

**THE ATTITUDES OF SECONDARY SCHOOL LEARNERS  
TOWARDS BIOLOGY AND IMPLICATIONS FOR  
CURRICULA DEVELOPMENT**

by

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## DECLARATION

I declare that **THE ATTITUDES OF SECONDARY SCHOOL LEARNERS TOWARDS BIOLOGY AND IMPLICATIONS FOR CURRICULA DEVELOPMENT** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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## **DEDICATION**

This research is dedicated to my late Mother and my children.

## SUMMARY

This study focused on curriculum development in biology education. It was based on the present biology curricula from grade 10-12. The purpose of the study was to investigate the attitudes of secondary school learners towards involvement in curriculum development and specific biology content areas of all three grades. The assumption was that future curriculum planning and development in science (biology) education should consider learners' preferences, interests and needs. For the empirical investigation, a sample of 666 grades 10, 11 and 12 learners from three different school types (rural, ex-model C and private schools) in the Northern Province completed an attitude questionnaire. Statistical analysis of the results led to the following findings, amongst others.

- With regard to willingness to be involved in curriculum development, the results were as follows:
  - (a) Significant differences were found between learners when *age* and *school type* were used as moderator variables.
  - (b) No significant differences were found when grade and gender were used as moderator variables.
- Regarding the attitudes of learners towards involvement in curriculum development and specific biology content, some low but significant relationships and a number of significant differences were found between learners' attitudes towards involvement in curriculum development and specific biology content for all the grades. In each instance, age, gender and school type were also taken into consideration.

These findings suggest a complete and significant restructuring of the biology curriculum in secondary schools. A learner-centred curriculum design that actively involves learners in decision-making will consider the needs and interests of learners. This is seen as appropriate in an outcomes-based approach and may lead to more motivated learners.

(ii)

### **KEY WORDS**

attitudes, biology, science, questionnaire, curriculum, curriculum development, models of curriculum development, curriculum approaches and designs, ideology and curriculum, learner-centred curriculum, attitudes towards biology, adolescence, outcomes based education, teacher factors, learner factors, classroom factors

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## CHAPTER ONE

### THE RESEARCH PROBLEM: STATEMENT AND DEFINITION OF CONCEPTS

#### 1.1 INTRODUCTION

Rudduck (in Mac an Ghail 1992) has emphasised the importance of the role that learners should play in their own learning and development. He said: "If we are to be true to the language of curriculum reform - 'student-centred learning', 'a negotiated' curriculum, 'transforming the expectations of the students' then we have to consider the part students play in the curriculum change". Ornstein (1982:406) also wrote: "Progressive educators believe that when the interests and needs of learners were incorporated into the curriculum, intrinsic motivation resulted". According to Kelly (1989:99), children work better and learn more effectively when they are interested in what they are required to do. This implies that their attitudes towards learning are positive.

It has long been established that learners bring with them to school all kinds of intuitive ideas of their own to explain various scientific phenomena and give meaning to the world in which they live (Gunