the enormous shortage of qualified teachers and the cultural background of a large group of Black children is not taken into account in the process of syllabus revision (HSRC 1981b:49).

This quotation also serves to underscore other aspects, beside the composition of people who make decisions about the biolog content taught in African schools. The criteria used fo selecting biology content does not include the needs of Africa schools such as the cultural background, the shortage o facilities, the inadequately prepared teachers and the caree needs of pupils. In other words, the biology curriculum offere in African schools have not always reflected the ideals, value and needs of the African community or of the country as a whole Biology education does not attempt to address the needs of th community in the areas of health care, water and sanitation, the lack of nourishing food and many other needs which were referred to in Chapter 4. As a result, biology education is not seen as preparing African pupils for the practical realities of life or being concerned with the real needs of the African community.

The criteria used to select biology content in South Africa has overemphasised the structure of biology as a discipline. Consequently, the curriculum has benefited those pupils who will opt for a career in science while neglecting those pupils who need to benefit from science education in order to cope with society. The relevance of this research study, therefore, can be seen in the attempt to include biosocial issues in the biology curriculum so that African pupils at the senior secondary stage of schooling can also benefit from biology instruction.

In concluding this section, an attempt is made to propose a se of criteria, adapted from the theoretical discussion above, fo selecting curricular content for African schools, viz:

(a) The content should maximise the possibility of teachin the processes, skills and attitudes important t biology, and increase the competence and capability o pupils.

(b) The curriculum should have relevance, applicability an be transferable to a range of contexts e.g environmental, technological, etc. during and afte school.

(c) Biology content must integrate with other curriculum areas such as health education and technological education.

(d) Such curricula must take into account local circumstances, community aspirations and needs.

(e) It must give personal satisfaction, assist students to take charge and appeal to both male and female students.

The proposed set of criteria described above, could assist with the development of biology curriculum that will recognise the tremendous advances in the subject biology and the related technology; take into account the changes in personal, societal and career needs; and acknowledge the interaction between biology, technology and society. In short, the biology curriculum should prepare pupils adequately for adult life in the South African setting. It should increase their level of understanding and achievement in the area of biology, educate them for easy assimilation into the labour market and assist in the development of well integrated persons and useful members of society.

5.4 THE ROLE OF TEACHERS IN CURRICULUM DEVELOPMENT

It was indicated in the above section that the choice of content is not only governed by the suggested principles or criteria, but by many people who have legitimate claims or interests in selecting the content. Different groups of people may generate different lists of criteria. For example, a parent's list might be different from an industrialist's list. Teachers, like other groups in society, also have an interest in the choice of curriculum content. In addition, teachers are directly involved in the implementation of the curriculum. For these reasons, the teacher's role in curriculum development has attracted considerable debate.

Different views have been expressed by Western writers with regard to the role of teachers in the development and implementation of the curriculum. One point of view is that curriculum development requires knowledge and expertise beyond that which teachers have generally acquired (Sieber 1972; Tanner and Tanner 1980). According to this view, the principal role of teachers is that of implementing the curriculum. It is further argued that because teachers have neither the time nor the resources to develop curricula it is best to leave curriculum development in the hands of curriculum developers, teacher educators, university lecturers and educational administrators.

Alternative arguments suggest that the role of teachers is fundamental to curriculum processes in different ways. Some people see the teachers' role as the translation of curriculum materials into learning experiences (Connelly and Ben-Peretz 1980). The reason behind this assertion is that teachers are in the best position for realising the potential of a particular curriculum in their local situation. Indeed, teachers ma crucial decisions about what is to be taught and how it should b taught at the classroom level. This is expressed well by Bayona Carter and Punch (1990) when they write:

> ...whatever Ministers of Education, Directors General or Study Boards might prescribe or recommend, in the final analysis teachers must teach and the real maker of curriculum is the teacher as he/she constructs an operational curriculum appropriate to particular pupils and to a particular classroom situation ...
> (Bayona,Carter and Punch 1990:12)

The activities of teachers such as, interpreting and modifyir syllabuses and curriculum materials, as well as adapting ar implementing curriculum packages at classroom level indicate thē teachers do not implement curricula in an arbitrary manner Research evidence has begun to acknowledge that the success of curriculum in any school system depends heavily on teache involvement in curriculum development (Silberstein and Tami 1986; Martin-Kniep and Uhrmacher 1992). Teacher involvement i curriculum development may generate positive attitudes and sense of ownership of that curriculum. This may result i teachers being more committed to implementing and to effectir changes in the classroom.

Arguments in support of teacher involvement in curricul development revolve around three issues: teachers' knowled about recent developments in the field; teachers' knowledge c the local environment in which the curriculum is implemented; ar the teachers' professional autonomy in making judgement concerning students and classroom situations. These three arguments are presented in greater detail below.

The mass of information that has been accumulated in biology and bio-technology is a powerful force for change. Curriculum planners need to consider the bulk of new information in biology for inclusion in the school curriculum. Since it is impossible to teach all of it, a selection of the content to be taught will have to be made. In order to exercise an effective selection of content, the team of curriculum developers ought to include biology teachers. Teacher participation in curriculum development is critical because teachers are in the best position to select the most relevant curriculum materials. As specialists in their field of biology teaching, they should have knowledge or easy access to knowledge regarding recent developments in biology concepts, theories, principles and research findings. Teachers should also be aware of new teaching methodologies, assessment procedures or the tools in biology education. This extensive input to the curriculum process described above, can only be given by such individuals who are closely linked to the subject matter.

Teachers may also have certain beliefs concerning the importance and relevance of content topics to be taught. These beliefs can influence the overall implementation of the curriculum in that certain topics may be preferred over others. A research study conducted by Cronin-Jones (1991) revealed that science teachers beliefs about the importance of certain biology topics affectec the depth of content presentation and the range of intendec lesson activities during the implementation process. He furthe observed that science teachers' beliefs also differed from th beliefs of curriculum developers in other areas such as th teacher's role in the classroom, the relevance of curriculu content to students' needs, and the underlying philosophy of th intended curriculum. Other studies reported that teachers adap curricula to fit their knowledge, priorities and unique classroo settings as well as their own value systems (Roberts 1982; Smit and Anderson 1984). As a result, implemented curricula may b different from intended curricula. In order to ensure mor congruence between intended and implemented curricula Cronin-Jones (1991:248) advocates that curriculum developers nee to solicit input from a wide range of teachers during all phase of curriculum development.

The teachers' professional autonomy and his knowledge of th local environment are other arguments in favour of th involvement of teachers in the curriculum process. It is argue that teachers have autonomy in making decisions about student choice of objectives, content and instructional strategie Bayona, Carter and Punch (1990:14) observe that no matter h restricted teachers are in curriculum decision-making, behi doors they still do as their judgement dictates. Some reaso that influence decisions made by teachers during t implementation process are: the local conditions in whi teachers have to operate; teacher characteristics such as socia: background, educational level and teaching experience; and th individual differences and needs of students. It follows tha teachers have a better awareness and understanding of local need and aspirations than curriculum experts.

The situation described above where teachers are involved in tł implementation of the curriculum whilst they are excluded in tł development of that curriculum is common in most developir countries, including South Africa. The critical state of scien teaching in South Africa was thoroughly reviewed by the De Lan Report in 1981 (HSRC 1981). One of the problems surrounding t teaching of science, addressed in the De Lange Report, w curriculum development and the subsequent shortcomings in t syllabuses. Numerous papers and discussion documents on scien education which are in agreement with this report, ha criticised the minimal or marginal participation of scien teachers in the curriculum process (Bradley *et al*, 1989; SCI 1989; NEPI 1992).

Although little research has been done on the powerful influer science teachers may have on curriculum development, many scier educators recognise the potential of the role teachers can p in future curriculum development. In South Africa, tl potential has been demonstrated by an independent project star in 1976 in African primary and junior secondary schools, cal the Science Education Project (SEP). This project direc involved African science teachers in both development anc implementation of curriculum materials. Evidence indicates that SEP teachers demonstrated interest and personal satisfaction fo: being included as part of a creative process (Bradley *et al* 1989:20). It is also reported that the teachers who participate in the development of curriculum materials SEP became aware o significant shifts in curriculum emphasis in other parts of th world (Macdonald and Rogan 1990:129). The evidence from bot these projects suggests that science teachers can play a vita role in curriculum development if given the necessary time an support.

5.5 CONCLUSION

This chapter attempted to discuss events involved in developing biology curriculum. Many people can contribute to this exercise Committees appointed by government departments and ministries (education contribute to the formulation of the curriculum polic and in the selection of biology content and methods of teachi that content, normally contained in the syllabus or course gui for each class. Writers and publishers produce textbooks a other materials for students and teachers. Biology teachers, turn, contribute by teaching students the prescribed content.

Of these, the first and the last mentioned, that is, curricul committees and teachers, have been the two areas of focus in th chapter. The argument presented is that the African communi has not been involved in the development of the biolog; curriculum which is used in African schools. Curriculu committees appointed by government departments of educatio: tended to exclude those people who would be best informed abou the needs and aspirations of the African community. It i further argued that the minimal participation of biology teacher in the curriculum process (only in teaching) deprives the whol curriculum process of valuable contribution from teachers African teachers, in particular, could provide valuabl information about the local environment in which the curricul will be implemented, both inside and outside the classroo Through participation in the curriculum development proces teachers in turn, would gain a sense of ownership of t curriculum and will strive to implement it in their classrooms.

The focus of this research project, is to determine the extent which African teachers can identify biology-related social issu that affect the African community in Natal. Part of the da will also reveal those biosocial issues that could be included the biology curriculum at primary and high school level. It hoped that the valuable information about the local environme that can be obtained in this study will indicate that it possible for African teachers to participate in the developme of the curriculum.

CHAPTER 6

DESIGN OF THE STUDY

6.1 INTRODUCTION

When considering research methodology the natural and socia scientists have, for a long time, been in disagreement about th degree of emphasis which should be placed on research theory ar formal methodology when designing a research programme. In thi study an attempt to have an equal balance of theory and metho was maintained. A quantitative research design has been used this study with a view to gathering data to support theori discussed in the previous chapters. A survey research method w chosen for this study because it was considered an appropria method of soliciting opinions regarding biology-related soci problems from a wide section of the population of teachers. is also appropriate gathering factual data about the responder themselves, such as their educational backgrounds, teachi experience and so on. With the factual information and t opinions obtained from respondents, it is hoped that patter will emerge which will show corrections between the data and theory. The study agrees with Kerlinger (1973:153) who poi out that:

> The researcher usually has a choice of research designs, methods of observation, methods of measurement, and types of analysis. All of these must be congruent; they must fit together. Most important, the design, methods of observation, measurement, and

statistical analysis must all be appropriate to the research problem.

The research problem, the identification of the biology-relatec social problems affecting the African community, and the rationale for the selection of the problem has been establishec in the preceding chapters. At this stage, the procedure anc methods used to gather information from the respondents as wel as the analysis of data are discussed. This chapter is divide into two broad sections: firstly, 'The Use of Survey ' in whic the research population and sample, the instrument constructio (which includes pilot work), the questionnaire format, th collection of data and the translation and coding of th questionnaire are discussed; secondly, 'Data Analysis' where th methods of analysing data are presented.

6.2 POPULATION AND SAMPLING

The study area is delimited geographically to the north-coasta region of Natal, stretching from Durban in the south to Ubombo i the north. This region, also called the North Coast Region ha fourteen education areas called inspectorial circuits (see Figur 1.1 on page 12). Inspectorial circuits are geographical area determined by an educational authority for inspection of al schools within that area. There is a total of twenty fiv inspectorial circuits which fall under the KwaZulu Department c Education and Culture. Fourteen of these inspectorial circuit fall within the study area. Due to the differences ir topography, population settlements and the state of the school buildings and facilities, it was decided that all fourteen inspectorial circuits within the study area should be sampled. In addition, colleges of education and universities, which were within the study area, engaged in training African students for teaching in secondary schools, were sampled.

Biology teachers were selected for the study because the problem under investigation relates to biology and the role of teachers in the curriculum process, as discussed in Chapter 4, is crucial. In some specific and appropriate inspectorial circuits two groups of subjects took part in the study: the group of student-teachers who were doing their final year of training at colleges of education and universities; and the group of standards 8, 9 and 10 biology teachers who were visited at fifty four schools by the researcher (see Figure 1.2, page 13).

Final year student-teachers at colleges and universities were selected in this study for two reasons. The first was to assess whether student-teachers from colleges and universities would have different opinions about biology-related issues as compared to biology teachers. The second reason was that since colleges and universities are institutions where students have access to recent and current knowledge in any discipline, the views of student-teachers from these institutions were regarded as valuable for this study. Due to smaller numbers of African students following science careers at colleges and universitie in this country, whole populations of student-teacher specialising in methods of teaching biology at secondary school were sampled.

Biology teachers selected for this study were those teachin standards 8, 9 and 10. These classes form the senior secondar school level. At the end of this level students either procee to tertiary level for further career education or leave schoo for jobs in industry. It was, therefore, important for thi study to select teachers who were engaged in teaching thes students since education at this level forms the basis of futur careers and/or informed decisions that may be taken regardin biology-related social issues within society.

Stratified random sampling of schools was used in order to selec representative schools in three areas: urban, peri-urban an rural. This type of sampling was chosen because a large sectic of the African community stay in peri-urban and rural areas Therefore, a number of schools had been built in these areas Stratified sampling offered three relatively homogeneous strat from which sampling could be done. Generally, four schools i each inspectoral circuit were visited for investigation. In few smaller circuits, three schools were visited. Table 6. indicates the number of schools visited in each circuit.

Random sampling was sometimes made difficult because of the scattered nature of the schools in rural areas and school boycotts or class disruptions in certain schools or circuits. In such cases, because of practical difficulties, the researcher was forced to choose the closest school to the selected one. Two schools, one in the Ubombo circuit and another in the Nongoma circuit, were affected in this way. Access to certain schools was difficult due to sporadic school boycotts which have been a characteristic of an African scholar's life since 1976. In such cases it was dangerous for the researcher to undertake research in affected schools. For example, most schools in the Mpumalanga circuit was being affected by violence and school disruptions at the time data were gathered for this study.

TABLE 6.1 NUMBER OF INSPECTORIAL CIRCUITS AND SCHOOLS VISITED

INSPECTORIAL CIRCUITS	NUMBER OF SCHOOLS IN EACH CIRCUIT	NUMBER OF SCHOOLS SELECTED
1. Umlazi	5	3
2. Umlazi South	8	4
3. Kwamashu	9	4
4. Edendale	10	4
5. Ndwedwe	18	4
6. Maphumulo	16	4
7. Inkanyezi	12	4
8. Mehlesizwe	11	4
9. Enseleni	8	4
10. Hlabisa	10	4
11. Mahlabathini	12	4
12. Nongoma	15	4
13. Ubombo	10	4
14. Nkandla	8	3
TOTAL	152	54

It became necessary to substitute the whole Mpumalanga circuit with the Nongoma circuit even though this circuit does not fall within the geographic north-coastal region of Natal. However this substitution of the Mpumalanga circuit did not adversely affect the design of the study. In a way it helped to increase the balance in the number of rural schools when compared to the urban schools in the study. Finally, the total number of rural schools as against urban schools surveyed in this study were as follows: 49,5 percent were urban schools while 50,5 percent were rural schools.

6.3 <u>THE SURVEY AND NON-SURVEY METHODS</u>

In designing educational research there are various methods that can be used to collect data for purposes of analysis. This research study makes use of two types of methods: a particular survey method using the person-to-person questionnaire technique and another single method using the document analysis technique. Since the scope of this study covers the above-mentioned technique, none of the other methods cited in research literature are used or discussed in this study.

6.3.1 <u>The Survey Method</u>

The survey is seen as a valuable research strategy for providing solutions to existing problems in science education. The potential uses of survey as a strategy of research in science education has been highlighted as a significant way of generating new information which can be used as the basis for future planning and action (Abraham *et al*, 1982; Butts 1983). Butts (1983:189) believes that survey research can provide clearer documentation on the five 'context variables' that describe the science education enterprise: the student, the science teacher, the classroom, the school, and the community. He further cites examples of questions where survey research could provide essential new information on the following two aspects: the primary purpose of science courses and the instructional approach to science.

Survey studies that have yielded important information regarding the extent to which science and technology-related issues are treated in schools have been conducted in the United States of America and the United Kingdom. Information on which aspects of biosocial issues are included in school curricula, what science educators and students think should be taught, and what society thinks its schools should be providing, have been obtained through survey studies conducted by Bybee and Mau (1986), Bybee and Najafi (1986) and Bybee (1987b).

The lack of research studies of this nature in South Africa, particularly studies which canvass the opinion of Africans on science-related educational matters, presented the researcher with a lack of crucial resource material. The use of the survey in this study was important in eliciting the opinions of Africans, particularly teachers, regarding what kind of biology education should be taught. This included two groups of teachers, namely biology teachers and student-teachers. While generalisations from this survey are limited to biology teachers in the north-coastal region of Natal, the territorial orbit of the study, there are implications for biology teaching in the wider South African context. Figure 1.1 (on page 12) indicates the geographical area in which the study was conducted.

6.3.1.1 The Questionnaire

Related to the survey method, the questionnaire, in particular the person-to-person variety, was seen as the core of all the methods that could be used in collecting data in this study. Two types of questionnaires were used in this study: one for the teachers and the other for student-teachers. The variables included in each questionnaire were divided into three parts (see Appendix C.1 and C.2). The first part of the questionnaire dealt with the personal background and educational status of biology teachers and student-teachers. In the second part, the following eleven biology-related issues were listed: food resources, water resources, energy resources, human health and diseases, land use, sex education, pollution, population growth, drug problems, immunisation, and nature conservation. For each of the above, teachers were asked to indicate on a Likert-type scale the following:

* how important the problem/issue was in their lives
* how well they understood each problem/issue
* how well they thought African adults understood each issue

* what sources of information they used for these issues
* the sources of information used by African adults for these issues
* the degree to which they thought schools were teaching these issues
* how will the quality of life be affected if these issues are not taught at school
* the degree to which each issue should be taught at school

The third part of the questionnaire was designed to measure th nature of understanding that biology teachers an student-teachers had about each category of biology-relate social issues. The respondents were required to select what the thought was the best definition of each concept from a list o descriptions given.

In designing the questionnaire, the eleven categories o biology-related problems that teachers had to respond to wer derived from the following three sources. Firstly, categorie were built from an extensive literature review on science an technology problems of a global nature. A careful selection c problems that are prevalent within the South African society wa made from a list of global problems identified by researc studies done by Rosenthal (1985), Bybee and Mau (1986), and Bybe and Najafi (1986). For example, food and energy resources population growth, nature conservation, human health an diseases, and sex education are global problems that wer identified by the above-mentioned studies. Secondly, informa: interviews regarding the most pressing social problems in the African community were conducted amongst students, parents teachers, professional individuals, educators and church leaders Thirdly, a review of South African publications, such as medica: journals, social science journals and health journals, as well a: statements from the media such as daily and weekly newspapers radio and television, were used to design some of the items i: the questionnaire.

The third part of the instrument was adapted from Schaefe (1984). According to Schaefer (1984:3) a concept requirin elaboration has three aspects: its name, its meaning and it associative framework. These three aspects of a concept ar valuable in helping to understand the relationship between wha people know about a concept and what fields of everyday life the associate with the concept. Schaefer (1984:3) believes that th way a concept is translated into behaviour is influenced by person's understanding of the meaning as well as the associativ framework of that concept.

Three approaches for determining the associative framework of concept have been identified as: a Free Association Test, Bound Association Test and the Test of Understanding (Schaefe 1984: 3-4). The difference between the first two above-mentione tests is that in the Free Association Test, the respondent spontaneously write down what comes into their minds when a ke concept or word is mentioned. In the Bound Association Test respondents refer to the concept as well as various aspects displayed around the concept and then write down any associatior that relates the concept to the various aspects. The thirc approach, the Test of Understanding elucidates the nature o: understanding that the respondents have about a concept.

For this study, the Test of Understanding used by Schaefer (1984 9-10) on students' understanding of the concept of health in si countries, was used as a model to construct part three of th research instruments. The main reason for choosing this approac is that it helps to determine what the respondents understan about a concept rather than what they associate it with. Sinc the respondents in this study were teachers, who directl influence children's development of new knowledge as well a children's attitude and behaviour, their understanding c concepts is important. This approach attempts to reveal whethe respondents have a narrow or a broad understanding of concept which relate to other aspects of everyday life.

The third part of the questionnaires, therefore, contained eleve concepts related to the problems investigated in part two (se Appendix C.1 & C.2). For each of the eleven concepts fi statements serving as definitions or explanation of each concep were constructed and respondents were required to choose statement which best described that particular concept. Fc example, the concept "health" had five statements as follows:

* Health is absence of disease
* It can be attained principally by physical-material means e.g.medicine and nutrients
* A balanced existence between people and the natural or man-made physical environments in which they live
* It is the state of complete physical, psychological and social well-being
* Health manifests itself in the ability of a human being to be happy in spite of physical or emotional handicaps.

6.3.1.2 Collection of Data and Coding

The collection of data in the field was achieved through the circulation of questionnaires with closed-ended questions to secondary schools, universities and colleges of education. Permission to undertake research survey in schools and colleges was requested from the Department of Education and Culture (KwaZulu) as well as from the Department of Education and Training (D.E.T.). In addition, letters of permission to circuit inspectors of schools where data were to be collected, were written and dispatched. In all instances permission to undertake research was granted by the education authorities after transmittal letters were dispatched to the two education departments (see Appendix-B).

The data were personally collected by the researcher using the person-to-person interview technique. This made it possible for the researcher to have informal and personalised talks with biology teachers, thereby putting them at ease before asking the to respond to the questionnaire. The collection of data by th researcher also eliminated possible errors or inconsistencie that might have occurred if assistant researchers were employed In order to secure maximum participation in the study, th anonymity of respondents was assured and maintained.

The coding of the questionnaires was undertaken after th teachers and student-teachers had responded to most of th questions. The post-coding of questions was favoured because i presented an opportunity to adjust the response-codes in terms o the manner in which the questions were answered. In addition post-coding made it easy to deal with a few open-ended questions For example, several questions required the following response "other problem items (specify)".

The coding itself consisted of allocating numerical values fo each respondent as well as for each response to a question. I the coding process different possible answer categories wer given separate numerical values. For example, relating to Sex male was coded (01); female (02) and a no-response (00) Respondents who gave no response to a question were coded with double zero (00). The advantage of such coding was t distinguish such responses from actual responses and to estimat how many respondents were either not sure of the question, wh avoided it or did not see or understand it.

6.3.1.3 Pilot Work

All pilot work interviews were undertaken in the Empangeni and Richards Bay area. The questionnaire was administered to ten subjects. Fifty percent of the subjects were African teachers of biology in secondary schools, while the other fifty percent were student-teachers in their final year of training at the Esikhawini College of Education and at the University of Zululand.

The original questionnaires took approximately forty minutes t complete. There was need to reduce the time required for eac interview because of an apparent lack of interest an concentration by the respondents. The list of science-relate problems was reduced from thirteen to eleven, thus eliminatin the two problems that were regarded as being minor importance In addition, a question (in part two of the questionnaire regarding the degree to which parents, teachers, the busines sector, curriculum planners, and students should have input c each of the science-related issues, was eliminated. The pilc analysis revealed that this item caused confusion and wa therefore removed from the questionnaire, reducing the tin required (approximately 30 minutes) to complete it.

After the pilot study, parts one and three of the origin questionnaires remained unchanged (see Appendix C.1 and C.2 Part one contained eleven questions dealing with the length teaching service and qualifications of the teache socio-economic characteristics of the respondents as well as the area where each school was situated. Part two was reduced to ten questions which required information on the eleven science-related problems. The information that was requirec ranged from the degree to which each of the science-relatec problems is important to the individual and to the community, tc how much each of the problems are dealt with and should be dealt with at schools.

Finally, the pilot study results reflected an overall respons accuracy or validity of 80 percent to questionnaire items. Afte all the changes were instituted the final questionnaire require only twenty minutes to complete.

6.3.2 <u>The Non-Survey Method</u>

This research study made use of only one type of non-surve method: namely the documents analysis technique. This entail studying the documents such as the syllabuses and some litera sources reviewing and commenting on the syllabuses (HSRC 1981 1981b; SCISA 1989; NEPI 1992; Hartshorne 1992; Christie 1992 The biology syllabuses taken up for analysis are the most curre and have been revised. Their dates of implementation are follows:

Standard 8 - implementation date: January 1986

Standard 9 - implementation date: January 1988

Standard 10 - implementation date: January 1989

These syllabuses were reviewed with the aim of establishing what is taught regarding biosocial issues at senior secondary schoo] level. Each syllabus was analysed to see whether the prescribe(content could be classified into one or more of the elever preselected biosocial issues investigated in this study.

The analysis also attempted to reveal the amount of time devote to biology-related social issues in the prescribed syllabuses The teaching time set out for each unit of biology content i prescribed by syllabus authorities and implies that teachers ar strictly controlled from outside and therefore their contributic in enriching the syllabus content is minimised. The prescribe time for teaching biology content is commonly laid down a time-table periods. For the purpose of this study, a percentag of the teaching use time was achieved by working out the ratio (the number of teaching periods per unit and the total number (teaching units for the entire syllabus. A more detaile explanation and illustrations of these analyses can be found : Chapter 7.

6.4 DATA ANALYSIS

Upon completion of the survey, each coded questionnaire item w recorded and scanned for any recording errors. All questionnai related data were keypunched and computer analysed employing t Statistical Analysis System (SAS) programme running on the I model 4331 mainframe computer of the University of Zululand. Th programme is regarded as one of the best for analysing statistics in social research. At the time of analysis it was the only statistical programme at the researcher's disposal that was capable of handling, simultaneously, about 99 respondents and 29[illegible] variables from this research study in particular. However, for the purpose of this study, only the frequency and rank distributions, means and cross-tabulations were utilised.

The three objectives of the study require two principal areas of data analysis. The first area of data analysis relates to the objectives concerning identification of biology-related social problems, the nature of understanding biology-related issues, the sources of information on the issues, and the biosocial issues to be included in the biology curriculum.

The second area of analysis relates to the objectives concerning the relationships between independent variables (personal characteristics, educational status and institutions of learning), identified biology-related problems, the nature of understanding and the content to be included in the biology curriculum. Table 6.2 provides an overview of the research tasks and respective statistical techniques that were used for analysis through the SAS computer programme. The statistical techniques that were frequently used in this study include: absolute frequency and percentage frequency distribution tables, the rank distribution, the means or averages and cross-tabulations which are also known as contingency tables (Bailey 1982). The[illegible] techniques have been used to introduce some measure of precision in describing and explaining some of the emerging values, patterns and relationships among the variables under study (Weisberg and Bowen 1977).

TABLE 6.2: OVERVIEW OF STATISTICAL ANALYSIS AND COMPUTER PROGRAMME FOR EACH TASK

TASK TO CARRY OUT	STATISTICAL ANALYSIS	COMPUTER PROGRAMME
Identification of biology-related issues/problems	Absolute and Percentage Frequencies	SAS (Proc.Freq)
Identification of sources of information about issues	Absolute and Percentage Frequencies	SAS (Proc.Freq)
Identification of biosocial school content	Absolute and Percentage Frequencies	SAS (Proc.Freq)
Description of nature of understanding about issues	Absolute and Percentage Frequencies	SAS (Proc.Freq)
Relationships between: independent variables and ranking of biosocial issues, understanding, and biosocial school content.	Cross-Tabulations Frequencies and Rank Distributions	SAS (Proc.Freq) (X by Y) (Proc.Rank)

The frequency tables specifically indicated the regularity wi which any response from teachers and student-teachers biosocial issue tended to occur. The usage of the frequer distribution measures was selected because it is simple as we as being a basic statistical technique that helps to underst the number of times any issue that is being considered, occu

In addition, many of the tasks and variables analysed (see Table 6.2) are amenable to the frequency distribution technique. In some instances the frequency data were converted into rank distributions which were useful in revealing the value range - high, median and low - of responses to biosocial problems.

The cross-tabulations are used in this study with the view of revealing relationships between some independent and dependent variables. The study considered most of the demographic characteristics such as sex, age, level of education, place of residence, location of school, and teaching experience, to constitute most of the independent variables. The crossing of variables is an attempt to introduce simplicity in a complex situation, and also to give the data more meaning and understanding. For example, educational experience is interrelated with the identification of biology-related issues or problems areas within the study area. In other words, this crossing would reveal to us whether the respondents' educational experiences has any significant influence on biology-related issues.

6.5 <u>CONCLUSION</u>

In this chapter an attempt has been made to describe the research design used in this study. The design sought to utilise a combination of qualitative and quantitative research procedures. Despite these intentions it must be mentioned that the methods of analysis conceived here, do not sufficiently represent the many possible statistical techniques that could be used in this inquiry. It should be understood that qualitative informatior collected regarding African education and science education woulc be difficult to evaluate statistically because of its social, historical and value-loaded nature. Situations such as the perception of various items of biosocial issues are not easy t evaluate mainly because some of these items are abstract. Thus the use of computer based statistical measures cannot be relie upon as the best evaluation tool.

Another important aspect of the research design was the use c the survey method. Its application was considered appropriate i as far as it would be able to get direct information from th respondents: the teachers and student-teachers. Furthermore, tl survey has been accepted as an deal method of collectir information from society on science and technology-relate issues.

In addition to what has been said above, there are a f shortcomings in the research design employed in this study th need to be mentioned:

(a) It was not easy to make a clear distinction between t facts of biology and biology-related social issue These facts and issues were the basis upon whi subjects had to respond.

(b) The classification of the syllabus content into the eleven biosocial issues posed some difficulty in that some of the biological concepts are interrelated.

(c) The pre-selection of biology-related problems in formulating the research instrument was biased towards the researcher. This meant that respondents did not get an opportunity to suggest biology-related problems of their own.

Notwithstanding these shortcomings, it can be assumed that th value of this investigation, as a contribution to scienc education, cannot be minimised. It is to be noted that some o the techniques used in designing this study, and viewe positively in some other studies, have been cited earlier in thi chapter.

CHAPTER 7

PRESENTATION OF DATA

7.1 INTRODUCTION

The presentation of data in this chapter will be discussed in the following sections:

(a) The first area considers the personal characteristics o: respondents, that is, the teachers and student-teachers. Data o: their sex, educational and professional experience, teachin experience and subject specialisation are presented.

(b) The second section presents data on the extent to whic African schools in the north-coastal region of Natal are teachin about biosocial issues. Part of this data is the respondents assessment of the situation in schools while the other part is a analysis of prescribed content in the standards 8, 9 and 1 biology syllabuses.

(c) The third section looks at the identification of the mos important biology-related social problems. This section als includes identification of biosocial issues which could b included in the biology curriculum at different education levels. Lastly, data indicating how the quality of life wi: change by year 2000 are presented in this section.

(d) The fourth area presents data on the extent of knowledge th respondents have about biosocial issues and the nature of th knowledge. It also presents data on teachers' a: student-teachers' perceptions about how knowledgeable the Afric adults are regarding these issues.

(e) The last section presents data concerning the sources of information used by teachers and student-teachers to obtain information about these biology-related social issues. Data on the sources used by African adults are also presented in this section.

7.2 RESPONDENTS' CHARACTERISTICS

The respondents for this study were of two types: teachers wh were already in the field and student-teachers who were doin their final year in teacher education programme (student-teachers). Of a total number of ninety-nine teacher (N=99) participating in the study, 60,6 percent were males, an 39,4 percent were females. Student-teachers were ninety-thre (N=93) in total, of which 51,6 percent were males and 48, percent were females. So, although the majority of respondent participating in this study were males, a substantial number o females (over 40%) participated in the study. Table 7.1 shows th age range of student-teachers and teachers who participated i this investigation.

TABLE 7.1: AGES OF TEACHERS AND STUDENT-TEACHERS

STUDENT-TEACHERS			TEACHERS		
Age	Frequency	%	Age	Frequency	%
18-21 years	24	25,8	18-29 years	65	65,7
22-25 years	56	60,2	30-49 years	32	32,3
26 years +	13	14,0	50-55 years	2	2.0
TOTAL	93	100,0		99	100,0

The data show that a substantial number of student-teachers and teachers (86,0%) were young, that is, less than 30 years old. This means that the majority of biology teachers presently teaching in the north-coastal region of Natal still have a number of years of teaching ahead of them.

In terms of experience in teaching biology at senior secondary level, the data in Table 7.2 reveal that the majority (80,9%) of the teachers had teaching experience ranging from zero to five years.

TABLE 7.2: TEACHER EXPERIENCE IN TEACHING BIOLOGY

YEARS	PRESENT SCHOOL Frequency	%
0 - 2years	26	26,3
2 - 3 years	29	29,3
4 - 5 years	25	25,3
6 - 7 years	3	3,0
7 - 8 years	12	12,1
9 years & over	4	4,0
	99	100,0

This figure suggests that most biology teachers in the nort coastal region of Natal have limited experience in teaching. Th figure also corresponds with data in Table 7.1 which indicate that the majority of biology teachers are young.

Notwithstanding the youthful age of the majority of teachers ar their limited teaching experience, Table 7.3 indicates that mos of them teach senior classes. Data in Table 7.3 show that mo than a third of the teachers have taught standards 8, 9 and 10 for more than three years. In fact, in most schools sampled for this study only one teacher was responsible for teaching all three senior classes.

TABLE 7.3: TEACHER EXPERIENCE IN TEACHING STANDARDS 8, 9 & 10

YEARS	STANDARD 8 Freq.	%	STANDARD 9 Freq.	%	STANDARD 10 Freq.	%
0 - 2years	22	22,2	14	14,1	18	18,2
2-3 years	27	27,3	23	23,2	17	17,2
4-5 years	7	7,1	15	15,2	21	21,2
6-7 years	3	3,0	7	7,1	4	4,0
7-8 years	11	11,1	7	7,1	7	7,1
9 years & over	28	28,3	32	32,3	31	31,3
No response	1	1,0	1	1,0	1	1,0
	99	100,0	99	100,0	99	100,0

The implication from these data are that biology teachers ar likely to teach senior classes as soon as they graduate frc colleges or universities. This situation also indicates thа young teachers are likely to get little or no guidance from olde biology teachers during their first few years of teaching.

A question regarding the academic and professional qualificatio of teachers revealed that a majority of teachers have post-matr qualifications. Table 7.4 below indicates that a total of 79 percent of the teachers possess STD, SSTD, UED or HED diploma Table 7.4 also reveals that of the 79.8 percent of teachers w qualify to teach at senior secondary school level, only a sma fraction (17.2%) of teachers graduated from universities. The are teachers who studied for an SSTD, UED or HED diploma. For instance SSTD is a third year professional diploma which is done after natural science degree courses, at first and second year

TABLE 7.4: BIOLOGY TEACHERS' PROFESSIONAL QUALIFICATIONS (N=99)

TEACHING DIPLOMA	ABSOLUTE FREQ.	FREQUENCY PERCENTAGE
Primary Teacher's Diploma (PTD)	3	3,0
Primary Teacher's Course (PTC)	4	4,0
Junior Secondary Teacher's Course (JSTC)	8	8,1
University Dip. in Secondary Educ.(UDSE)	2	2,0
Secondary Teacher's Diploma (STD)	62	62,6
Senior Secondary Teacher's Diploma (SSTD)	10	10,1
University Education Diploma (UED) or Higher Education Diploma (HED)	7	7,1
No Teacher Qualifications	3	3.1
	99	100,0

level, have been passed. A UED and HED diploma is done after Bachelor of Science (B.Sc.) degree has been passed. Teachers wh have university education may have acquired more depth in th biology content for effective teaching at senior secondar schools. However, teachers who have an STD diploma are likely t have acquired substantial understanding and expertise in teachi senior secondary school pupils after three years of training.

A response to a question referring to the specialisation subjec in teaching methods (see Appendix C.1), revealed that 64 perce of the teachers had specialised in the teaching of biology, a 23 percent had specialised in the teaching of general scienc A small fraction (13%) of teachers had not specialised in the teaching of either biology or general science. These findings also show that some teachers who had specialised in the teaching of general science, from primary school to junior secondary school level, were teaching biology at senior level. However, with assistance and more in depth study of biology content, teachers specialising in the teaching of general science are able to cope with teaching biology at senior secondary level. From this data, it can be concluded that the majority of teachers participating in this investigation were suitably qualified to teach biology at senior secondary school level.

Only final year student-teachers who were specialising in teaching biology or general science were asked to participate in this investigation. Sixty six student-teachers (71%) wer following the Secondary Teacher's Diploma (STD) at colleges o education, while seventeen student-teachers (18%) were doing th Senior Secondary Teacher's Diploma (SSTD). Only 3 percent of th student-teachers were doing University Education Diploma (UED) o Higher Education Diploma (HED) at universities while 8 percen were doing the University Diploma in Secondary Education (UDSE) From the total of ninety three student-teachers, eighty si student-teachers (92%) were specialising in the teaching o biology. Only seven student-teachers (8%) who were following th UDSE diploma specialised in the teaching of general science.

The majority of student-teachers (71%) in colleges c education would (at the end of their studies) also be suitabl qualified to teach senior secondary biology. Student- teachers following an SSTD, UED or HED diploma, having acquired more depth in biology content at university, will also be well qualified. A very small fraction of student-teachers doing UDSE (8%) and specialising in teaching general science would have the potential of teaching biology to senior classes if they had the necessary guidance and support.

In general, the majority of teachers and student-teachers in this study were suitably qualified to teach biology at senior secondary school level. In view of the acute shortage of qualified natural science teachers in South Africa, particularly in African schools, as discussed in Chapter 3, a majority of seventy nine qualified teachers (79.8%) for this study is a high percentage under the circumstances (see Table 7.4, page 153) Only twenty teachers (20,2%) in this study were either qualifie to teach at junior secondary school level, primary school leve or not qualified as teachers. The information obtained in thi study was from a majority of teachers who were qualified to teac biology at senior secondary school level.

The majority of teachers and student-teachers in this study wer young. More than half of them were males and the majorit had teaching experience of between 2 to 5 years. Finally, mos of these teachers had experience in teaching biology in al senior classes, that is, standards 8, 9 and 10.

The influence of age, sex and teaching experience of these teachers on their opinions about other items under investigation in this study, will be discussed in the analysis and interpretation chapter.

7.3 EXTENT TO WHICH BIOLOGY-RELATED ISSUES ARE TAUGHT

Data presented in this section was obtained in two ways. First, teachers and student-teachers were asked to indicate the amount of teaching done that was related to biosocial issues. Secondly the prescribed biology content of the standards 8, 9 and 10 syllabuses was analysed to see whether it did or did not include social issues.

7.3.1 Responses of Teachers and Student-Teachers

Teachers and student-teachers were asked to indicate how muc their local schools were teaching different aged children abou biology-related issues/problems. The perception of both teacher and student-teachers was that very little is taught in the earl years of schooling, that is, at the primary school level However, there is a gradual increase in the amount of biosocia issues taught from junior secondary level to tertiary educatio level. Table 7.5 displays data which indicate the teachers perception of how much is taught regarding each biosocial issu at junior secondary to tertiary school level.

In general, the data show that at junior secondary school level the following issues, supported by over 40% teachers, are dealt with moderately: water, food and energy resources, human health and diseases, land use and pollution.

TABLE 7.5: TEACHERS' INDICATION OF THE EXTENT TO WHICH SCHOOLS TEACH ABOUT BIOLOGY-RELATED SOCIAL ISSUES (N = 99).

GRADE LEVEL OR AGE	BIOLOGY-RELATED PROBLEMS	GREAT	MODERATE	SLIGHT	NOT AT ALL	DON'T KNOW
		%	%	%	%	%
JUNIOR SECONDARY (13-16yrs)	Food resources	46	47	7	-	-
	Water resources	37	56	7	-	-
	Energy resources	34	46	19	1	-
	Human health & diseases	36	43	18	3	-
	Land use	21	44	25	7	3
	Sex education	12	21	26	36	5
	Pollution	19	41	31	7	2
	Population growth	20	33	33	11	3
	Drug problems	15	22	34	26	3
	Immunisation	15	35	28	18	4
	Nature conservation	31	39	20	9	1
SENIOR SECONDARY (17-18yrs)	Food resources	56	37	6	1	-
	Water resources	57	35	8	-	-
	Energy resources	47	42	10	1	-
	Human health & diseases	42	42	13	2	1
	Land use	31	42	21	6	-
	Sex education	25	23	23	26	3
	Pollution	37	38	18	6	1
	Population growth	38	36	23	3	-
	Drug problems	27	23	33	15	2
	Immunisation	22	34	27	13	4
	Nature conservation	41	36	19	3	1
TERTIARY EDUCATION (19 + yrs)	Food resources	60	30	4	2	4
	Water resources	60	30	5	1	4
	Energy resources	56	31	8	2	3
	Human health & diseases	60	32	3	3	2
	Land use	45	34	14	4	3
	Sex education	41	30	12	11	6
	Pollution	46	41	8	2	3
	Population growth	51	40	5	1	3
	Drug problems	47	31	9	8	5
	Immunisation	37	32	18	8	5
	Nature conservation	59	28	9	4	-

Issues such as population growth, immunisation, nature conservation, drugs and sex education appear to be dealt with to a slight extent. Sex education and drugs, to a lesser extent, seem to be issues that more than a third of the teachers thought are not taught at all.

Student-teachers (Table 7.6) tended to agree with the teachers about the following issues which are taught at junior secondary schools: food, water, energy, human health and diseases. However, more than 60 percent of student-teachers thought that these issues were dealt with to a great extent at this level of schooling. Nature conservation, immunisation, drugs, and land use were dealt with to a moderate extent. In general, student-teachers indicated that teaching about pollution, population growth and sex education, was dealt with to a slight extent. The data in Table 7.6 present these observations.

At senior secondary school level, over 50 percent of teachers thought that only two issues: food and water resources were dealt with to a great extent. In general, over 40 percent of the teachers thought all other issues, that is, energy resources, human health and diseases, land use, pollution, population growth, and nature conservation were sufficiently taught at this level. Issues on drugs, immunisation and sex education were, however, placed between the categories 'slightly' and 'not at all' by more than 40 percent of the teachers. The data in Tabl

7.5 suggest that the teaching of biosocial issues at tertiary level is generally good when compared to the junior and senior secondary levels.

TABLE 7.6: STUDENT-TEACHERS' INDICATION OF THE EXTENT TO WHICH SCHOOLS TEACH ABOUT BIOLOGY-RELATED SOCIAL ISSUES (N = 99).

GRADE LEVEL OR AGE	BIOLOGY-RELATED PROBLEMS	GREAT	MODERATE	SLIGHT	NOT AT ALL	DON'T KNOW
		%	%	%	%	%
JUNIOR SECONDARY (13-16yrs)	Food resources	70	25	2	2	-
	Water resources	60	29	8	2	1
	Energy resources	57	20	18	2	2
	Human health & diseases	60	25	10	4	1
	Land use	26	26	37	8	3
	Sex education	10	33	29	24	3
	Pollution	18	31	40	9	2
	Population growth	23	18	38	17	4
	Drug problems	28	25	28	16	3
	Immunisation	30	25	26	13	6
	Nature conservation	37	36	19	7	1
SENIOR SECONDARY (17-18yrs)	Food resources	75	21	2	1	1
	Water resources	65	31	2	2	1
	Energy resources	67	25	6	2	-
	Human health & diseases	62	22	11	3	2
	Land use	37	37	19	4	3
	Sex education	29	28	18	21	4
	Pollution	37	40	14	6	3
	Population growth	39	30	22	9	-
	Drug problems	39	31	15	12	3
	Immunisation	32	28	23	11	6
	Nature conservation	52	32	12	4	-
TERTIARY (19 + yrs)	Food resources	82	9	5	4	1
	Energy resources	75	12	9	3	1
	Human health & diseases	74	19	4	3	-
	Land use	51	27	16	3	3
	Sex education	48	18	13	18	3
	Pollution	56	22	15	4	3
	Population growth	60	27	8	4	1
	Drug problems	55	23	11	8	3
	Immunisation	47	30	12	8	3
	Nature conservation	63	23	8	4	2

On the whole student-teachers thought that all biology-related issues under investigation were sufficiently dealt with at senior secondary schools. A large percentage (over 60%) of the student-teachers thought that issues on food, water and energy resources, human health and diseases were dealt with to a great extent (see Table 7.6). It is only in three of the issues: sex education, immunisation and population growth, where almost a third of the student-teachers indicated 'slight' teaching or 'not at all'. The data in Table 7.6 indicate that student-teachers thought that biosocial issues were well covered.

There are several trends revealed by the data presented in this section. Firstly, teachers and student-teachers thought that all levels of schooling, from junior secondary to tertiary level, teach more about food, water, energy, nature conservation and human health and diseases. All other issues were dealt with either moderately or slightly. Secondly, issues such as sex education, immunisation, population growth and drugs were consistently indicated by both teachers and student-teachers as issues which are neglected at secondary school levels. Lastly, although ranking percentages of student-teachers were higher than that of teachers, there was considerable agreement between teachers and student-teachers about what is taught in African schools.

7.3.2 Content Analysis of Biology Syllabuses

An analysis of standards 8,9 and 10 biology syllabus was dc with the aim of identifying sections of biology content th could be classified as biosocial issues. The biological conte of an issue was included, whether or not the social implicatic were raised in the content as laid down in the syllabus. F instance, the topic "the heart and blood circulation" would placed under "human health and diseases" even though the emphas on teaching is on the structure and functions of the heart sin one could include a discussion of how regular exercise a balanced diet with less fat can reduce coronary heart disease.

It was realised that some parts of biological content could classified under two or more biosocial issues. For instanc nutrition and food types could be placed under "food resource or under "energy resources". This made it difficult to establi clear, independent distinctions in the classification biological content into the eleven biosocial issues. To avo including the same aspect of content in all biosocial categori where it could fit, an aspect was classified under one catego and not repeated in other categories. The rationale was that a holistic approach is adopted in the teaching of biology, t interrelationship between any two or more biological aspects wi be revealed. Therefore, any aspect need only to be classifi under one biosocial issue.

TABLE: 7.7: BIOLOGICAL CONTENT IN THE STANDARD 8, 9 AND 10 SYLLABUSES THAT ARE ASPECTS OF BIOSOCIAL ISSUES

CLASS	CONTENT	TEACHING PERIODS	PERCENTAGE TIME	BIOSOCIAL ISSUE
STANDARD EIGHT	Ecology: ecosystems Conservation of indigenous flora, funa & other natural resources	40	22	NATURE CONSERVATION
	Pollution of air, water and land	5	3	POLLUTION
	Human physiology: skeleton, blood and lymphatic systems.	60	32	HUMAN HEALTH & DISEASES
STANDARD NINE	Viruses and bacteria	14	6	HUMAN HEALTH & DISEASES
	Mycophytes	13	6	
	Protozoa and platyheminthes	22	10	
	Cell division and Genetics: mitosis and meiosis, DNA, sex, determination, inheritance mutation, and natural selection	42	19	SEX EDUCATON
	Human physiology: reproductive organs & function, fertilisation, development, post-natal care.	14	6	
STANDARD TEN	Biological compounds and nutrients: food types and their importance	19	10	FOOD RESOURCES
	Water relationships in plants	11	6	WATER RESOURCES
	Importance of water in food	2	1	
	Excretion and urinary system in humans	13	7	
	Homeostasis: water regulation	5	3	
	Population dynamics: parameters affecting populations, energy flow, regulation & survival.	21	12	POPULATION GROWTH
	Photosynthesis & cellular respiration	25	14	ENERGY RESOURCES
	Digestion and supply of energy to human body	10	6	
	Role of vitamins and effects of deficiency	2	1	HUMAN HEALTH & DISEASES

The data obtained from the analysis of the prescribed biolc content from standards 8, 9 and 10 syllabuses are presented Table 7.7. It can be seen from this table that most of t biology content taught from standard 8 to 10 could be classifi under the following biosocial issues: nature conservatic pollution, human health and diseases, sex education, fc resource, water resources, population growth and ener resources. Biology content which is classified under land us drugs and immunisation is not included in the standards 8, 9 a 10 syllabuses. It can also be seen from the data that the conte under each biosocial issue is dealt with separately as a ur during one year of study. For instance, food resources, wat resource and population growth are dealt with only in standa 10. There is no connection with other units during standards or 9 which reflect interrelationships that exist within biolo Although the content classified under "human health and disease appears in all the three consecutive years of study, separa aspects are treated in each year. For instance, the 'skelet blood and lymphatic systems' are done in standard 8, 'geneti in standard 9 and 'homeostasis, excretion and urinary system' standard 10. It is not easy to understand the rationale for t selection of this content for each year.

A closer look at biology syllabuses reveals that most of t content is not treated from the perspective of a social conte The major aim of teaching biology seems to be the understandi of biology facts and principles. In addition, the number

teaching periods or the percentage of time devoted to those f
aspects that include a social aspect, is limited. For instanc
Table 7.7 shows that only 5 periods should be devoted
"pollution of air, water and land".

7.4 IDENTIFICATION OF BIOLOGY-RELATED SOCIAL PROBLEMS

There are a variety of ways in which data associated wi
biology-related social problems can be presented. The intenti
of this section is to highlight the aspects of the study in whi
teachers and student-teachers responded to social problems th
impinge on life, affect the curriculum and address the quality
life in the year 2000.

7.4.1 Problems that Impinge on the Life of Africans

Teachers and student-teachers were asked to identify and ra
according to importance those biology-related problems whi
affected their lives the most. Table 7.8 reveals the opinic
expressed by the teachers and student-teachers. It shows th
the majority of teachers (over 80%) ranked food and wat
resources as amongst the most important problems affecting li
in the African community. Energy resources, human health a
diseases, and nature conservation were the second (over 60%) mo
important problems. The third-most important problems f
teachers (50%) were pollution, population growth, land use a
drugs. The least important problems (less than 50%) we
immunisation and sex education.

TABLE 7.8 TEACHERS' AND STUDENT-TEACHERS' RANKING OF BIOLOGY-RELATED SOCIAL PROBLEMS (N=99 AND N=93 RESPECTIVELY)

PROBLEM	TEACHERS Freq.(%)	TEACHERS Rank	STUDENT-TEACHERS Freq.(%)	STUDENT-TEACHERS Rank
Food resources	84,8	1	79,6	2
Water resources	84,8	1	83,9	1
Energy resources	65,7	3	64,5	4
Human health & diseases	65,7	3	62,4	5
Land use	49,5	8	44,1	7
Sex education	41,4	11	31,2	11
Pollution	51,5	6	44,1	7
Population growth	51,5	6	40,9	9
Drug problems	49,5	8	34,4	10
Immunisation	47,5	10	52,7	6
Nature conservation	64,6	5	68,8	3

Data in Table 7.8 also show that student-teachers largely agre with teachers in identifying the most serious and the lea important problems. The fact that the majority student-teachers (over 80%) also identified water and fo resources as the most important problems, while natu conservation, energy resources, human health and diseases we identified as the second most important problems is evidence total agreement about local problems. The third-most importa problems, for student-teachers (ranked by over 40% immunisation, pollution, land use, and population growth we also fairly similar to those problems identified by teacher The data also show that teachers and student-teachers concurr that sex education was the least important problem in the lives.

A possible explanation for the total agreement demonstrated these results above may be that the problems investigated in tl study affected most African communities in the north-coast region of Natal. As a result, teachers and student-teachers we similarly affected by each of these problems.

A cross-tabular analysis of important biology-related proble (Table 7.8) as against sex and age (Table 7.1) of both teache and student-teachers indicated an even distribution. In genera there was agreement that the choice of important problems cou not be attributed to age or sex of respondents in nine of t biology-related problems. However, a slightly higher percenta (32%) of female student-teachers identified problems on s education and drugs as being very important compared to percent of male student-teachers. This could suggest th females are more sensitive to these problems than their ma counterparts are. It is also possible that fema student-teachers were at an age when they were personal affected by these problems.

A further cross tabulation of professional qualifications (Tab 7.4) and experience in teaching biology in standards 8, 9 and (Table 7.3) with identification of important problems (Table 7. revealed similar results. In other words, the teachers' choic of the most important problems were neither influenced by thei qualifications nor their teaching experience. The persona experiences with the problems researched, therefore, is reasonable explanation for the choices made by teachers.

TABLE 7.9: TEACHERS' INDICATION OF THE EXTENT TO WHICH EACH BIOLOGY-RELATED
ISSUE SHOULD BE TAUGHT AT DIFFERENT SCHOOL LEVELS (N = 99).

GRADE LEVEL OR AGE	BIOLOGY-RELATED PROBLEMS	GREAT	MODERATE	SLIGHT	NOT AT ALL	D KN
		%	%	%	%	
JUNIOR SECONDARY (13-16yrs)	Food resources	76	22	2	-	
	Water resources	74	24	1	1	
	Energy resources	75	22	2	1	
	Human health & diseases	81	17	1	1	
	Land use	62	34	4	-	
	Sex education	66	24	7	3	
	Pollution	66	27	5	1	
	Population growth	60	31	8	1	
	Drug problems	71	20	8	1	
	Immunisation	59	25	13	2	
	Nature conservation	79	15	5	1	
SENIOR SECONDARY (17-18yrs)	Food resources	89	10	1	-	
	Water resources	88	10	2	-	
	Energy resources	87	11	1	1	
	Human health & diseases	90	8	2	-	
	Land use	74	23	3	-	
	Sex education	85	10	4	1	
	Pollution	81	13	5	1	
	Population growth	82	14	3	1	
	Drug problems	85	11	4	-	
	Immunisation	72	19	7	1	
	Nature conservation	85	11	3	1	
TERTIARY EDUCATION (19 + yrs)	Food resources	85	14	1	-	
	Water resources	82	15	2	1	
	Energy resources	83	14	2	1	
	Human health & diseases	86	12	1	1	
	Land use	76	20	3	1	
	Sex education	84	10	3	3	
	Pollution	80	16	2	1	
	Population growth	84	12	4	-	
	Drug problems	84	12	4	1	
	Immunisation	71	21	6	2	
	Nature conservation	86	11	1	2	

7.4.2 Issues for Incorporation into the Curriculum

On the question of how much emphasis should be placed on teachi each of the biology-related issues at different age/grade leve a clear majority of teachers and student-teachers indicated th it was very important to study these issues. At junior seconda level more than 60% of teachers, and at senior secondary a tertiary level more than 80% of teachers recommended that great emphasis should be placed on all the eleven biology-relat social problems (see Table 7.9). The above mentioned percenta values also suggest an increasing emphasis on the teachi biosocial issues from junior to senior secondary school leve Perceptions of the extent to which teachers think each biosoci issue should be taught from junior secondary to the tertia education level are shown in Table 7.9.

The high percentage ranking of human health and disease (81% junior secondary, 90% at senior secondary) by teachers (see Tab 7.9) indicated a greater need for teaching these issues. T implication could be that although schools teach a lot of hum physiology (see Table 7.7) the emphasis on the structure a functions of the different parts of the body does not help pupi to cope with their health problems.

The data in Table 7.10 show that the majority of student-teache indicated that greater emphasis should be placed on teachi biosocial issues at junior secondary schools, senior seconda schools and well as at tertiary level. The greatest emphas on teaching, at junior and senior secondary schools, indicated over 70 percent student-teachers should be on food, wate energy, human health and diseases and nature conservation.

TABLE 7.10: STUDENT-TEACHERS' INDICATION OF THE EXTENT TO WHICH EACH BIOLOGY-RELATED SOCIAL ISSUE SHOULD BE TAUGHT AT DIFFERENT SCHOOL LEVELS (N = 93).

GRADE LEVEL OR AGE	BIOLOGY-RELATED PROBLEMS	GREAT	MODERATE	SLIGHT	NOT AT ALL	DC KI
		%	%	%	%	
JUNIOR SECONDARY (13-16yrs)	Food resources	75	20	1	1	
	Water resources	75	15	10	-	
	Energy resources	73	18	5	3	
	Human health & diseases	77	13	9	1	
	Land use	45	32	19	1	
	Sex education	54	32	9	3	
	Pollution	52	33	9	7	
	Population growth	48	34	13	2	
	Drug problems	65	20	10	4	
	Immunisation	54	27	16	3	
	Nature conservation	71	16	10	3	
SENIOR SECONDARY (17-18yrs)	Food resources	84	10	4	2	
	Water resources	82	13	4	1	
	Energy resources	81	14	3	2	
	Human health & diseases	79	15	4	1	
	Land use	67	19	10	2	
	Sex education	69	18	8	4	
	Pollution	66	25	7	3	
	Population growth	71	13	14	1	
	Drug problems	70	20	7	2	
	Immunisation	60	20	16	3	
	Nature conservation	76	15	4	2	
TERTIARY EDUCATION (19 + yrs)	Food resources	82	15	3	-	
	Water resources	81	14	5	-	
	Energy resources	80	14	7	-	
	Human health & diseases	80	17	1	1	
	Land use	63	27	5	2	
	Sex education	71	17	6	3	
	Pollution	68	22	9	2	
	Population growth	73	16	8	2	
	Drug problems	71	20	5	3	
	Immunisation	66	20	10	4	
	Nature conservation	76	15	6	1	

Population growth was also rated highly (71%) at senior second compared to 48 percent at junior secondary school level. possible explanation could be that student-teachers felt t more information about this issue was required at sen secondary than at junior secondary level.

The above results also show the support that teachers student-teachers would give to have for a school curriculum wh addresses biosocial issues. Recognising that the support African parents is also important in decisions made about education of their children, a question investigating whet African parents could support such a curriculum was inclu in the questionnaire.

Teachers and student-teachers were, therefore, asked for th opinions on whether African adults should support the inclus of biosocial issues in the biology curriculum. The results the response of teachers and student-teachers is shown on Ta 7.11. It can be seen from Table 7.11 that the majority teachers and student-teachers suggested that African adu would support the incorporation of all the biosocial iss investigated in this study. Table 7.11 also shows that while perception of both teachers and student-teachers was that m issues would be supported 'greatly' or 'moderately ', more t 20 percent thought support on population growth and sex educat would be slight. Although this question was not directed African adults themselves, the perceptions of teachers student-teachers could be an indicator of the attitude some the adults might have towards these issues.

TABLE 7.11: TEACHERS' AND STUDENT TEACHERS' OPINIONS ABOUT THE SUPPORT AFRICA ADULTS WOULD GIVE IF BIOSOCIAL ISSUES ARE INCLUDED IN THE BIOLOGY CURRICULUM (N=99 & N=93).

RESPONDENTS	PROBLEM	GREAT	MODERATE	SLIGHT	NOT AT ALL	D K
		%	%	%	%	
TEACHERS	Food resources	64	30	5	1	
	Water resources	60	30	10	-	
	Energy resources	48	34	15	3	
	Human health & diseases	68	24	9	-	
	Land use	60	26	11	1	
	Sex education	53	18	23	4	
	Pollution	49	33	14	4	
	Population growth	52	25	20	3	
	Drug problems	60	22	13	3	
	Immunisation	53	32	11	3	
	Nature conservation	63	23	12	2	
STUDENT-TEACHERS	Food resources	75	14	8	3	
	Water resources	67	23	11	-	
	Energy resources	53	31	15	1	
	Human health & diseases	61	27	9	2	
	Land use	45	32	16	3	
	Sex education	41	27	24	5	
	Pollution	41	37	17	3	
	Population growth	39	36	25	1	
	Drug problems	54	24	16	4	
	Immunisation	51	27	19	2	
	Nature conservation	57	23	18	1	

7.4.3 Quality of Life in the Year 2000

Information was also sought about how the quality of life wo be by the year 2000 if biosocial issues were not addressed school. Table 7.12 shows that both teachers and student-teach

thought that all the eleven problems investigated would be wor
or much worse by year 2000. Population growth (56%) and dr
problems (57%) were rated as leading problems by teacher
Student-teachers also rated the above problems at 46 percent a
47 percent respectively (see Table 7.12).

TABLE 7.12: TEACHERS' AND STUDENT-TEACHERS' INDICATION OF CHANGE FOR BIOLOGY-RELATED PROBLEMS BY THE YEAR 2000 (N=99 & N=93).

RESPONDENTS	PROBLEM	MUCH BETTER %	BETTER %	SAME %	WORSE %	MUCH WORSE %
TEACHERS	Food resources	7	11	10	42	29
	Water resources	9	9	12	39	30
	Energy resources	8	9	15	38	29
	Human health & diseases	10	6	8	29	47
	Land use	7	6	11	40	35
	Sex education	8	8	9	27	48
	Pollution	5	10	5	34	46
	Population growth	5	6	8	25	56
	Drug problems	5	8	5	26	57
	Immunisation	6	7	13	40	33
	Nature conservation	9	4	10	32	44
STUDENT-TEACHERS	Food resources	14	7	17	38	23
	Water resources	9	16	14	36	26
	Energy resources	13	10	17	36	25
	Human health & diseases	6	14	10	23	46
	Land use	13	7	19	29	32
	Sex education	11	11	15	32	31
	Pollution	10	13	12	28	38
	Population growth	11	13	7	24	46
	Drug problems	9	9	9	27	47
	Immunisation	11	13	17	34	23
	Nature conservation	10	14	10	26	41

In general, teachers and student-teachers strongly agreed th unless teaching biosocial issues is introduced in schools, t problems in the north-coastal region of Natal will be worse much worse in future. Data presented in the previous subsectio also show agreement between teachers and student-teache concerning the serious problems which impinge on life, t biosocial issues that should be taught at schools, and t support that African adults will give if biosocial issues a included in the curriculum.

7.5 KNOWLEDGE OF BIOSOCIAL ISSUES

It was important for this study to investigate the extent understanding that teachers, student-teachers and African adul have about biosocial issues. For teachers and student-teacher the importance of their knowledge lies in the fact that thorou knowledge is necessary for teaching these issues at school. indication of the extent of knowledge possessed by teachers a student-teachers would assist in decisions about how mu information on biosocial issues should be included in teach education programmes. It was also important to investigate h knowledgeable African adults are about these issues because th study was investigating the need for addressing these issues schools. The amount and depth of biosocial information present at school can be determined by the degree of understanding th adults already have regarding these issues.

7.5.1 <u>Extent to which Biosocial Issues are Understood</u>

The data obtained from a question about how knowledgeable tl teachers and the student-teachers were about biology-relat problems are presented in Table 7.13 below. More than 60 perce of the teachers indicated that their knowledge about food a water resources, pollution and nature conservation was betwe 'excellent' and 'good'. Satisfactory knowledge was indicated f problems concerning population growth, drug problems, health a diseases, and energy resources.

TABLE 7.13: BIOLOGY TEACHERS' AND STUDENT-TEACHERS' KNOWLEDGE ABOUT BIOLOGY-RELATED SOCIAL PROBLEMS (N = 99 & N = 93)

BIOLOGY-RELATED PROBLEMS	EXCELLENT		GOOD		SATISFACTORY		FAIR		POOR	
	Te. %	St. %	Te. %	St %	Te. %	St. %	Te. %	St. %	Te. %	S
Food resources	20	42	52	40	23	11	7	26	-	
Water resources	21	41	52	40	21	15	6	3	-	
Energy resource	15	24	34	47	39	19	10	8	1	
Health & Diseases	12	28	39	28	23	27	20	11	5	
Land use	9	17	33	28	35	29	15	20	7	
Sex education	13	19	26	26	28	26	18	15	14	1
Pollution	23	26	40	36	21	22	13	5	2	1
Population growth	19	31	39	26	24	25	12	10	5	
Drug problems	14	20	22	20	34	27	19	20	9	1
Immunisation	9	23	33	29	34	24	16	18	7	
Nature conservation	26	31	38	38	23	18	7	7	5	

N.B. (Te) denotes Teachers. (St) denotes Student-teachers. I some cases, the total percentage does not add up to 100% because of the 'rounding off" error.

Although the data show that land use, immunisation and s education are problems that teachers are least knowledgeab about, almost a third of the teachers indicated a satisfacto understanding of these problems. In general, data in Table 7.

suggest that teachers thought that their understanding biosocial issues was satisfactory except for three issues.

The response of student-teachers to the question of how much th know about the biosocial problems is also presented in Tab 7.13. More than 60 percent of student-teachers thought that th were very knowledgeable about food, water, energy resource pollution and nature conservation. Their understanding of fc and water problems were the best known with a rating of percent and 41 percent respectively. The second best knc problems were human health and disease, population growth, a immunisation. Student-teachers were least knowledgeable abc land use, sex education and drugs. In general, t student-teachers rating of their knowledge was higher than t rating made by teachers. A possible reason for the high rati could be that student-teachers were engaged in studies th focused on standards 8, 9 and 10 biology content. They wer therefore, more confident of their knowledge than teachers were

Table 7.14 presents data on the perception held by teachers a student-teachers about the African adults' understanding biology-related problems. In general, teachers a student-teachers believe that adults are slightly knowledgeat about these problems. A little more than a third of the teache thought that African adults have satisfactory knowledge abc food, water, energy resources, health and diseases, land use a immunisation (see Table 7.14).

TABLE 7.14: TEACHERS' AND STUDENT-TEACHERS' OPINION OF THE AFRICAN ADULTS' KNOWLEDGE ABOUT BIOLOGY-RELATED SOCIAL PROBLEMS (N = 99 & N = 93)

BIOLOGY-RELATED PROBLEMS	EXCELLENT Te. %	St. %	GOOD Te. %	St. %	SATISFACTORY Te. %	St. %	FAIR Te. %	St. %	POOR Te. %	St %
Food resources	6	27	18	32	38	23	26	15	11	3
Water resources	4	20	21	33	32	28	31	13	11	5
Energy resource	4	11	7	25	29	31	32	16	26	16
Human health & diseases	4	14	9	22	26	31	36	25	24	9
Land use	3	16	7	14	31	31	33	16	25	23
Sex education	2	5	7	5	18	18	22	25	51	46
Pollution	4	4	5	11	17	17	25	29	49	39
Population growth	5	11	8	8	20	25	18	23	49	34
Drug problems	7	12	10	12	18	25	28	27	36	23
Immunisation	2	14	13	22	38	34	24	20	22	9
Nature conservation	3	14	11	14	22	17	26	24	37	31

N.B. (Te) denotes Teachers. (St) denotes student-teachers.

Table 7.14 shows that almost half the teachers indicated that adults have a poor understanding of problems concerning sex education (51%), pollution (49%) and population growth (49%). These problems were also identified by student-teachers as issues which are poorly understood by African adults: sex education (46%), pollution (39%), population growth (34%). Nature conservation, drugs, land use and health problems were also perceived to be amongst the least understood issues by more than a third of the teachers and student-teachers. The implication from these data, that African adults have poor knowledge of more than half of the investigated problems, is a challenge to current educationists, particularly in science education.

Inferences from these results show that teachers and student-teachers believe that they understand biosocial issues better than African adults. Furthermore, the subjects were in agreement about those problems that African adults knew something about and those that they knew very little about. One possible explanation for their agreement could be based on their observation about how adults were actually coping with these problems. Poor understanding about biosocial issues has implications for the quality of life of African adults and their communities.

7.5.2 <u>The Nature of Understanding of Biosocial Issues</u>

In addition to the teachers' and student-teachers' own rating of their knowledge, an attempt was made to investigate the nature of their understanding. To determine this understanding teachers and student-teachers were asked to choose a statement which best described each of the eleven biosocial concepts.

The data presented in Table 7.15 show that more that 60 percent of the teachers have a broad and holistic understanding of the concepts: health, malnutrition, nature conservation, population growth, immunity, energy resources, pollution, agriculture and water resources.

'ABLE 7.15a : TEST OF THE NATURE OF UNDERSTANDING OF CONCEPTS

:ONCEPT	DESCRIPTION	PERCENTAGE RESPONSE	
		Teachers	Students
IEALTH	(a) Health is absence of disease.	8	14
	(b) It can be attained principally by physical material means e.g. medicine and nutrients.	8	5
	(c) A balanced existence between people and the natural or man-made physical environment in which they live.	26	31
	(d) It is the state of complete physical, psychological and social well-being.	53	38
	(e) Health manifests itself in the ability of a human being to be happy in spite of physical or emotional handicaps.	3	12
IALNUTRITION	(a) A condition where diet omits some foods necessary for health.	28	30
	(b) It a disease caused by deficiency of protein in the body.	2	5
	(c) It can be about insufficient food production, uneven distribution of food or attitudes to certain unfamiliar foods.	12	16
	(d) It is caused by the intake of unbalanced diet, especially in protein and in energy supply foods.	55	47
	(e) Results when the daily intake of food falls below 1500 calories.	2	1
EX EDUCATION	(a) Knowledge about the human body and body functions, especially reproduction.	13	29
	(b) Provision of knowledge about contraception and family planning.	7	8
	(c) Teaching about the act of sexual intercourse.	2	2
	(d) Includes sets of attitudes, values, personal relationships and responsible sexual behaviour.	48	38
	(e) Factual information about the physical, emotional and social aspects of human sexual development from conception to old age.	28	24
ATURE ONSERVATION	(a) Management of human use of the biosphere, so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet needs of the future.	63	44
	(b) Preservation of natural environment.	11	24
	(c) Preservation of animals in game reserves, game parks or zoo.	1	1
	(d) Keep something from harm, decay, or loss with a view to later use.	9	14
	(e) A recognition by man of his interdependence with his environment, and man's participation towards solving real-life, local environmental problems.	15	17

Table 7.15b (continued)

CONCEPT	DESCRIPTION	PERCENTAGE RESPONSE	
		Teachers	Students
POPULATION GROWTH	(a) The addition of newly born individuals to the existing population by reproduction.	30	30
	(b) An increase in population which determines the rate at which natural resources are used up or destroyed.	54	51
	(c) A tendency of a specie to reproduce more offsprings in order to insure its survival and generate genetic variability.	6	12
	(d) Efforts to reduce population growth rate include various methods of 'birth control'.	6	4
	(e) Factors such as improved agricultural practices and medical science promote better levels of survival and will take care the growing population.	3	3
AGRICULTURE	(a) Should be practised by individuals who live in rural areas or intend to be farmers.	7	10
	(b) Growing cash-crops for sale on a small or large scale, excluding food production for yourself and family to survive.	3	3
	(c) Essential practice for our continued health yet disturbs the balance of nature through removal of natural vegetation, excessive use of artificial fertilisers and insecticides.	7	10
	(d) Animal husbandry should be encouraged although animal protein contain less essential amino acids than does plant protein.	14	13
	(e) Effective irrigation-schemes can increase the yields, frequency and variety of crops.	68	71
IMMUNITY	(a) Protection of a person from an infectious disease by the introduction of a vaccine which stimulates the body to form antibodies against that disease.	74	72
	(b) New-born babies possess passive acquired immunity from their mothers which last for life.	5	3
	(c) A high resistance to illness.	5	10
	(d) May last for life, once a person has been inoculated against that particular disease.	2	2
	(e) Protection of a community against an infectious disease is increased by adhering to an immunisation programme.	12	13
DRUGS	(a) Medicinal substances used alone or as an ingredient to alleviate physical pain and emotional illnesses.	22	32
	(b) Substances which alter people's perception of the world and make a person escape from the unpleasant realities of life.	37	27
	(c) Substances which can be required by the body in increasing amounts in order to produce the desired effects.	5	16
	(d) Socially acceptable substances, like coffee or alcohol cannot lead to ill-health and death even if used in excess.	2	3
	(e) Medicinal extracts from plants or herbs, from bacteria and fungi or from synthetics, which can kill pathogens without harming the patient when taken in a safe dose.	31	22

Table 7.15c (continued)

CONCEPT	DESCRIPTION	PERCENTAGE RESPONSE	
		Teachers	Students
ENERGY RESOURCES	(a) The sun is the source of all energy i.e. food energy, fossil energy, wind power, water power and atomic energy.	66	68
	(b) The ability to differentiate energy usage on the basis of cost efficiency andfunction efficiency determines rate of progress of a developing society.	8	9
	(c) Transfer of energy between the living beings and the medium that surrounds them.	5	11
	(d) Energy sources like wood, cow dung, and biogas are considered finite and irreplaceable.	8	7
	(e) A community cannot be encouraged to change its living habits, to get maximum benefit out of the minimum energy reserve available through conservation.	11	7
POLLUTION	(a) A high concentration of poisons in the environment to damage man's health or well-being.	31	40
	(b) Emission of toxic substances into the atmosphere cannot alter the atmospheric properties.	1	4
	(c) An increase in the volume of water-borne waste in a river cannot endanger the biotic community because rivers have a capacity for self purification.	0	2
	(d) Pollutants are all kinds of substances which unsettle ecosystems in a way that, in the short or long term, could produce negative effects on mankind.	65	51
	(e) Lack of oxygen, temperature increases, poison and oil are the main forms of water pollution.	1	3
WATER RESOURCES	(a) Fresh water supply on the earth is unlimited.	7	18
	(b) The shortage of protected water supply in human settlements is responsible for diseases like diarrhoea, cholera, typhoid etc.	7	12
	(c) The hydrological cycle is responsible for renewing a big fraction of the world's total usable water supply.	12	15
	(d) Land water consists of surface water, subsurface water, soil water, and sea water.	15	12
	(e) Availability of water resources does not only include development of new resources, but also the conservation of available water, the elimination of waste and recycling of water used.	56	42

Such an understanding reflects not only the biological principles but also the social, economic, or cultural dimensions. However, narrow views of understanding limited to explanations related to the structure of biology only were seen in drugs (37%), population growth (30%), sex education (22%) and health (19%). Sometimes complete misconceptions were shown, for instance, 9 percent of the teachers suggested that sex education was "knowledge about contraception and family planning" and "the act of sexual intercourse".

In general, more than 50 percent of the student-teachers tended to choose statements that were broad and represented a holistic view of on five concepts: agriculture, population growth, pollution, immunity and energy resources. More than a third of the student-teachers chose statements which had no reference to the social or technological context. For example, 37 percent of the student-teachers understood sex education to be the following:

(a)	Knowledge about the human body and body functions, especially reproduction.	29%
(b)	Provision of knowledge about contraception and family planning.	8%
		37%

Other statements which reflected narrow views were on issues such as nature conservation (38%), drugs (27%) and health (26%). Student-teachers also appeared to have more misconceptions than

teachers on these issues. For instance, let us consider th‹
following: (Also refer to Table 7.15):

Health: Statement (a) was chosen by 14 percent of the student-teachers compared to 8 percent of the teachers.

Water resources: Statement (a) was chosen by 18 percent of the student-teachers compared to 7 percent of the teachers.

A cross-tabular analysis of the nature of understanding abou biosocial issues (Table 7.15) as against age (Table 7.1) teaching experience (Table 7.2), professional qualification (Table 7.4) was done. In general, there was agreement that th understanding of concepts could not be attributed to age teaching experience and professional qualifications of bot teachers and student-teachers. However, a proportionally hig percentage (12%-20%) of student-teachers following a Secondar Teacher's Diploma were inclined to choose statements tha reflected a narrow understanding of certain concepts.

A comparison of both the teachers' and student-teachers' ow ratings of how much they knew about biology-related problem (see Table 7.13) with the nature of their understanding (Tabl 7.15) shows that they rated their knowledge higher than what wa revealed by the test of understanding. The number o student-teachers (20%-30%), who ranked "excellent" knowledge o six of the problems is unrealistically high when compared to their actual achievement as indicated in Table 7.15.

7.5.3 Perception of African Adults' Knowledge

Indications that African adults know little about most biosocial issues was revealed in Table 7.14 above. The perception of both teachers and student-teachers, as discussed above, was that adults have a poor understanding of more than half of the problems under investigation.

TABLE 7.16: TEACHERS' AND STUDENT-TEACHERS' OPINIONS OF THE NEED FOR AFRICAN ADULTS TO HAVE BIOSOCIAL KNOWLEDGE

RESPONDENTS	PROBLEM	GREAT %	MODERATE %	SLIGHT %	NOT AT ALL %	DON'T KNOW %
TEACHERS	Food resources	80	18	2	-	-
	Water resources	78	21	1	-	-
	Energy resources	67	26	5	2	-
	Human health & diseases	84	15	1	-	-
	Land use	70	26	3	1	-
	Sex education	90	8	2	-	-
	Pollution	81	16	2	1	-
	Population growth	85	11	4	-	-
	Drug problems	81	15	4	-	-
	Immunisation	80	15	4	1	-
	Nature conservation	90	8	2	-	-
STUDENT TEACHERS	Food resources	83	13	4	-	-
	Water resources	73	22	3	2	-
	Energy resources	67	26	4	3	-
	Human health & diseases	81	13	3	2	1
	Land use	60	28	6	3	2
	Sex education	67	22	10	1	1
	Pollution	65	30	4	1	-
	Population growth	68	24	4	2	2
	Drug problems	63	25	8	3	1
	Immunisation	58	31	8	2	1
	Nature conservation	73	16	9	2	-

Related data, on the extent to which adults need information about biosocial issues, is presented in Table 7.16.

In general, data in Table 7.16 indicates that both teachers and student-teachers felt strongly that African adults need more information about biosocial issues. From the data it appears that both teachers and student-teachers felt that the need for information was great (more than 60%) on most issues. It is of interest to note that teachers thought that African adults need more information even on issues such as sex education (90%) and population growth (85%). These issues were indicated by teachers, in the previous section (see Table 7.11), as issues that would not be strongly supported for incorporation into the curriculum by African adults.

7.6 SOURCES OF INFORMATION ABOUT BIOSOCIAL ISSUES

In order that biosocial issues should be better understood by the African community, it is imperative that the flow of information must be improved and uninhibited. In this section responses of teachers and student-teachers are discussed regarding how they perceive their usage of information, as well as its sources.

7.6.1 Information Used by Teachers and Student-Teachers

Two questions intended to determine the general and specific sources the respondents use for information about biology-related problems were included in the questionnaires. The data of the general and specific sources of information used by teachers and student-teachers is shown in Table 7.17. The data in Table 7.17 indicate that the most important general sources for both teachers and student-teachers, in decreasing order of importance, were print media, social institutions, personal experience, audio-visual media and people.

TABLE 7.17: MAJOR SOURCES OF INFORMATION USED BY TEACHERS AND STUDENT-TEACHERS TO OBTAIN INFORMATION ABOUT BIOSOCIAL ISSUES

GENERAL SOURCES	SPECIFIC SOURCES	TEACHERS Freq. (%)	STUDENT-TEACHERS Freq. (%)
PRINT MEDIA	Professional journals	35,4	41,7
	Newspapers	25,3	24.7
	Textbooks	73,7	77,4
	Magazines	17,2	14,0
	Government documents	29,3	21,5
AUDIO-VISUAL MEDIA	Radio	35,4	35,5
	Television	47,5	53,8
	Films	29,3	37,6
	Posters	33,3	28,0
	Computer programmes	16,2	26,9
PERSONAL EXPERIENCE	Educational work	65,7	58,1
	Research	38,4	49,5
	Social involvement	37,4	36,6
	Employment/Work	26,3	19,4
PEOPLE	Family/Friends	31,3	36.6
	Marketing representatives	8.1	11,8
	Community leaders	17,2	16,1
	Faith healers	6,1	17,2
	Herbalists/Isangomas	5,1	17,2
	Medical doctors	60,6	55,9
SOCIAL INSTITUTION	Schools	79,8	81,7
	Museums	43,4	32,3
	Places of Worship	19,2	22,6
	Hospitals & Clinics	45,5	53,8
	Public libraries	56,6	61,3

The implications here are that teachers and student-teachers obtain most information on biosocial issues from print media. As the most important source of information, the print media need to be easily accessible and affordable, as well as full of information on biosocial issues. Table 7.17 also reveals that schools and textbooks were the most important specific sources for the majority of both teachers (79,8% and 73,7% respectively) and student-teachers (81,7% and 77,4% respectively). The second-most important sources, supported by more than 50 percent of teachers and student-teachers, were educational work, medical doctor and public libraries (see Table 7.17). Although hospitals and clinics, museums, research and television were not ranked high as sources of information, over 40 percent of teachers or student-teachers use these sources.

The least important sources of information for teachers and student-teachers were marketing representatives, faith healers and herbalists. From this table it can be seen that teachers and student-teachers use a variety of sources. Presumably, each source of information provides insight into a particular biosocial issue or knowledge.

7.6.2 Perceived African Adults' Sources of Information

The perception of teachers and student-teachers about the sources of information used by African adults was that schools and textbooks were the chief sources. The teachers suggested that the most important sources of information for adults, in decreasing order of importance, were schools (76%), textbooks (76%), medical doctors (73%), radio (71%), hospitals and clinics (69%), family and friends (62%). The least important sources of information for adults which were suggested by teachers were the professional journals, government journals and faith healers.

Student-teachers' response to the same question indicated that while schools and books are highly ranked (89% and 81% respectively) these are followed by the radio (80%), family and friends (76%), medical doctors (74%), hospital and clinics (71%) and television (67%). Although places of worship, herbalists family and friends were not ranked highly as sources of information, over 40% of both teachers and student-teachers suggested that a section of the adult African population obtains information from these sources.

The above results suggest that the most important sources of information on biosocial issues for teachers, student-teachers and African adults in the north-coastal region of Natal are schools and textbooks. In view of the lack of application and context in the biology content prescribed in syllabuses as well as the fact that textbooks are written to fit the dictates of the syllabuses, the nature of the current information obtained in schools and from textbooks is questionable. However, the results strengthens the main idea of this study, which is that biosocial issues should be included in the curriculum so that more people have access to the information.

7.7 CONCLUSION

This chapter has attempted to give a quantitative analysis inferred from the presentation of data which were collected via surveys with biology teachers and student-teachers. Several questions examined the following respondents' perceptions of the most important biology-related social problems in the African community; respondents' knowledge and the estimation of public understanding of these problems; and respondents' recommendations concerning the inclusion of biology-related social issues in the school biology curriculum.

Data from both surveys, biology teachers and student-teachers indicated that there was agreement on most questions investigated in this study. Results indicate that the areas of greatest concern are those of food, water and energy resources as well as health and diseases. The majority of teachers and student-teachers felt that they were knowledgeable about biology-related issues. The nature of understanding that they had, however, was for the most part a narrow, factual view of concepts that neglected the social perspective.

The analysis of biology topics that are prescribed for teaching in the standards 8, 9 and 10 syllabuses revealed a lack or a minimal application of biology concepts to real life problems. These results supported the lack of a broad and holistic understanding of concepts that emerged from the responses of the subjects in Table 6.11. In general, the findings showed that the identification of the most important biology-related social problems for inclusion in the school curriculum was not necessarily influenced by most of the personal characteristics of the subjects.

The interpretational explanations in the next chapter will help place the presentation and analysis of data in perspective. While there are limitations in this survey, the findings may provide an initial fund of information and support for the emerging science-technology-society theme in biology education.

CHAPTER 8

ANALYSIS AND INTERPRETATION OF DATA

8.1 INTRODUCTION

The data analysis and the discussions in the previous chapters provide a framework for interpretation and conclusions about biology teachers' opinions on biology-related social issues. The discussion in this chapter is closely related to the research objectives and the pertinent questions this investigation set out to answer.

This study examined the extent to which biology teachers and student-teachers, in the Natal north-coastal region, can identify biology-related social problems in their communities. The study further attempted to determine teachers' knowledge about identified biology-related social issues and to determine which relevant biology-related issues could be included in the secondary school biology curriculum.

For purposes of clearer understanding of the issues to be interpreted, the nine objectives presented in Chapter 7 have been grouped for discussion into four sections. The sections are as follows:

(a) The first section discusses the extent to which schools are teaching biology-related social problems. This section interprets the responses of teachers and student-teachers as well as the results of the content analysis of the standards 8, 9 and 10 biology syllabuses.

(b) The second section discusses the following objectives: identification of important biology-related social problems; the indication of whether biology-related issues should be studied at different school levels; and the indication of the degree of change in the quality of life by year 2000 if the issues are not taught at school.

(c) The third section deals with objectives that sought to find out the following: how knowledgeable teachers and student-teachers were about biology-related issues; the nature of understanding that teachers and student-teachers have about the issues; and to elicit teachers' and student-teachers' opinions of African adults' understanding of these issues.

(d) The last section discusses the sources of information that teachers and student-teachers use to obtain information regarding biology-related issues. This section also interprets opinions obtained from teachers and student-teachers about the sources of information on biosocial issues used by African adults.

8.2 EXTENT TO WHICH BIOLOGY-RELATED ISSUES ARE TAUGHT

One of the aims of this study was to examine the extent to which biosocial issues are included in the biology curriculum prescribed for African schools. The study focused on determining the degree to which biosocial issues concerning food, water, energy, human health and diseases, land use, sex education, pollution, population growth, drugs, immunisation and nature conservation were grafted in biology syllabuses and taught in biology classes.

8.2.1 Responses of Teachers and Student-Teachers

The response of teachers and student-teachers to the question: 'to what extent do local schools teach children of different ages biosocial issues', showed that moderate exposure of these issues occurs. Teachers and student-teachers agreed that very little is taught at primary school level, while there was "moderate" exposure at junior secondary to the tertiary school level. Furthermore, the results showed that there is a gradual increase in the amount of what is taught at different ages, from primary level to tertiary level.

Although the results generally suggest that the extent to which biosocial issues are exposed from junior secondary to tertiary level is 'moderate', in reality there was sufficient exposure to only five issues. Results showed that teachers indicated that there was 'great' exposure to issues on water (57%), food (56%), energy resources (47%), health and diseases(42%), and natur conservation (41%) at senior secondary school level Student-teachers also ranked the above mentioned issues ver high: food (75%), water (65%), energy (67%), human health an diseases (62%) and nature conservation (52%). However, th results do not indicate whether the content taught is mainly o basic biology facts or whether it involves application of biolog facts and the solutions to problems.

In general the exposure to problems concerning land use, se education, pollution, population growth, drugs, and immunisatio was thought to be 'slight' at junior secondary schools (se Tables 7.5 and 7.6). It is possible that both teachers an student-teachers were aware that the prescribed content fo junior secondary school did not include these issues. An information on the above mentioned biosocial issues can only b obtained through the interrelationship that exists betwee biological concepts.

The response from teachers and student-teachers indicated that at senior secondary and tertiary level slightly more exposure to issues on land use, sex education, pollution, population growth, drugs, and immunisation occurs (see Tables 7.5 and 7.6). Agreement between teachers and student-teachers about the extent of teaching done in relation to these issues indicates their knowledge about the content prescribed in the syllabuses. Most student-teachers and teachers in this study had passed matriculation where the content of syllabuses of senior secondary classes was the same. In addition, the post-matriculation teaching diploma offered at colleges of education goes through the content prescribed for secondary education when preparing student-teachers for the teaching profession. This also explains why the percentage ranking of student-teachers was higher than that of teachers.

However, the response of teachers and student-teachers does not indicate the depth of the content that is taught nor the context of biology teaching in class. It is possible that the lower percentage ranking of teachers indicates that they were more aware, than student-teachers, that there is a difference between basic biology and social biology. In other words, the biology taught at schools presented more facts than a critical discussion of how biology knowledge and technology impacts on society. Notwithstanding, the results of data obtained from teachers and student-teachers in this section, provide us with knowledge that some aspects of biosocial issues are taught in African schools.

8.2.2 Content Analysis of Biology Syllabuses

The analysis of standards 8, 9 and 10 biology syllabuses revealed that topics covered in the syllabuses are generally designed to present biology information in the context of a logical structure of the discipline. In most topics in the syllabuses the emphasis is placed on biology facts and principles. Some topics which are basically problem-oriented like those on pollution, nature conservation and population growth, seem to be given superficial treatment (see Table 7.7). In addition, the time spent on some topics is minimal. For instance, the percentage of time devoted to the teaching of population dynamics in standard ten is 12 percent, while pollution in standard eight has 3 percent of the time devoted to it. It is also evident that when issues on these topics are treated, the global perspective is neglected. The main reason for this is the absence of any direct reference to biology-related social issues in the syllabus. The impression created by excluding global perspectives from the syllabuses, is that South African problems are unrelated to similar problems occurring internationally.

Topics such as human physiology, food and nutrients, and physiology of plants are covered extensively and have a considerable amount of time or number of teaching periods allocated to them (see Table 7.7). However, the analysis revealed that the emphasis in these topics is on biology facts and principles. The interrelationships between biology, technology and society, between biology and other disciplines, the emphasis on personal and social applications of biology as well as career awareness are not discussed in the biology syllabus content. Problems or issues related to these topics, which could help develop skills such as problem-solving and decision-making, are not included. For example, in the topic "Nutrients and Foods" the following problems/issues could be included to make the topic more relevant to children's lives:

(a) What is the nutritional value of indigenous Africar foods?

(b) Should our decision about which food to buy be basec upon what advertisers claim or on the ingredients o the food product listed on the container?

(c) How important are chemical additives in our food?

(d) Would it be better to use chemical fertilisers o natural fertilisers, such as manure, in order t improve the yield of crops?

The presentation of topics in this manner will not only assist i educating the African community about science related issues, bu also increase their awareness of the benefits and ill-effect associated with the items under discussion.

The percentage of time devoted to biology content that i regarded as part of biosocial categories, as seen in Table 6.12 was found to be different for each category. For example, in th standard eight syllabus 3 percent of the teaching time i allocated to "pollution" while "human health" has 32 percen teaching time allocated to it. It should also be noted that i the entire three-year senior secondary curriculum, pollution i only treated in standard eight. There is no explanation in th preamble or anywhere else in the syllabuses regarding th differences in time allocation for each topic. The fact that bot the problems of pollution and health discussed above were ranke as the most important to the lives of respondents in the stud area, indicates that there is no correlation between what i taught in schools and what the community needs. Therefore, the time allocated to each topic has no bearing on the needs of the community.

Another important finding in this section is that the number of prescribed teaching periods or the percentage of time devoted to each topic creates an inflexible time frame through which the prescribed content should be taught by the end of each standard. Because of the vast number of biology facts and principles that need to be learnt, as compared to the time allocated, there is very little opportunity to discuss issues outside of the prescribed content. Some of the other compounding factors are: the examination questions do not assess higher level skills like the application of biology knowledge to real life situations, but seem only to require the recall of facts; the amount of time allocated to each topic and the work programme designed by education authorities is rigidly used by school inspectors to monitor the progress or the lack thereof in teaching at schools. This rigid adherence to the time schedule and following the work programme subsequently limits the teacher's creativity and teaching style.

8.3 IMPORTANT BIOLOGY-RELATED SOCIAL PROBLEMS

The second broad aim of this study was to determine whether teachers and student-teachers can identify biosocial problems that are prevalent in the African community. The identification and the awareness of local problems that may be associated with a biology component is important for the relevance of biology education. If adequately developed, the biology curriculum could integrate topics that address the needs and interests of the children and the entire communities.

8.3.1 Problems that Impinge on the Life of Africans

The analysis of data on important biology-related problems which affect life in the African community indicated that more than 80 percent of both biology teachers and student-teachers (see Table 7.8) ranked the following problems as being the most important: food resources (79,6 percent by student-teachers and 84,8 percent by teachers) and water resources (83,9 percent by student-teachers and 84,8 percent by teachers).

The above-mentioned results suggest that the majority of teachers and student-teachers in this investigation were in agreement regarding food and water as being most serious problems in the north-coastal region of Natal. A possible motivating factor for the identification of these problems is that the scarcity of food and water is a life threatening situation which is extremely difficult to endure on a daily basis. Proper nutrition impacts on ones physical and mental development; it also affects ones susceptibility to both infection and diseases. In close correlation to food and water resources, energy issues were perceived as very important because energy, *inter alia*, is regarded as necessary for the preparation of food as well as providing energy for the individual, the home, and industry.

The second most important set of problems identified by over 60 percent of the teachers and student-teachers is: energy resources; human health and diseases; and nature conservation (see Table 7.8). These problems relate to the preservation and continued survival of human species and its offspring. Health and energy resources support life and ones ability to work towards acquiring an improved quality of life. The high percentage response (averaging 65,3 percent) relating to the perception of these three problems, shows that they are as important as the food and water resources. The basis for the high regard for these issues could be the experiences of suffering publicised by the media in many areas of Africa.

To most respondents nature conservation suggested the preservation of life-giving resources. It was associated with the survival of human society. It is possible that teachers and student-teachers placed nature conservation in the second most important category because they perceived it to be associated with the better management of resources for the benefit of present and future generations. The respondents' scale of concern may first have been about the resolution of immediate problems of obtaining food, water and energy for daily survival. Secondly, concern could be about the preservation of these resources for posterity. It is also possible that the education and socialisation of teachers and student-teachers could hav influenced the high scoring for nature conservation (66,7%), i contrast with energy (65,1%) and health (64,1%) resources.

On the whole, the above-mentioned issues (food, water, energy health and conservation) continue to be perceived as importan because the respondents are part of the African community tha is experiencing hardships. Furthermore, teachers are confronte daily with learning problems related to malnourished and sic children. As a result, they are constantly aware of problem within the African community, and as leaders, they are expecte to assist in finding solutions to these predicaments.

Biology-related social problems which were identified as th first and second most important issues by a substantial number o teachers and student-teachers are consistent with observation and what media reports pointed to during the time of dat collection in this research. Media reports on drought, famine health and diseases in the north-coastal region of Natal ar discussed in Chapter 4. It is therefore possible that th respondents in this study perceived that these problems were no just for their families, but were for the whole region. It i also possible that the current socio-political problems in Sout Africa and the accompanying political violence have destabilise families and increased unemployment. This, in turn, ha exacerbated the problems of poverty, exposure to health problem and diseases, and water-related resources.

The results show that the third category of problems viewed a:
important include population growth, pollution and land use
These problems were viewed as less threatening to the immediat
lives of individuals in comparison with the problems discusse
above. In the light of all the apartheid policy and law:
(discussed in Chapter 2), which attempted to control the lives o
Africans in this country, it is possible that problems of lan
use and population growth were viewed by teachers and student
teachers as foreign to the sentiments of the African community
For instance, the governmental restrictions on free movement an
settlement imposed on Africans, could have resulted in perceivin
these issues as further contrivances to control the lives o
Africans. In addition, the African culture regards children a
being a gift from God, as a source of procreation and as
surety that the aged will be looked after.

In the case of pollution it is possible that teachers an
student-teachers did not rank it highly because they associate
it with industry and not with individuals in society. I
discussion, respondents did not perceive themselves as hig
polluters because they were not in possession of money an
resources to afford them that opportunity.

The problems that were seen as least important were immunisatio
(47,5%) and sex education (41,4%) indicated by teachers, an
drugs (34,4%) and sex education (31,2%) indicated b
student-teachers. These responses can be interpreted in variou

ways. Immunisation and drugs were not perceived as seriou problems because of the following: firstly, both teachers an student-teachers value the importance of immunisation and were together with their families and other members of the community ensuring protection against infectious diseases. The fact tha student-teachers ranked immunisation higher (see Table 7.8) coul be attributed to the realisation that health services ar important yet are in short supply. The latter include: th shortage of hospitals and clinics in African areas and the lon distances parents travelled to existing health facilities Immunisation is therefore perceived as a problem of the broade African community.

Secondly, problems concerning drugs were revealed as les important, more by student-teachers than teachers, because fewe members in the community were perceived as engaging in dru abuse. Another explanation could be that since drugs ar expensive to buy, the lack of money prevented many people fro abusing drugs. Thirdly, sex education was identified as the leas important problem because both teachers and student-teacher either thought that individuals in the community have sufficien knowledge about it or do not need any knowledge about se education. Another explanation could be that sex education i viewed negatively either because it is seen as 'teaching about sexual intercourse' or it involves contraception and famil planning. The latter was made very unpopular by the Sout African government during the apartheid era, when it wa associated with the social engineering of the population. Data in Table 7.8 show that 9 percent of teachers and 10 percent of student-teachers in this study held the above mentioned views.

8.3.2 Issues for Incorporation into the Curriculum

The second objective in this section attempted to establish whether biosocial problems or issues were important enough to be studied at school. Results showed that over 70 percent of biology teachers and student-teachers (Tables 7.9 and 7.10) indicated that it is very important to include the study of all eleven biosocial issues in schools. The study of these issues was indicated for all school levels, that is, primary, junior and senior secondary schools, as well as for tertiary education. However, a significant number of both biology teachers and student-teachers (80%) indicated a need for greater emphasis in teaching biosocial issues at senior secondary school and tertiary level, compared to 60 percent at junior secondary and 40 percent at primary school level. These results indicate that teachers felt that the emphasis of teaching these issues should increase with the rise in the level of schooling.

A fundamental interpretation emerging from the above results is that schools should teach biosocial issues. Knowledge about biosocial issues is needed by all children at all school levels, that is, primary, junior secondary and senior secondary, as well as by students at the tertiary education level. The fact that teachers felt that the degree of emphasis on studying biosocial issues should be less in the lower classes and more in th higher classes indicates a recognition that the age of pupil should be considered in relation to the type, amount and depth o knowledge to be taught. According to Driver (1988:137) it i important to recognise that, during learning, individual construct their knowledge as a result of interaction betwee their current conceptions and ongoing experiences.

In teaching biosocial issues, therefore, the recognition an importance of experience among children in their construction o knowledge, will need to be observed and re-evaluated. When thi is done, the selection of appropriate issues to suit particula class experiences should be considered. Secondly, experience that children acquire through participation with their familie and individuals in the community may differ with age and thei level of education. For example, the experiences of primar school children differ from those of students at secondary schoo level, through their being exposed to higher levels o information and communication.

In the United States of America, United Kingdom and som developing countries like Botswana, Nigeria and the Phillipine the majority of science educators and research reports (Lewis 1981; Bybee, 1987; Jegede, 1988; Nganunu, 1988; Tan, 1988;) als strongly support the inclusion of biosocial issues in the schoo curriculum. In fact, the countries mentioned above have als developed new curricula which include science-technology-societ issues. The fact that the majority of respondents in this stud; strongly support the study of biosocial problems at schoo: indicates that a re-assessment of biology content and the goal: of biology education in schools for Africans, and perhaps Sout: Africa at-large, is necessary. These findings strongly suppor the appeal for a biology curriculum that can furnish student with appropriate knowledge to resolve real-life problems an issues made in Chapter 4 and 5. The findings also support th argument presented in Chapter 3 where an appeal was made t include personal and societal dimensions as part of the goals o biology education.

8.3.3 Quality of Life in the Year 2000

In rounding off the problems associated with biosocial issues subjects were asked to respond to the question: 'To what exten will biosocial problems change by the year 2000 if they are no taught in schools?' The results of this investigation sugges that a significant number (over 60%) of both biology teachers an student-teachers felt that all problems related to food, wate: and energy resources, human health and diseases, land use, se: education, pollution, population growth, drugs, immunisation an nature conservation will not get better. This view is shared b; findings from surveys done in the United States of America wher over 50 percent of science educators and college students though that world hunger, population growth, air quality, wate: resources and war technology would be worse by the year 200((Bybee and Mau, 1986; Bybee and Najafi, 1986).

In view of the results from this inquiry, the emergin interpretation is that there will be no substantial improvemen in the quality of life of the African people in the north coastal region of Natal, unless these issues are taught a schools. Furthermore, a serious effort has to be made t urgently redress the educational imbalances and socio-economi inequalities associated with apartheid in South Africa. Th findings further indicated that respondents are aware of an accept the fact that schools are places where the mos information about biosocial problems could be obtained (se Tables 7.9 and 7.10). Knowledge obtained from schools is likel to be structured, comprehensive, integrated and lead to bette development of problem-solving skills and informed judgement i students. In addition, school children constitute a larg section of the community and future citizens of the Africa community. Therefore, teaching biosocial issues at school wil ensure that more individuals who will make decisions for th African community by year 2000, are informed about these issues.

8.4 <u>KNOWLEDGE OF BIOSOCIAL ISSUES</u>

The nature of understanding and knowledge about biosocial issue possessed by teachers and student-teachers was one of the mai aims of this study. The extent of understanding and knowledg regarding social problems with a biological component possesse by teachers and student-teachers could help in indicating whethe they can cope with teaching biosocial topics. The responses o

teachers and student-teachers will be discussed under th
following subcategories:

(a) The extent of understanding through the respondents' ow rating.

(b) The nature of understanding measured by choosing statement that indicate the connection of biosocial concepts wit other aspects of knowledge.

(c) The perceptions held by teachers and student-teachers i relation to how much African adults know about biosocia issues.

8.4.1 Extent to Which Biosocial Issues are Understood

In this investigation teachers and student-teachers were asked t rate their own knowledge about biology-related social problems More than 60 percent of teachers indicated that their knowledg of food (72%) and water (73%) resources, pollution (63%) an nature conservation (64%) was very good (see Table 7.13) Problems concerning population growth, drug problems, health an diseases, and energy resources were revealed as being known th second best. Issues on which teachers had "fair" to "poor knowledge were land use, immunisation and sex education.

In general, student-teachers indicated that their knowledge o all biosocial issues was not good. These student-teachers (ove 60 %) indicated that they were most knowledgeable about foo (82%), water (81%) and energy (71%) resources, pollution (62% and nature conservation (69) - (see Table 7.13). The second bes known problems relate to human health and diseases, populatior growth and immunisation. Student-teachers indicated that they have the least knowledge about land use, sex education and drug problems.

The response of teachers and student-teachers, in this study indicate that a high percentage of respondents knew somethin about each problem. Results show that more than 40 percent o teachers and student-teachers have fairly satisfactory knowledg about problems that were identified as being of least importance which are, immunisation, drugs and sex education. Therefore, bot teachers and student-teachers seemed not to rank a problem a least important just because they knew little (or more) about it It is interesting to note that student-teachers had a muc higher percentage rating on "excellent" understanding about eac problem, when compared to the teachers' evaluation. A possibl explanation could be that student-teachers were, at the time dat were collected, involved in biology learning and projects writing assignments, exposed to a variety of educationa materials as well as preparing for the final examinations. As result, they may have perceived their knowledge as being mor than that of the teachers.

The overall interpretation of these results reveals that biolog teachers and student-teachers do not have a good understanding o most biosocial issues. Through their own assessment, teacher and student-teachers indicated a need for more information abou biosocial issues. This study has revealed that possession of goo knowledge about all local biology-related problems is regarded a being critical for teachers and student-teachers, because the are responsible for educating junior and senior secondary pupils It should be understood that secondary school pupils are at th threshold of entering the adult world. Only adequately traine biology teachers can devise relevant educational materials an learning projects that will most likely include local biosocia topics which can assist pupils in improving the quality of lif in their homes and that of the community at large.

8.4.2 The Nature of Understanding Biosocial Issues

In an attempt to obtain some indication of the actua understanding of biology-related social issues, biology teacher and student-teachers were asked to choose statements that bes described each of the eleven pre-selected biosocial issues o concepts. It must be noted that this section of the questionnair did not try to assess the depth of understanding that respondent had about biosocial issues for the purpose of teaching these issues at school. However, the section attempted to find out i an understanding of concepts by respondents was associated witl other elements such as the economy, society, technology and so on. Such understanding is thought to make the meaning o description of the concepts more wider and complete.

The results in this investigation show that more than 60 percent of biology teachers chose statements that could be described as broad and related to several aspects of life or othe disciplines: health, malnutrition, nature conservation population growth, immunity, energy resources, pollution agriculture and water resources. Although more than 50 percen of teachers held holistic views on the meaning of 'se education' and 'drug problems', a considerable number o teachers chose statements that were narrow for describing dru problems (37%) and sex education (22%). Other areas where narro views were held were population growth (30%) and health (19%) Some misconceptions were also revealed when, for instance, percent of teachers chose statements describing sex education a 'knowledge about contraception and family planning' or 'teachin about the act of sexual intercourse'.

The responses of student-teachers, in this inquiry indicate tha more than 50 percent had a holistic view on all th biology-related problems chosen for investigation. Almost third of the student-teachers chose statements showing a narro view. Understanding of concepts that were restricted to factua biological explanations, without reference to the social technological and other contexts, appeared to be substantial For instance, explanations packed with biology facts were chose for the following problems: sex education (39%), natur conservation (38%), population growth (30%), drugs (27%), an health (26%). A much higher percentage of student-teachers a opposed to teachers also showed misconceptions when they chos statements regarding health (14%) and water resources (18%).

It is encouraging that more than half of the teachers and student-teachers in this study showed a broad, holistic understanding of biosocial issues. The majority of biology teachers and student-teachers are residents in the African communities of the north-coastal region of Natal. Therefore, they may have personal experiences with biosocial problems emanating from social interaction with other school children and individuals from outside the study area. These experiences may have broadened their perception of biosocial problems in terms of their understanding that other aspects of knowledge, pertaining to social, economic, political and technological issues, come into play in describing and in resolving these problems. The respondents' conceptions of problems are bound to extend beyond the narrow view, a view confined to biology facts devoid of context.

These findings are supported by the constructivists view of knowledge, discussed in Chapter 5, which maintains that the construction of meaning or knowledge is through experience with the physical environment and through social interaction (Kelly, 1955; Driver, 1988). This philosophical viewpoint within the realm of science education is gradually gaining acceptance and could improve with the emerging changes in the science curriculum and the demise of the policy of apartheid.

Another interpretation of results in this section is that the majority of teachers and student-teachers have a good knowledge of the biological component of each social problem. This is to be expected considering that biological information can be received in all academic settings such as secondary schools, colleges of education and universities. Firstly, the content analysis of biology syllabuses discussed earlier in this chapter shows that the biology content presented at standards 8, 9,and 10 either neglects the social context or gives a brief and superficial treatment of problems. Secondly, in colleges of education the level of biology content is unchallenging and not likely to widen the student's knowledge beyond standard 10 (Salmon and Woods, 1991:64). The main reason for this stagnation is that there is usually a repetition of content prescribed for standards 8 to 10, as well as that covered in colleges of education. Lastly, universities specialise in broadening and deepening biology principles and research with a total disregard for the social impact of biology research and products of bio-technology.

From the above discussion, it can be assumed that when the majority of teachers and student-teachers indicated that they know something about biosocial issues (see para. 8.4.1 above), they were referring to the biology facts and principles presented in academic classes. Very few or none of them had an opportunity to participate in educational programmes that deal with or critically analyse the scientific, technological and social aspects of these biosocial problems.

Misconceptions or narrow explanations of certain concepts held by some teachers and student-teachers, in this study, can be explained in two ways. Firstly, some of the misconceptions arise from negative views held by members of the African community which is caused by ignorance about the actual description or educational content embraced by a particular concept. Sex education is a typical example. Secondly, narrow explanations can arise from the kind of education which lacks integration and the interdisciplinary perspective. The understanding of the concept 'health' as the "absence of disease" is an example of this narrow view. This definition of 'health' does not recognise current ideas that health involves the total well-being of the whole person, that is, including aspects of the physical, mental and social well-being (Garrard 1986:4).

Such misconceptions and lack of competence in spelling out biosocial issues could result in faulty foundations being laid in the classroom, if structured curriculum components on biosocial issues are not taught. The importance of the teachers' understanding of socially relevant biological issues is also critical for the willingness of teachers to impart knowledge and participate in developing relevant biosocial curricula.

It must be noted, however, that the part of the questionnaire dealing with the understanding of concepts, only attempted to reveal the meaning and association with other aspects that biology teachers and student-teachers had about each concept.

The depth of understanding and knowledge about these issues, tha is, whether teachers had enough knowledge to use in solving thes problems, in teaching content on biosocial issues or in usin appropriate methods to teach issues-based studies, was no solicited. It is possible that some teachers would cope wit teaching biosocial issues while others would not cope. However the information emerging from this section provides insight int teachers' and student-teachers' understanding of biosocia problems, and the role they may play in educating or designin teaching programmes in biology involving societal issues. Th information is also valuable for the purposes of designin teacher education programmes and appropriate educationa materials when the time comes for reconstructing biolog education.

8.4.3 <u>Perceptions of African Adults' Knowledge</u>

Teachers and student-teachers were asked to respond to th question: 'To what extent are African adults aware o biology-related social issues?' In general, results indicat that adults are slightly knowledgeable about most of these issue (see Table 7.14). For example, half of the teachers think adult have a "poor" understanding of issues such as sex educatio (51%), pollution (49%) and population growth (49%). In addition more than a third of the teachers think adults have a poo understanding of drug problems (36%) and of nature conservatio (37%).

The response of student-teachers to the same question tends to b in agreement with the above results. More than a third of th student-teachers think African adults have a poor understandin of the following problems: sex education (46%), pollution (39% population growth (34%) and nature conservation (31%). Agreemen was also evident when 25 percent of both teachers and studen teachers indicated that the knowledge of adults is poor o problems concerning energy resources, human health and diseases land use, and immunisation.

It must be noted that the above results are not a direc assessment of the African adults' understanding of biosocia issues/problems. Such an assessment is beyond the scope of thi inquiry. The justification for including such an item is tha the teachers and student-teachers surveyed are in positions o leadership, community development, as well as in designin learning programmes based on the perceived needs and interests o adult members of their local communities. It is expected that based on their information of the communities in which they wor and stay, the opinions given by teachers and student-teacher were informed and unbiased.

There are two possible explanations for the opinions that adult have poor understanding of most biology-related issues. Firstly as discussed in Chapter 2, most African adults in South Afric are not well educated. Most adults who did not reach standard 1 would, therefore, have far less knowledge about biosocial issue than the teachers and student-teachers. Secondly, the lack o non-formal, scientific literacy programmes or communit development projects that focus on the development of skill related to coping in a world dominated by science and technolog means that adults have no opportunity to improve the quality o their lives.

Although there is debate about how knowledgeable the public ough to be, the results above indicate that there may be too man adults who know very little or are not aware of the issues. situation like this may result in too many people doing nothin to resolve this problem. At worst, they may become responsibl for exacerbating the problems. The effect of the interactio between science, technology and society on the life styles o many individuals increases the urgency of providing scientifi literacy programmes or relevant community based programmes.

8.5 <u>SOURCES OF INFORMATION ABOUT BIOSOCIAL ISSUES</u>

The last issue to be examined is that of information acquisition This focus of the inquiry was to determine what, where and ho teachers and student-teachers obtain information about biosocia issues. The related questionnaire was intended to provid insight into the availability or non-availability of effectiv educational materials with a science-technology-societ perspective. The ensuing discussion in the next paragraph i based on two information-related items which were investigated:

(a) The specific sources of information teachers and student teachers use to obtain knowledge about biosocial issues.

(b) The student-teachers' and teachers' opinions of the source of information African people use to obtain knowledge abou biosocial issues.

8.5.1 <u>Information Used by Teachers and Student-Teachers</u>

The results revealed that, in decreasing order, the mos important sources used by more than 50 percent of teachers an student-teachers were: schools, textbooks, educational work medical doctors, public libraries, hospitals and clinics an television. The least important sources were magazines o journals, newspapers, herbalists, faith healers, places o worship, computer programmes and marketing representatives.

Schools and textbooks emerged as the most important sources o information for teachers (79,8% and 73,7% respectively) and fo student-teachers (81,7% and 77,4% respectively) in this study. Several explanations can be presented for this situation. Firstly, teachers and student-teachers may inadvertently have considered only one aspect of the problems, that is, the biological component. Other components of the problems and related solutions such as the social, technological, economic, political, psychological and so on, were not recognised as being crucial. Therefore, the information obtained from schools and textbooks through their educational work is regarded as the most important.

Secondly, teachers and student-teachers may rely heavily o: textbooks and schools as their sources of knowledge. The reaso: for this is that the information received is structured in familiar and acceptable manner, which involves systematic hierarchical and a classificatory arrangement of concepts an their explanations. Such an arrangement makes the informatio: easy to understand when compared to other sources which ma emphasise problem solving, decision making and information wher clear cut answers do not always emerge.

Thirdly, schools and textbooks seem to be the only source available and used for most biology-related problems. Thi being the case, this study can therefore, provide some insight into the quality of information sources available to teachers an student-teachers, whether they were used or not.

Other sources of information that were identified by more than 5 percent of teachers and student-teachers were the educationa work, medical doctor, public libraries, hospitals and clinics an television (see Table 7.17). Possible explanations for thes sources taking second place of importance may be the following not much information is likely to be gleaned from all thes sources because of the infrequent visits and the distance travelled by teachers to these centres in order to ge information; although information on particular problems, fo: example health, can be obtained there is no readily availabl information on most of the other problems, except in publi(libraries.

Television programmes cannot provide all the necessar: information because they may not be geared towards providin; detailed information on biology-related social problems. I: addition, few teachers and student-teachers may posses, television sets and some African communities have no electricity Therefore, the information presented on television reaches fe' individuals.

Table 7.17 revealed that teachers and student-teachers identifie(magazines or journals, newspapers, herbalists, faith healers places of worship, computer programmes and marketin representatives as the least important sources. These source may not be recognised by teachers and student-teachers a valuable sources of information on local issues. It may also b possible that teachers and student-teachers do not regard, fo instance, herbalists and faith healers as influential provider of information regarding biosocial issues.

8.5.2 <u>Perceived African Adults' Sources of Information</u>

Teachers and student-teachers were asked to indicate the source of information used by African adults to acquire knowledge abou biosocial issues. The results showed that teachers indicate(that the most important sources of information for African adult: were schools (76%) and textbooks (76%). Student-teachers als(

had high ranking for schools (89%) and textbooks (81%). Information sources that were recognised as of second importance, by more than 60 percent of both teachers and student-teachers, include medical doctors, radio, hospitals and clinics, and family or friends. Less important sources identified were places of worship and herbalists. Although teachers and student-teachers ranked these sources low, a reasonable number of the respondents seemed to think that adults do seek information about biosocial issues from religious leaders and herbalists. The least important sources were perceived as the professional journals, government journals and faith healers.

The heavy reliance on schools and textbooks, by adults, suggests that there are limited sources of information for both teachers and adults. It also suggests that African adults are as educated as the teachers whereas this is not the case for most of the African adults. Another interpretation may be that the decisions made by African adults on biosocial issues is informed by what they gained from textbooks and schools during their school days. This brings to question the nature of the information adults receive in terms of the advances in knowledge and the changing present-day situations.

A further reason for questioning the quality of information is based on the fact that biosocial issues are either not clearly identifiable in syllabi or are presented in a superficial manner. This was evidenced in the preamble of the biology syllabuses and in the content analysis of the standards 8, 9 and 10 biolog syllabuses (see Table 7.7). It is possible, therefore, that th knowledge gained by adults at schools and from textbook contained very little information on biosocial issues. It i doubtful that the kind of knowledge adults obtained can be use to effectively cope with all the problems investigated in thi study.

Teachers and student-teachers also thought that African adult obtained information from medical doctors, hospitals and clinics the radio and the family or friends. One explanation is that th radio is the most affordable communication device for mos African families, even those who are in rural areas. Africa adults are also more likely to acquire information from member of the family or friends because Africans have strong famil connections. Their strong religious beliefs and community tie may also be responsible for their respecting religious an traditional leaders as providers of knowledge related to thei coping with life.

Since school textbooks are written to suit the prescribed syllab in South Africa, it can be assumed that biology textbooks focu strongly on facts and principles while neglecting the applicatio of the principles and concepts to societal problems. As such the information obtained in textbooks used by teachers, student teachers and adults in the study, can be expected to presen biology facts which neglect the social and technologica contexts.

8.6 CONCLUSION

The overall interpretation of results in this investigation suggests that the prescribed content in the standards 8, 9 and 1 biology syllabuses for African schools does not sufficientl address biosocial problems. Problems or issues that affect th daily life of African communities in the north-coastal region o Natal, are either superficially treated or neglected at school Teaching is focused mainly on the knowledge of biological fact and principles. As a result, African children are unlikely t apply school knowledge critically to resolve problems experience at home and elsewhere.

The results further suggest that the biology teachers, who coul be the key to emphasising the social implications of biolog principles they teach in class, are themselves restricted by th prescribed content and the prescribed time allocated to eac topic. In addition, their reliance on textbooks as mai information sources restricts their knowledge of the biolog component of the social problems rather than providing th solution to the problems. Teachers do not seem to show resourceful and enterprising spirit in availing themselves o information sources that are not prescribed in the syllabus.

However, the results indicate that teachers and student-teachers were able to identify the most important biology-related social problems in the north-coastal region of Natal. They also recognised that these problems were multi-disciplinary in nature and, therefore, their solutions would require a holistic approach to the knowledge of all the disciplines involved.

The knowledge of the local environment, local schools and that o the needs and aspirations of the local people, possessed by teachers, places them in the best position for curriculum initiatives. Therefore, the argument presented in this chapte concerning the importance of teachers in identifying an selecting relevant biology content for teaching in local school should be regarded as crucial in the reconstruction of a ne biology curriculum for African schools.

CHAPTER 9

SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.1 INTRODUCTION

The fundamental question raised in this study was to investigat the opinion biology teachers have about biology-related socia problems affecting the African community in the north-coasta region of Natal. Biology teachers teaching standards 8, 9 and 1 in African schools were required to select and discuss problem or issues related to the biology-technology-society theme from list that was provided. The major aim of the study was t determine the extent to which biology-related social issues ar being taught and/or can be taught in African schools, so as t make biology education relevant to the lives of the pupils a well as to the needs of the African community.

The more specific objectives of the study were to:

(a) Identify important biology-related social problems that affect the African community.

(b) Determine how well biology teachers understood these problems.

(c) Elicit the teachers' opinions about the understanding African adults have of these biology-related problems.

(d) Pinpoint the sources of information teachers use to obtai knowledge about biology-related problems or issues.

(e) Solicit the teachers' opinions about sources of information used by African adults to obtain knowledge about these issues.

(f) Indicate the degree to which schools were teaching these issues.

(g) Estimate the teachers' opinions about the quality of life in the year 2000, if these issues continue to be neglecte in schools.

(h) Recognise the emphasis that should be placed on each issu at different school levels.

(i) Determine whether biology-related social problems or issues are included as content in the standard 8, 9 and 1 biology syllabuses.

In the previous chapter these objectives were categorised int groups of three and given a comprehensive commentary o interpretation. Methodologically, objectives (a) to (h) wer addressed through the use of the questionnaire. For th remaining objective (i), a content analysis of the biolog syllabus for standards 8, 9 and 10 was undertaken to obtai information from which conclusions could be drawn. The aim o this research study was to establish the importance of th biology-technology-society theme as a crucial aspect to b considered, when the secondary school curriculum is developed In this research the biology teachers were regarded as a crucia link between biology education and the needs and aspirations o the African community. This chapter considers some of the mai findings of this study and the related implications. The finding and implications are presented concurrently. The chapter end with recommendations.

9.2 MODE OF INQUIRY

The survey research methodology was the mode of inquiry in thi study. This mode of inquiry was valuable in eliciting opinion and views of African teachers and student-teachers in relation t the teaching of biology in African schools. The surve instrument used for collecting data regarding what relevar biology content should be included in the syllabuses, create much interest among respondents. Since the researcher visite all sampled schools and colleges in order to administer tl questionnaire, it was possible to clarify the intentions behir the research, to answer specific and general questions as well ε and to observe the area in which the school or college : situated. The respondents regarded their participation ε valuable and co-operated fully without fear that their work wa being assessed. This relaxed attitude of the respondents has : some way increased the level of reliability of this inquiry.

In order to assess the biology content that is currently taugl in African schools, an analysis of the prescribed content : syllabuses was done. This was also regarded as additional dat collection. This form of content analysis provided valuab] information about the number of biosocial issues that a1 included in the prescribed syllabuses, as well as the amount o time devoted to teaching biosocial issues. The informatio obtained from this analysis became critical when considering th reconstruction of a biology curriculum that raise biology-technology-society issues.

9.3 SUMMARY OF CONCEPTUAL AND THEORETICAL ISSUES

A summary of the most pertinent issues that emerged from th literature reviewed for this study is presented below. Among th issues emerging from this study is the present crisis in th education of Africans in South Africa, particularly the crisis i science education. Part of this crisis in science educatic concerns the relevance of the prescribed content to the persona and societal needs of individual students. Some of the issue that emerge from this study, therefore, are concerned with tl paradigm shift of school science and the realities of scientifically and technologically oriented society (Ch.3:63-71)

The literary sources indicate that the crisis in the genera education of Africans has been largely promoted by unequal sta funding of African education, when compared to other races. T meagre funds provided for African education resulted in tl shortage of schools, classrooms, libraries and other resourc such as textbooks, stationery and equipment. Other relat consequences are the acute shortage of qualified teachers, lar classes and overcrowding, a high rate of pupils dropping out school; poor Matriculation results and a high rate o unemployment amongst the youth. School boycotts by pupils an the general unrest, which was a reaction to all the problem experienced by pupils in African schools, aggravated the crisi in African education.

All the problems mentioned above have a strong bearing on th poor state of science education in African schools. Evidence i the present study indicates that additional problems in biolog education, to those mentioned above, include the shortage o laboratories and apparatus, biology textbooks and referenc material, and qualified biology teachers particularly for senio secondary classes. These shortages and overcrowded classe resulted in excessive use of rote memorisation of biology facts an absence of experimentation and a lack of application o concepts to real life situations or teaching biology withou reference to contemporary social issues (Ch.2:32-41).

A major issue that emerges from the review of sources is th demand for relevance of science education to the needs an aspirations of African pupils as well as for the country as whole. In an attempt to find out what relevant biology conten could be included in the present biology curriculum in Africa schools, a review of the contemporary conceptual framework fo biology education, that has a human emphasis, was done. synopsis of the literature indicates that there is a ne conceptualisation of the nature of science, the goals of teachin biology, the criteria for selecting biology content and the role of teachers and the community in the development of the biology curriculum. The following are points which have emerged from the re-conceptualisation.

9.3.1 Science as a Social Construct

Evidence from literary sources indicates that scientific knowledge, like all knowledge, is a human-social construction. This view rejects the objective and value-free character of science that is emphasised by the positivistic philosophy which promotes the notion that science offers a unique route to objective truth derived by proper application of the scientific method (Ch.5:108-112). Consequently, teaching science to children requires careful consideration of the social and cultural influences on their learning because the learning process involves the construction of meaning and understanding in ways that are coherent and relevant to particular individuals.

Further research literary sources indicate that the aims of science education have so far been dominated by knowledge and processes of science only, to the exclusion of the social and cultural context from which science is produced. The new conceptualisation of a socially constructed scientific knowledge and the influence that science has on society, indicates that a new set of goals for science education needs to be formulated. These goals, suggested by the literature reviewed for this study recommends a balance between the three dimensions: scientifi content or knowledge, processes or skills of science and th technological and social context in which scientific knowledge i applied and developed.

9.3.2 <u>Social Relevance of Biology Curriculum</u>

Literature reviewed indicates that biology and the products c biotechnological research play an important role in improving c modifying the quality of life in modern society. However evidence from literary sources suggests that the relationshi between biology, technology and society is not emphasised in th school biology curriculum of the developed and developin countries. There is consensus that the inclusion of biolog content that reflects the biology-technology-society interactio in the curriculum is important (Ch.3 and 5). It is hoped tha this kind of curriculum will be more relevant and useful in th lives of school children, than the acquisition of biolog knowledge for its own sake.

The results of this study have also indicated that there is n emphasis on the biology-technology-society relationship in th biology curriculum offered in African schools (Ch.4:92-96). I is hoped that the contribution made by this study will assist i the reconstruction of a biology curriculum that meets persona and societal needs. Literary sources also indicate that the selection criteria for biology content should not only emphasise the structure of biology knowledge as is the case currently Criteria for choosing biology content should include relevance t contemporary issues, social utility, and its ability to show th relationship of biology to technology and other subjects. I addition, the biology content should form a basis for furthe education in school and outside the school, and it should provid for personal satisfaction and the career needs of childre (Ch.5:112-120). The biology content which is currently offere in schools emphasises the structure of the discipline an scientific processes. This was also revealed by the results o this study. In other words, the selection of biology content offered in African schools neglected criteria such as current social issues, personal and social needs, and career needs.

On the basis of the above mentioned research evidence it is clea that the present aims of teaching biology and the criteria fo selecting syllabus content should be re-assessed in terms of the current and the future needs of individuals and communities. This is particularly important for empowering citizens in Africar communities for the lives they will live in South Africa.

9.3.3 Teacher Participation in Curriculum Development

Literary sources show that the participation of teachers in the development of school biology curricula is crucial and should be sought for two reasons (Ch.5:120-126). Firstly, it should be acknowledged that it is the teacher who best understands the needs, the problems and the ideals of the school and loca community in which the curriculum will be implemented. Secondly the acceptance of the teachers' professional autonomy in makin decisions and judgements in the classroom about th implementation of the intended curriculum should be recognised This is in relation to pupils' needs, priorities and uniqu classroom settings, the school resources, community aspirations the teacher's own knowledge of the subject matter, as well as th teacher's own value system.

The cited literature indicates that participation in curriculu development can also benefit teachers in various ways. Some o the benefits could be: increased knowledge of biology content, a better understanding of teaching methods, an awareness of the context in which the curriculum is developed, and the increase professionalism of teachers. It is anticipated that this inquiry will reveal the importance of teachers in identifying biology content which is relevant to the needs of the African school children and their community. Two important results of the study show the following: teachers were able to identify the most important biosocial issues in the African community; and teachers were also able to indicate problems which should be included in the biology syllabuses.

9.3.4 <u>Community Involvement in Curriculum Development</u>

Cited research findings suggest that biology education should be related to community needs and interests (Ch.4:83-91).

Collaboration with parents, community leaders or representative and the private sector is important in the selection of biolog content that will satisfy the needs of a community. It i important to identify each community's biology-related issues fo inclusion in the biology curriculum offered in the local schools

The involvement of the community in devising the school biolog curriculum can benefit both the community and individual pupils The community will have a say in what should be taught at school so that pupils are better prepared for community development Pupils will also realise their own potential in developmen projects that are intended to uplift the community.

9.4 MAIN FINDINGS AND IMPLICATIONS

The main findings of this inquiry are categorised into thre groups. The first category deals with how much is taugh concerning biosocial issues as revealed by the content analysi of the senior biology syllabuses. The second category deals wit the identification and selection of important biosocial issue that impinge on life in the African community. The thir category deals with the knowledge of biosocial issues tha teachers and student-teachers possess. The fourth categor attempts to find out the sources of information that teachers an student-teachers used in order to get information about biosocia issues.

9.4.1 Extent to which Biosocial Issues are Taught

Findings in this sub-section come from two areas: the response o teachers and student-teachers to a question on how much school are teaching regarding biosocial issues; and an analysis of th prescribed content for biology standards 8, 9 and 10 classes.

9.4.1.1 Response of Teachers and Student-Teachers

In general, it can be concluded from the findings of this stud that some aspects of biosocial issues are taught in Africa schools. Teachers and student-teachers indicated that th percentage of what is taught increases gradually from primary t tertiary level. In general, **teachers and student-teachers thin that very little content pertaining to biosocial issues is taugh at primary school level while more teaching occurs in secondar and tertiary school levels** (Ch.7:156-160).

Results further indicated that in reality only five biology-related problems have sufficient exposure at school. The five problems which were identified as having exposure are the following: food, water, and energy resources; human health and diseases; and nature conservation (Ch.8:192-194). However, the results of content analysis discussed later in this section indicate that biology facts and principles are taught. The other problems, such as land use, pollution, population growth, sex education, drugs and immunisation were given slight exposure.

The fact that at least something is taught regarding som aspects of biosocial issues is encouraging. The aspects which ar taught in African schools may be academic in approach emphasisin the acquisition of biology facts rather than solving problem through the application of biology knowledge. However, th aspects which are taught can provide a basis for designin educational materials or programmes relating to local problem and needs.

9.4.1.2 Content Analysis of Biology Syllabuses

An important additional finding of this study concerning how muc is taught regarding biology-related issues in schools, came fro an analysis of prescribed biology content for standards 8, 9 an 10 classes. This content analysis (Ch.7:161-164) revealed th following:

(a) **that the emphasis in teaching is on the following themes food and nutrients; water and energy resources; human physiology plant physiology; and nature conservation. In the syllabuse these themes are presented separately without showing an interrelationship that exists. The teachers and pupils ar expected to make the connection themselves. Issues such a health, sex education, drugs and immunisation are not dealt wit in a manner in which the information acquired can be used t resolve problems.**

(b) **that the emphasis on prescribed content is on teaching tl structure of biology knowledge and inquiry. The brief ai superficial reference to the application of biology concepts as teaching strategy,in the preamble of the syllabuses, does nc correspond to the knowledge-oriented presentation of content : the syllabuses. Problems or issues related to biology-technolo(-society which influence the quality of life of individuals i society are not dealt with in the prescribed syllabuses.**

(c) **that the prescribed number of teaching periods allocated t each topic creates an inflexible time frame through which tł prescribed content should be taught by the end of each standarc** There is very little or no time, therefore, for the teacher ar the pupils to discuss or apply biology concepts to personal ar community issues or problems.

The implications of these findings are that the biolog curriculum offered in African secondary schools rests heavily o knowledge. The emphasis on factual knowledge that excludes th personal, social and technological contexts, is of littl assistance to pupils who hope to cope with the realities of life

The absence of biology-related social problems and issues in the biology curriculum reflects a lack of relevance to some of the important community needs and interests. Therefore, a re-evaluation of the goals for teaching biology and the selectior of content prescribed in the biology syllabuses is critical foi

African pupils. This syllabus renewal is also critical f(meeting the country's need for biologists and citizens who ca make informed decisions about biology-related social issues.

9.4.2 Important Biology-Related Social Problems

One of the main aims of this study was to investigate whethe teachers and student-teachers can identify important biosocia problems that impinge on the lives of the African community. Th identification of crucial problems in the African community b biology teachers is important for this study for two reasons Firstly, teachers are regarded as leaders involved in upliftin the African community. Secondly, the teachers' awareness of th problems in the community, and their involvement in the kind c education that can help people solve those problems or improv the quality of life in the community can go a long way t improving life in the African community. The summary of the mai findings in this section is divided into the following thre subsections.

9.4.2.1 Problems that Impinge on the Life of Africans

The main findings in this section indicated that biology-relate(social problems can be grouped into four categories according t(their importance to teachers and student-teachers. There was agreement between teachers and student-teachers in thei identifying the most serious issues. **Both teachers and student-teachers identified food and water resources as the most**

important issues while energy resources, human health an diseases, and nature conservation were rated as the second mos important. Agreement between teachers and student-teachers wa also evidenced when both identified pollution, population growt and land use as the third most important group of problems Differing opinions were seen only when teachers included drugs i the third category rather than including immunisation as th student-teachers did. **The results also show that the leas important problems for teachers were immunisation and se education, while student-teachers identified drugs and se education as the least important problems** (Ch.7:165).

The findings show that there was a high degree of agreement between teachers and student-teachers, on the most importan biology-related problems that impinge on life in the Africa community. The implications of these findings is that teacher and student-teachers are well informed about issues in th communities where they work and live. Biology teachers an student-teachers in African schools are capable of identifyin societal problems in the community. The close association o teachers with the pupils and parents in the community make i possible for teachers to have first hand knowledge of the need and problems in the community. It can be assumed, therefore that teachers can contribute valuable information to curriculu development and what could be taught in schools in order t improve the quality of life in the African community.

The most serious issues that were identified by teachers an student-teachers relate to basic human needs or the dail survival of individuals. These issues represent daily concern and hardships regarding hunger, shelter and health. Problem which were identified as being of secondary importance relate t the preservation or future survival of individuals. In view o the findings from the content analysis of the current standar 8,9 and 10 syllabuses, it is apparent that there is n relationship between the needs of the African community and th biology content taught at African schools.

9.4.2.2 Biosocial Issues for Incorporation in the Curriculum

The research findings show that the majority of teachers an student-teachers supported the view that it was very importan to incorporate all biology-related issues investigated in thi study into the biology curriculum (Ch.7:168). **Greater emphasi at the secondary school level should be placed on the teaching o human health and diseases. This was indicated by both teacher and student-teachers. This issue was followed closely b teaching about food, water, energy and nature conservation** Issues such as drugs, sex education, pollution, land use population growth and immunisation were regarded as fairl important by more than fifty percent of both teachers an student-teachers.

Furthermore, **results of this investigation show that all th issues investigated should be taught at all levels: primary,**

junior secondary, senior secondary and tertiary level (Ch.8:203) However, findings also show that teachers and student-teacher indicated that the emphasis on teaching each issue shoul increase with the rise in the level of schooling. For example some exposure at primary, moderate exposure at junior secondar and greater exposure at senior secondary and tertiary levels wa suggested for all biology-related problems under investigation.

The implications of the above findings suggest that there is a urgent need to include biology-related issues in the schoo curriculum. An important implication relative to the selectio of school curricular content is that selection criteria shoul not be limited to narrow biological principles and theories. Th old selection criteria should be broadened to take into accoun the interaction between biology, technology and society; and th local circumstances related to personal and societal needs an aspirations. Selection criteria related to career goals o individual pupils and biology knowledge that provides a basi for further study, should also be considered during the proces of selecting biology content.

With improved selection criteria, the approach to the teaching o biology that is currently used in African schools will also nee to change. New and alternative teaching approaches, such as issue-based approaches which emphasise skills such as problem solving, value judgement, decision making, and considering alternatives for social action will need to be tried out. The skills learnt through an issue-based approach, for example, wil eventually promote a greater awareness and knowledge abou biology-related problems within the African community in Sout Africa. This awareness and knowledge will possibly enabl individuals in the community to resolve problems or to intercep and contain the problems.

9.4.2.3 Quality of Life in the Year 2000

The majority of teachers and student-teachers in this surve indicated that all the investigated biology-related problems wil be worse and not better, by the year 2000. The items rate 'much worse' were population growth, drugs, human health an diseases, pollution, nature conservation and sex education. I **general, the findings suggest that there will be no improvemen in the quality of life of the African people, in th north-coastal region of Natal, by the year 2000 if these problem are not contained or resolved** (Ch.7:171-173).

The pessimistic view presented by teachers and student-teacher about the worsening situation of biology-related problems in th African community by year 2000, is cause for concern. Awarenes of the tremendous advances in the medical and health sciences, for example, did not seem to convince teachers an student-teachers that the problem of human health and disease would improve by the year 2000. This finding is the most challenging for educators because an understanding of biology-technology-society issues is essential if students, who will be active citizens in future, are to contribute to th improvement of the quality of life in their communities.

One way of resolving these problems would be to provide relevan information to assist in the decision-making processes and t provide problem-solving skills to cope with biology-relate social problems. Such information and skills about biosocia issues can be provided within the community through schoo education programmes or literacy programmes for adults.

9.4.3 <u>Knowledge of Biosocial Issues</u>

The importance of the teachers' understanding of biosocial issue arises from the fact that they are a crucial link between scienc education and society's needs and aspirations. Teachers an student-teachers responded to three questions. The first questio required them to assess their own knowledge. The second questio attempted to find out whether their understanding of biosocia issues was associated with other aspects of life. Thirdly, th opinion of teachers and student-teachers was solicited regardin how much African adults know about biosocial issues. A summar of the findings from these two questions is discussed below.

9.4.3.1 Extent to which Biosocial Issues are Understood

The main findings indicate that more than half of the teachers and student-teachers are knowledgeable about food resources, water resources, pollution, nature conservation and energy resources (Ch.7:174-175). A fair amount of knowledge regardi issues on human health and diseases, population growth, dr problems and immunisation was indicated by teachers a student-teachers. Finally, they appeared to be leas knowledgeable about problems concerning land use and se education.

In general, these **findings indicate that through self assessment the majority of teachers and student-teachers did not feel tha their knowledge about biosocial issues was very goo** (Ch.8:207-209). The implications are that there is a need fo pre-service and in-service teacher education programmes whic include and stress modules or aspects of biosocial issues Although teachers and student-teachers know something abou biosocial problems, the quantity and quality of their curren information is unknown. For people who may be involved i teaching biology-related issues, the extent of their knowledg regarding these issues becomes critical.

9.4.3.2 The Nature of Understanding Biosocial Issues

It was important for this study to determine the existin knowledge concerning biosocial issues that teachers an student-teachers had. The importance lies in the fact that th success of any education programme on biosocial issues that coul be implemented will depend on the teachers. Therefore, i addition to the self assessment of the extent of understanding that teachers and student-teachers had, an item to illuminate the nature of understanding about these issues was included i the questionnaire.

The summary of findings on the nature of understanding held b teachers and student-teachers **indicated that the majority had somewhat holistic view of the following problems: health malnutrition, nature conservation, population growth, immunity energy resources, pollution, agriculture and water resource** (Ch.7:177-181). In general teachers and student-teacher selected statements that defined biosocial problems through th many interrelated dimensions that affect human life such as th physical environment, social environment, technology, economy politics and so on.

Findings also showed that there was a holistic understanding o biology-related problems shown by teachers and student-teachers There was a slightly high percentage (over 20%) of those whos understanding can be viewed as being narrow. In particular statements indicating a narrow view of the following concept were chosen: health, drugs, malnutrition and nature conservatio (Ch.7:181-182).

The results have several implications. The somewhat holisti understanding of biosocial problems held by teachers and student-teachers is indicative of their broad understanding of th different components constituting these problems. Consequently, it can be assumed that they understand that the solutions fo these problems will not only require knowledge of biology, bu knowledge of all the components constituting each problem. Thi holistic understanding of biology-related problems may provid insight into the depth and breadth of information required i planning and designing relevant teacher education programmes.

Another implication is that, if adequately trained, teachers an student-teachers can also assist in devising educationa materials that relate to local conditions. Their knowledge o local needs and their ability to identify biology-related socia problems, as discussed earlier in this chapter, should qualif teachers and student-teachers as worthy people to consult o actively involve in such activities. Moreover, the fact tha there is a general shortage of school teachers in African school makes it imperative that the few trained ones should b employed. This stance is crucially compelling for scienc education and biology education in particular.

9.4.3.3 Perceptions of African Adults' Knowledge

In general, the summary of results indicated that African adult: are slightly knowledgeable about biosocial issues. However, a **substantial number of teachers and student-teachers indicate that African adults have a poor understanding of issues like se: education, pollution, population growth, nature conservation an drug problems** (Ch.7:183-184). It was intimated earlier that African adults comprise a group of people in which there is a large percentage of poorly educated individuals.

The implications arising from these results are that the majori of African adults are struggling with issues they do n understand. This lack of understanding may be the reason w some adults are powerless in resolving some of the problem There is a need, therefore, to provide information that will he citizens to make informed decisions or take appropriate actio when confronted with biosocial problems. The introduction adult literacy courses that include biosocial issues or loc programmes that provide skills and survival techniques for copi with a scientifically and technologically oriented South Afric should be considered.

9.4.4 <u>Sources of Information about Biosocial Issues</u>

The general conclusion from results obtained in this sectic suggests that the majority of teachers, student-teachers ar adults obtain information about biosocial issues from schools an textbooks. A summary of findings in each section is found below

9.4.4.1 Respondents' Sources of Information

In this study, **schools and textbooks were regarded as the mos important sources of information for the majority of teachers an student-teachers. Other sources listed were medical doctors, public libraries, hospitals or clinics and televisior** (Ch.7:184-186).

These results have several implications. Firstly, there is need to revise biology syllabuses, textbooks and othe educational materials so that they carry sufficient informatio for teachers and student-teachers. This revision should includ biology-related problems and other aspects covering th science-technology-society theme, which can assist teachers i teaching biosocial issues. Secondly, the goals of biolog education need to be re-formulated and emphasised in th syllabuses and textbooks. Thirdly, the teaching approach i schools and tertiary institutions needs to be changed so that th skills required for teaching biosocial issues can be internalise by the teachers and student-teachers. If biosocial issues ar adequately presented at schools and colleges, information abou these issues can be readily accessible to more teachers an school children.

9.4.4.2 Perceived African Adults' Sources of Information

The results of the investigation showed that **biology teachers an student-teachers think that African adults also obtained most o their information about biosocial issues from schools and books These results imply that schools within the community and th school textbooks are the most influential means of preparin pupils for full participation as citizens of each communit** (Ch.7:187). A further implication is that the incorporation o biology-related social issues in the school curriculum can therefore, reach a large section of the African population i comparison with any other source of information.

Another implication here is that if African adults use the sam sources as teachers and student-teachers, further attention int the nature of understanding of both adults and teachers i needed. This is particularly important since that most Africa adults are relatively less educated than teachers (see Chapte 2). To gain more information on this question, research into th extent of adults' and teachers' knowledge, beyond what has bee done in this study, should be conducted.

It seems reasonable to suggest that African adults also ge information from medical doctors, hospitals and clinics, th radio and from family or friends. The implication, however, i that the information gained may not be sufficient or wel organised for translation into action or lasting decisions. I therefore remains the responsibility of those in power o decision-making positions to bring about changes in society tha will seek to improve the situation of the African community.

9.5 RECOMMENDATIONS

Many recommendations given in this section emanate from the research findings and associated implications discussed in the previous sections of this chapter. For better comprehension, the recommendations are sub-divided into two categories. The first category relates to those recommendations which serve to assist in increasing the awareness and relevance of the biology curriculum in African schools. The second category presents recommendations which make an appeal for further research in th fields of science education and biology education in particular.

9.5.1 <u>Improvement of the Biology Curriculum</u>

On the basis of this investigation, recommendations for improvin the senior secondary biology curriculum in African school should be considered. These recommendations presuppose that th impending changes in the South African education system wil incorporate a revised biology curriculum for all school children

9.5.1.1. Goals of Biology Education

Emanating from the fore-going discussions, **it is recommended tha a re-evaluation of the goals of biology education for Africa schools in South Africa be done.** This re-evaluation of goals ma reveal the extent to which the present set of goals for teachin biology are relevant to the needs of the African community an the country as a whole.

Findings from this study suggest that there is a discrepanc between what is taught at school and the needs of the Africa community. Biology knowledge which is taught in African school did not seem to address the biosocial issues that affected lif of the people in the north-coastal region of Natal. Th recommendation made here is that a new set of goals for teachin biology should be developed. The new goals must not only focu on preparation of pupils for further study but also meet th social needs and career choices of pupils. This will provide a real-life context in which biology knowledge is taught.

9.5.1.2. Inclusion of Biosocial Issues in the Curriculum

Considering the need to formalise learning regarding biosocial issues, **it is recommended that the biology curriculum offered in schools should incorporate biosocial issues which affect people in South Africa.** This becomes important in African schools where not all students who take biology intend to be biologists or wish to continue with biology at tertiary level. Biology education must therefore provide opportunities for careers in biology as well as knowledge and skills for coping in a South Africa that is increasingly dominated by science and technology.

Findings of this study attempt to identify some biosocial issues which can be included in the biology curriculum offered in African schools in the north-coastal region of Natal. This suggests that supplementary curriculum materials dealing with locally relevant issues can be developed in addition to the core curriculum. Where different regions experience the same problems, inclusion of relevant biosocial issues on a wider scale may facilitate the work of curriculum planners and developers.

Another recommendation in this section is that **the criteria for selecting school biology content should be broadened so that all children benefit from studying biology. This will ensure that the principle of "science for all " is maintained in biology.**

Limited criteria such as biology for solving the manpower needs of South Africa or biology as a basis for further study at tertiary institutions should be avoided. Additional criteria for selecting biology content should also include content that emphasises the Science-Technology-Society theme; the interaction with other curriculum areas such as physics, health education and others; and content that takes into account personal, societal and career needs.

9.5.1.3 Approach to Teaching Biology

A sound approach in handling biology in schools must be made priority. Hence, **an issue-based approach in teaching biology is recommended. This will afford pupils skills for decision-making, application and problem-solving.** These skills will assist pupils to critically analyse and resolve biology-related problems.

9.5.1.4 Teacher Participation in Curriculum Development

The development of a biology curriculum with science-technology-society orientation needs to be considered. This curriculum should specify more than the content as is currently the case in textbooks and syllabuses. Hence, **it is recommended that teacher involvement in curriculum development should be encouraged.** This is necessary because teachers, as indicated in this inquiry, are better informed about schools and the needs and ideals of the communities where those schools are situated.

9.5.1.5 Teacher Education Programmes

When in pursuit of the curriculum change which is sensitive to biosocial issues, it will be necessary to re-evaluate teacher education programmes. **It is therefore recommended that pre-service and in-service teacher education programmes which focus on the content and the teaching approach of biosocial issues should be developed for biology teachers.** Teachers need initial education and continued support on evolving teaching skills and new strategies in biology and science education. These developments would increase the teachers' understanding of biology, its technological applications and the environmental implications.

9.5.1.6 Assessment in Biology

The methods used in assessing teachers, student-teachers and pupils in colleges and schools are an important component of the biology-related curriculum. **It is therefore recommended that evaluation and examination procedures be reviewed in accordance with the envisaged biosocial content and approaches in teaching and in science education.** It is generally accepted that the type of examination questions and procedures utilised often influence the teaching style of most teachers.

9.5.2. <u>Further Research on Biosocial Issues</u>

In view of the existence of a considerable amount of methodological and curricular gaps in the knowledge of issues

associated with biology as a subject taught in African schools i
South Africa, the following research effort is recommended fo
future exploration:

(a) **An investigation comparable or similar to this study shoul be undertaken in other geographical regions of Natal as wel as in other regions of South Africa.**

(b) **Investigations need to be conducted into the type o curriculum initiatives and materials needed for a relevan biology programmes.** This will most likely reveal whethe the study of biosocial issues is suitable for all pupils o for a select group of pupils.

(c) **An investigation of the role presently played b non-academic and the corporate world in offering biosocia related aspects of the biology curriculum must be vigorousl pursued.**

(d) Further research into **the role that can be played b teachers, student-teachers and school pupils towards the restructuring of a new biology curriculum that has community relevance** should be undertaken.

9.6 CONCLUSION

The needs and aspirations of the African people in the north coastal region of Natal are fundamentally about the improvemen of the quality of life in the area. The alleviation, if no elimination, of problems such as food shortage, health an diseases, pollution, energy shortage, population explosion unemployment and many more remain the fundamental aspiration o the majority of Africans in the area. African students hav become aware and vociferous about their educational needs as wel as their demands for a relevant education as early as 1976. Thi continued demand for an education that is relevant to the dail lives of the African students and people, such as involvin biosocial issues, is now being made by African parents educationists, teacher organisations and some employers, as wel as many other members of the public.

This research effort has attempted to address the question: t what extent is biology education relevant to real-life situation of African school children in the study area? The mai hypothesis of the study stipulates that the senior secondar school biology syllabuses prescribed for African schools in th north-coastal region of Natal neglects the biosocial component This hypothesis and other such related suppositions wer generally confirmed. Furthermore, the objectives in the preambl and the teaching approach recommended in the syllabuses do no reflect the real-life situation.

The results of this investigation have indicated that biolog content that has local or community relevance can be identifie and selected for incorporation in the school biology curriculum It has also indicated that biology teachers can provide valuabl information about what is taught or not taught in the schools the needs and aspirations of people in the local environment and how best to adapt a curriculum in a local setting.

Though the recommendations put forward in the study area ar limited to the north-coastal region of Natal, it is possible t have some of them considered for the wider South Africa. Th kind of conclusions reached in the study area represent significant starting point for change, reconstruction and furthe research in a new issues-related biology curriculum for changing South Africa.

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APPENDICES

APPENDIX - A

ABBREVIATION OF SCIENCE RELATED PROGRAMMES AND BODIES

ABBREVIATION	FULL MEANING OF ABBREVIATION	COUNTRY
AIBS	American Institute of Biological Sciences	USA
ASE	Association for Science Education	UK
ASTE	Association for Science Teacher Educators	RSA
BSCS	Biological Sciences Curriculum Study and Maths Education	USA
CBA	Chemical Bond Approach Project	UK
CHEMS	Chemical Educational Materials Study	UK
CSIR	Council for Scientific and Industrial Research	RSA
CUMSA	A Curriculum Model for Education in South Africa	RSA
DET	Department of Education and Training	RSA
DNE	Department of National Education	RSA
ERS	Education Renewal Strategy	RSA
FRD	Foundation for Research Development	RSA
HSRC	Human Sciences Research Council	RSA
IEHD	Institute for Education and Human Development	RSA
NAEP	National Assessment of Education Progress	USA
NFS	National Science Foundation	USA
NIE	National Institute of Education	RSA

PSSC	Physical Sciences Study Committee	USA
RIED	Research Institute for Environmental Diseases	RSA
SATIS	Science And Technology In Society	UK
SCIS	School Council Integrated Science Project	UK
SCISA	Science Curriculum Initiatives in South Africa	RSA
SEP	Science Education Project	RSA
SISCON	Science In a Social Context	UK
STS	Science Technology Society	USA
TOPS	Teacher Opportunity Programmes	RSA
TVEI	Technical and Vocational Educational Initiatives	UK
UED	University Education Diploma	RSA
UFPSC	Urban Foundation's Primary Science Project	RSA
WISCIP	West Indian Science Curriculum Innovation Project	CARRIBEAN

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APPENDIX - B

TRANSMITTAL LETTERS

LETTERS TO THE DEPARTMENT OF EDUCATION AND CULTURE (KWA-ZULU) AND THE DEPARTMENT OF EDUCATION AND TRAINING

8 June 1989

The Director of Education
....
....
....
.....

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN YOUR SCHOOLS AND COLLEGES

I hereby request your kind permission to undertake research c biology teaching and the nature of the curriculum, as well as hc it is perceived by teachers and student-teachers at schools ar colleges in your department. This research is undertaken mainl for academic purposes within the north-coastal region of Nata (KwaZulu included). It is hoped that its findings will becom useful in planning or restructuring the biology curriculum i African schools in this region.

The research is towards a doctoral degree (D.Ed) and i registered at the University of Durban-Westville. The title c my study is:

Biosocial Issues as a Component of Biology Education.
(The study examines the role of biological science as a socia force or influence to African children's daily lives and to th quality of life within their community).

All information collected from your schools and colleges relating to this investigation, will be kept as confidential a possible.

Your assistance in this regard will be highly appreciated.

Yours faithfully

N.V. MAGI (MRS)
Senior Lecturer: Faculty of Education

LETTER TO CIRCUIT INSPECTORS IN KWA-ZULU SCHOOLS

14 August 1989

The Circuit Inspector
....
....
....

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN BIOLOGY EDUCATION AT SCHOOLS WITHIN YOUR CIRCUIT.

I hereby request your kind permission to interview scienc teachers, particularly those who specialise in the teaching o Biology in several schools within your circuit. I am undertakin research for a doctoral programme (D.Ed.) at the University o Durban-Westville. The title of my study is:

BIOSOCIAL ISSUES AS A COMPONENT OF BIOLOGY EDUCATION.

This study is about the role of biological science as a socia force or influence to African children's daily lives and to th quality of life within their community.

Permission to conduct research in schools and colleges under th Department of Education and Culture has already been granted (See attached copy of the letter)

I hope my request will receive your favourable consideration.

Yours faithfully

N.V. MAGI (MRS)
Senior Lecturer: Faculty of Education

LETTER TO RECTORS OF COLLEGES

30 October 1989

The Principal
....
....
....

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN BIOLOGY EDUCATION AT YOUR COLLEGE.

I hereby request your kind permission to interview the teachin personnel and final year student-teachers who specialise in th teaching of Biology in your college. I am undertaking researc for a doctoral programme (D.Ed.) at the University o Durban-Westville. The title of my study is:

BIOSOCIAL ISSUES AS A COMPONENT OF BIOLOGY EDUCATION.

This study is about the role of biological science as a socia force or influence to African children's daily lives and to th quality of life within their community.

Permission to conduct research in schools and colleges under th Department of Education and Culture has already been granted (See attached copy of the letter)

I hope my request will receive your favourable consideration.

Yours faithfully

N.V. MAGI (MRS)
Senior Lecturer: Faculty of Education

LETTER TO PRINCIPALS OF SCHOOLS

30 October 1989

The Principal
....
....
....

Dear Sir/Madam

RE: REQUEST TO CONDUCT RESEARCH IN BIOLOGY EDUCATION AT YOUR SCHOOL.

I hereby request your kind permission to interview scienc teachers, particularly those who specialise in the teaching o Biology at your schools. I am undertaking research for doctoral programme (D.Ed.) at the University of Durban-Westville The title of my study is:

BIOSOCIAL ISSUES AS A COMPONENT OF BIOLOGY EDUCATION.

This study is about the role of biological science as a socia force or influence to African children's daily lives and to th quality of life within their community.

Permission to conduct research in schools under the Department of Education and Culture, and Education and Training have alread been granted. (See attached copy of the letter).

I hope my request will receive your favourable consideration.

Yours faithfully

N.V. MAGI (MRS)
Senior Lecturer: Faculty of Education

APPENDIX - C.1

QUESTIONNAIRE TO TEACHERS

(To Teachers)

DISTRICT ....
PLACE ....
DATE OF INTERVIEW ....
INTERVIEWER ....

A. PERSONAL BACKGROUND

1. Name of School ____

2. Where is your school located: (a) Urban __________
   (b) Peri-urban _____
   (c) Rural ___________

3. Sex: (a) Male ___________ (b) Female ________________

4. Age: (a) 18 -29 years ______ (b) 30-49 years _______
   (c) 50 - 65 years _____ (d) 66 years & Over_____

5. Number of years you taught Biology (a) present school _____
   (b) previous school ____

6. Number of years teaching Biology (a) standard 8 _________
   (b) standard 9 _________
   (c) standard 10 ________

7. Did you take Biology as a subject at Matric level? Yes_____
   No _____

8. Your highest academic qualification is: (Tick)
   (a) Matric ______ (b) Undergraduate ______
   (c) Graduate ______ (d) Postgraduate ______

9. If graduate, which courses did you take? ___________________
   ____
   ____

10. What is your professional qualification? __________________
    ____

11. Indicate the professional courses you obtained ___________
    ____
    ____
    ____

B. AWARENESS OF SCIENCE-RELATED PROBLEMS

12. Rank the following biology-related social problems according to their importance to your life. Tick under appropriate answer. (1 = very important, 5 = least important)

	1	2	3	4	5
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problem					
(j) Immunisation					
(k) Nature conservation					

13. Indicate the degree of your understanding about each of the following issues. Tick under the appropriate answer.

	Exce-llent	Good	Satis-factory	Fair	Poc
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problems					
(j) Immunization					
(k) Nature conservation					

14. Indicate (tick) the degree of understanding you think African adults have about each of the following issues?

	Exce-llent	Good	Satis-factory	Fair	Poor
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problems					
(j) Immunization					
(k) Nature conservation					

15. Rank in order of importance the specific sources o information you use to obtain information about biology-related issues. Tick under the appropriate answer.

Very Important	Important	Moderately Important	Less Important	Least Importan
1	2	3	4	5

	Specific Source	1	2	3	4	
Print Media	Professional Journals					
	Newspapers					
	Books (textbooks)					
	Monthly/Weekly Magazine					
	Government Documents					
	Other(specify)..........					
Audio/Visual Media	Radio					
	Television					
	Films (Movies)					
	Posters					
	Computer					
	Other (specify)..........					
Personal Experience	Educational work					
	Research					
	Social involvement					
	Employment/Work					
	Other (specify)..........					
People	Family/Friends					
	Marketing Representatives					
	Community leader					
	Faith healer					
	Herbalist/Isangoma					
	Medical doctor					
	Other (specify)..........					
Social Institutions	School					
	Museums					
	Place of worship					
	Hospitals & clinics					
	Public libraries					
	Other (specify)..........					

16. Rank in order of importance the specific sources Africa people use to obtain information about biology-relate issues. (Rank: 1 = very important, 5 = least important)

Very Important	Important	Moderately Important	Less Important	Least Importar
1	2	3	4	5

	<u>Specific Source</u>	1	2	3	4
Print Media	Professional Journals				
	Newspapers				
	Books (textbooks)				
	Monthly/Weekly Magazines				
	Government Documents				
	Other(specify)..........				
......					
Audio/Visual Media	Radio				
	Television				
	Films (Movies)				
	Posters				
	Computer				
	Other(specify)..........				
,,,......					
Personal Experience	Educational work				
	Research				
	Social involvement				
	Employment/Work				
	Other(specify)..........				
,,,......					
People	Family/Friends				
	Marketing Representatives				
	Community leader				
	Faith healer				
	Herbalist/Isangoma				
	Medical doctor				
	Other(specify)..........				
,,,......					
Social Institutions	School				
	Museums				

Place of worship					
Hospitals & clinics					
Public libraries					
Other(specify)..........					

,,,...

17. Indicate the degree to which you think schools are teachi about biology-related social problems. Tick the appropria column.

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don Kno
PRE-SCHOOL (0-5 years)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
JUNIOR PRIMARY (6-9 yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
SENIOR PRIMARY (10-12yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					

	Drug problems				
	Immunization				
	Nature conservation				

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don Kno
JUNIOR SECONDARY (13-16yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
SENIOR SECONDARY (17-18yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
TERTIARY EDUCATION (19 + yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

18. If something is not done at school, in terms of tl following biology-related social problems, then will tl quality of life of the people improve or get worse by tl year 2000? Tick under the appropriate answer.

	Much Better	Better	Same	Worse	Muc! Wor
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problems					
(j) Immunization					
(k) Nature conservation					

19. Indicate the degree to which each of the followi biology-related social problem should be taught at ea grade level or age. Tick under the appropriate colum

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don Kno
PRE-SCHOOL (0-5 years)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
JUNIOR PRIMARY (6-9 yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					

	Problems	Great	Mode-rate	Slight	Not at All	Don Kno
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don Kno
SENIOR PRIMARY (10-12yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
JUNIOR SECONDARY (13-16yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
SENIOR SECONDARY (17-18yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					

	Problem	Great	Mode-rate	Slight	Not at All	Don't Know
	Nature conservation					

Grade level or Age	Problem	Great	Mode-rate	Slight	Not at All	Don't Know
TERTIARY EDUCATION (19 + yrs)	Food resources					
	Water resources					
	Energy resources					
	Health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

20. Indicate the degree to which you think African adults ne[...] the knowledge/understanding of each biology-related soci[...] issue. Tick under the appropriate column.

	Great	Mode-rate	Slight	Not at All	Don' Know
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health/disease					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problem					
(j) Immunization					
(k) Nature conservation					

21. In your view, what degree of support will the African adu[...] community give, if each of these social issues we[...] included in the biology curriculum?

	Great	Mode-rate	Slight	Not at All	Don' Know
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health/disease					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					

(i) Drug problem					
(j) Immunization					
(k) Nature conservation					

C. UNDERSTANDING OF CONCEPTS

First read the concept or term supplied and the statemen listed next to it. Then, place a tick on the line next to statement which best describes or defines the concept.

HEALTH

(a) Health is absence of disease. ______

(b) It can be attained principally by physical-material means e.g. medicine and nutrients. ______

(c) A balanced existence between people and the natural or man-made physical environments in which the live. ______

(d) It is the state of complete physical, psychological and social well-being. ______

(e) Health manifests itself in the ability of a human being to be happy in spite of physical or emotional handicaps. ______

MALNUTRITION

(a) A condition where diet omits some foods necessary for health. ______

(b) It is a disease caused by deficiency of protein in the body. ______

(c) It can be about insufficient food production, uneven distribution of food or attitudes to certain unfamiliar foods. ______

(d) It is caused by the intake of unbalanced diet, especially in protein and in energy supply foods. ______

(e) Results when the daily intake of food falls below 1500 calories. ______

SEX EDUCATION

(a) Knowledge about the human body and body functions, especially reproduction. ______

(b) Provision of knowledge about contraception and family planning. ______

(c) Teaching about the act of sexual intercourse. ______

(d) Includes sets of attitudes, values, personal relationships and responsible sexual behaviour. _____

(e) Factual information about the physical, emotional and social aspects of human sexual development from conception to old age. _____

CONSERVATION

(a) Management of human use of the biosphere, so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet needs of the future. _____

(b) Preservation of natural environment. _____

(c) Preservation of animals in game parks & zoos. _____

(d) Keep something from harm, decay, or loss with a view to later use. _____

(e) A recognition by man of his interdependence of his environment, and man's participation towards solving real-life, local environmental problems. _____

POPULATION GROWTH

(a) The addition of newly born individuals to the existing population by reproduction. _____

(b) An increase in population which determines the rate at which natural resources are used up or destroyed. _____

(c) A tendency of a species to reproduce more offsprings in order to ensure its survival and generate genetic variability. _____

(d) Efforts to reduce population growth rate include various methods of 'birth control' _____

(e) Factors such as improved agricultural practices and medical science promote better levels of survival and the growing population. _____

AGRICULTURE

(a) Should be practised by individuals who live in rural areas or intend to be farmers. _____

(b) Growing cash-crops for sale on a small or large scale, excluding food production for yourself and family to survive. _____

(c) Essential practice for our continued health, yet disturbs nature's balance through removal of vegetation, over-use of artificial fertilisers _____

(d) Animal husbandry through which essential proteins are acquired. _____

(e) Effective irrigation-schemes can increase the yields, frequency and variety of crops. _____

IMMUNITY

(a) Protection of a person from an infectious disease by the introduction of a vaccine which stimulates the body to form antibodies against that disease. _____

(b) New-born babies possess passive acquired immunity from their mothers which last for life. _____

(c) A high resistance to illness. _____

(d) May last for life , once a person has been inoculated against that particular disease. _____

(e) Protection of a community against an infectious disease is increased by adhering to an immunization programme. _____

DRUGS

(a) Medicinal substances used alone or as an ingredient to alleviate physical pain and emotional illnesses. _____

(b) Non-medicinal substances which alter people's perception of the world and make a person escape from the unpleasant realities of life. _____

(c) Substances which can be required by the body in increasing amounts in order to produce the desired effects. _____

(d) Socially acceptable substances, like coffee or alcohol cannot lead to ill-health and death even if used in excess. _____

(e) Medicinal extracts from plants or herbs, from bacteria and fungi or from synthetics, which can kill pathogens without harming the patient when taken in a safe dose. _____

ENERGY RESOURCES

(a) The sun is the source of all energy i.e. food energy, fossil energy, wind power, water power and atomic energy. _____

(b) The ability to differentiate energy usage on the basis of function and cost efficiency. _____

(c) Transfer of energy between organisms and the medium that surrounds them. _____

(d) Energy sources like wood, cow dung, and biogas are considered finite and irreplaceable. _____

(e) A community should be encouraged, in its living habits, to get maximum benefit out of the minimum energy reserves available through conservation. _____

POLLUTION

(a) A high concentration of poisons in the environment to damage man's health or well-being. _____

(b) Emission of toxic substances into the atmosphere cannot alter the atmospheric properties. _____

(c) Increase in volume of water-borne waste in rivers cannot endanger the biotic community because rivers have a capacity for self purification. _____

(d) Pollutants are all kinds of substances which unsettle ecosystems in a way that could produce negative effects on ecosystems. _____

(e) Lack of oxygen, temperature increases, poison and oil are the main forms of water pollution. _____

WATER RESOURCES

(a) Fresh water supply on the earth is unlimited. _____

(b) The shortage of protected water supply in human settlements is responsible for diseases like diarrhoea, cholera, typhoid etc. _____

(c) The hydrological cycle is responsible for renewing a big fraction of the world's total usable water supply. _____

(d) Land water consists of surface water, subsurface water, soil water, and sea water. _____

(e) Availability of water resources does not only include the development of new resources, but also the conservation of existing water, elimination of waste material and recycling of used water. _____

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APPENDIX - C.2

QUESTIONNAIRE TO STUDENTS

(To Students)

DISTRICT ....
PLACE ....
DATE OF INTERVIEW ....
INTERVIEWER ....

A. PERSONAL BACKGROUND

1. Name of Institution ______________________________

2. Where is your institution located: (a) Urban ________
   (b) Peri-urban _____
   (c) Rural __________

3. Sex: (a) Male __________ (b) Female ______________

4. Age: (a) 15 -17 years ______ (b) 18 -21 years _______
   (c) 22 - 25 years _____ (d) 26 years & Over_____

5. When did you pass Matric/Senior Certificate (year) ________

6. Did you take the subject Biology in Matric? Yes____ No ___

7. If yes, (a) what pass symbol did you obtain in Biology?____

   (b) at which grade? Higher grade ___________
   Standard grade __________

8. Which degree/diploma are you following? __________________
   ____

9. In what year did you start studying towards your degree or diploma? ____

10. What are your professional intentions? __________________
    ____
    ____
    ____
    ____
    ____

B. AWARENESS OF SCIENCE-RELATED PROBLEMS

12. Rank the following biology-related social problems accordi to their importance to your life. Tick under appropria answer. (1 = very important, 5 = least important)

	1	2	3	4	5
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problem					
(j) Immunisation					
(k) Nature conservation					

13. Indicate the degree of your understanding about each of th following issues. Tick under the appropriate answer.

	Exce-llent	Good	Satis-factory	Fair	Pc
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problems					
(j) Immunization					
(k) Nature conservation					

14. Indicate (tick) the degree of understanding you think African adults have about each of the following issues.

	Exce-llent	Good	Satis-factory	Fair	Poc
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					

(h) Population growth				
(i) Drug problems				
(j) Immunization				
(k) Nature conservation				

15. Rank in order of importance the specific sources c information you use to obtain information about biolog related issues. Tick under the appropriate answer.

Very Important	Important	Moderately Important	Less Important	Least Importa
1	2	3	4	5

<u>Specific Source</u>

		1	2	3	4
Print Media	Professional Journals				
	Newspapers				
	Books (textbooks)				
	Monthly/Weekly Magazine				
	Government Documents				
	Other(specify)..........				
....					
Audio/Visual Media	Radio				
	Television				
	Films (Movies)				
	Posters				
	Computer				
	Other (specify).........				
....					
Personal Experience	Educational work				
	Research				
	Social involvement				
	Employment/Work				
	Other (specify).........				
....					
People	Family/Friends				
	Marketing Representatives				
	Community leader				
	Faith healer				
	Herbalist/Isangoma				
	Medical doctor				
	Other (specify).........				

Social Institutions	School					
	Museums					
	Place of worship					
	Hospitals & clinics					
	Public libraries					
	Other (specify)..........					

16. Rank in order of importance the specific sources Africa people use to obtain information about biology-relate issues. (Rank: 1 = very important, 5 = least important)

Very Important	Important	Moderately Important	Less Important	Least Importar
1	2	3	4	5

	Specific Source	1	2	3	4	
Print Media	Professional Journals					
	Newspapers					
	Books (textbooks)					
	Monthly/Weekly Magazines					
	Government Documents					
	Other(specify)..........					
Audio/Visual Media	Radio					
	Television					
	Films (Movies)					
	Posters					
	Computer					
	Other(specify)..........					
Personal Experience	Educational work					
	Research					
	Social involvement					
	Employment/Work					
	Other(specify)..........					
People	Family/Friends					

	Marketing Representatives					
	Community leader					
	Faith healer					
	Herbalist/Isangoma					
	Medical doctor					
	Other(specify)..........					

....

Social Institutions	School					
	Museums					
	Place of worship					
	Hospitals & clinics					
	Public libraries					
	Other(specify)..........					

....

17. Indicate the degree to which you think schools are teachi about biology-related social problems. Tick the appropria column.

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don' Know
PRE-SCHOOL (0-5 years)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
JUNIOR PRIMARY (6-9 yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

SENIOR PRIMARY (10-12yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don' Kno
JUNIOR SECONDARY (13-16yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
SENIOR SECONDARY (17-18yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
TERTIARY EDUCATION (19 + yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health					

& diseases					
Land use					
Sex education					
Pollution					
Population growth					
Drug problems					
Immunization					
Nature conservation					

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18. If something is not done at school, in terms of t[illegible] following biology-related social problems, then will t[illegible] quality of life of the people improve or get worse by t[illegible] year 2000? Tick under the appropriate answer

	Much Better	Better	Same	Worse	Muc Wor
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health & diseases					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problems					
(j) Immunization					
(k) Nature conservation					

19. Indicate the degree to which each of the followi[illegible] biology-related social problem should be taught at ea[illegible] grade level or age. Tick under the appropriate colum[illegible]

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don' Know
PRE-SCHOOL (0-5 years)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don' Know
	Nature conservation					
JUNIOR PRIMARY (6-9 yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

Grade level or Age	Problems	Great	Mode-rate	Slight	Not at All	Don' Know
SENIOR PRIMARY (10-12yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					
JUNIOR SECONDARY (13-16yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

Grade level or Age	Problem	Great	Moderate	Slight	Not at All	Don' Know
SENIOR SECONDARY (17-18yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

Grade level or Age	Problem	Great	Mode- rate	Slight	Not at All	Don' Know
TERTIARY EDUCATION (19 + yrs)	Food resources					
	Water resources					
	Energy resources					
	Human health & diseases					
	Land use					
	Sex education					
	Pollution					
	Population growth					
	Drug problems					
	Immunization					
	Nature conservation					

20. Indicate the degree to which you think African adults ne the knowledge/understanding of each biology-related soci issue. Tick under the appropriate column.

	Great	Mode- rate	Slight	Not at All	Don't Know
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health/disease					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problem					
(j) Immunization					

(k) Nature conservation					

21. In your view, what degree of support will the African adu community give, if each of these social issues we included in the biology curriculum?

	Great	Mode-rate	Slight	Not at All	Don't Know
(a) Food resources					
(b) Water resources					
(c) Energy resources					
(d) Human health/disease					
(e) Land use					
(f) Sex education					
(g) Pollution					
(h) Population growth					
(i) Drug problem					
(j) Immunization					
(k) Nature conservation					

C. UNDERSTANDING OF CONCEPTS

First read the concept or term supplied and the statemen listed next to it. Then, place a tick on the line next to statement which best describes or defines the concept.

HEALTH

(a) Health is absence of disease. ______

(b) It can be attained principally by physical-material means e.g. medicine and nutrients. ______

(c) A balanced existence between people and the natural or man-made physical environments in which the live. ______

(d) It is the state of complete physical, psychological and social well-being. ______

(e) Health manifests itself in the ability of a human being to be happy in spite of physical or emotional handicaps. ______

MALNUTRITION

(a) A condition where diet omits some foods necessary for health. ______

(b) It is a disease caused by deficiency of protein in the body. ______

(c) It can be about insufficient food production, uneven distribution of food or attitudes to certain unfamiliar foods. ______

(d) It is caused by the intake of unbalanced diet, especially in protein and in energy supply foods. _____

(e) Results when the daily intake of food falls below 1500 calories. _____

SEX EDUCATION

(a) Knowledge about the human body and body functions, especially reproduction. _____

(b) Provision of knowledge about contraception and family planning. _____

(c) Teaching about the act of sexual intercourse. _____

(d) Includes sets of attitudes, values, personal relationships and responsible sexual behaviour. _____

(e) Factual information about the physical, emotional and social aspects of human sexual development from conception to old age. _____

CONSERVATION

(a) Management of human use of the biosphere, so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential to meet needs of the future. _____

(b) Preservation of natural environment. _____

(c) Preservation of animals in game parks & zoos. _____

(d) Keep something from harm, decay, or loss with a view to later use. _____

(e) A recognition by man of his interdependence of his environment, and man's participation towards solving real-life, local environmental problems. _____

POPULATION GROWTH

(a) The addition of newly born individuals to the existing population by reproduction. _____

(b) An increase in population which determines the rate at which natural resources are used up or destroyed. _____

(c) A tendency of a specie to reproduce more offsprings in order to insure its survival and generate genetic variability. _____

(d) Efforts to reduce population growth rate include various methods of 'birth control' ______

(e) Factors such as improved agricultural practices and medical science promote better levels of survival and the growing population. ______

AGRICULTURE

(a) Should be practised by individuals who live in rural areas or intend to be farmers. ______

(b) Growing cash-crops for sale on a small or large scale, excluding food production for yourself and family to survive. ______

(c) Essential practice for our continued health, yet disturbs nature's balance through removal of vegetation, over-use of artificial fertilisers ______

(d) Animal husbandry through which essential proteins are acquired. ______

(e) Effective irrigation-schemes can increase the yields, frequency and variety of crops. ______

IMMUNITY

(a) Protection of a person from an infectious disease by the introduction of a vaccine which stimulates the body to form antibodies against that disease. ______

(b) New-born babies possess passive acquired immunity from their mothers which last for life. ______

(c) A high resistance to illness. ______

(d) May last for life , once a person has been inoculated against that particular disease. ______

(e) Protection of a community against an infectious disease is increased by adhering to an immunization programme. ______

DRUGS

(a) Medicinal substances used alone or as an ingredient to alleviate physical pain and emotional illnesses. ______

(b) Non-medicinal substances which alter people's perception of the world and make a person escape from the unpleasant realities of life. ______

(c) Substances which can be required by the body in increasing amounts in order to produce the desired effects. ______

(d) Socially acceptable substances, like coffee or alcohol cannot lead to ill-health and death even if used in excess. ____

(e) Medicinal extracts from plants or herbs, from bacteria and fungi or from synthetics, which can kill pathogens without harming the patient when taken in a safe dose. ____

ENERGY RESOURCES

(a) The sun is the source of all energy i.e. food energy, fossil energy, wind power, water power and atomic energy. ____

(b) The ability to differentiate energy usage on the basis of function and cost efficiency. ____

(c) Transfer of energy between organisms and the medium that surrounds them. ____

(d) Energy sources like wood, cow dung, and biogas are considered finite and irreplaceable. ____

(e) A community should be encouraged, in its living habits, to get maximum benefit out of the minimum energy reserves available through conservation. ____

POLLUTION

(a) A high concentration of poisons in the environment to damage man's health or well-being. ____

(b) Emission of toxic substances into the atmosphere cannot alter the atmospheric properties. ____

(c) Increase in volume of water-borne waste in rivers cannot endanger the biotic community because rivers have a capacity for self purification. ____

(d) Pollutants are all kinds of substances which unsettle ecosystems in a way that could produce negative effects on ecosystems. ____

(e) Lack of oxygen, temperature increases, poison and oil are the main forms of water pollution. ____

WATER RESOURCES

(a) Fresh water supply on the earth is unlimited. ____

(b) The shortage of protected water supply in human settlements is responsible for diseases like diarrhoea, cholera, typhoid etc. ____

(c) The hydrological cycle is responsible for renewing a big fraction of the world's total usable water supply. ____

(d) Land water consists of surface water, subsurface water, soil water, and sea water. ____

(e) Availability of water resources does not only include the development of new resources, but also the conservation of existing water, elimination of waste material and recycling of used water. ____

****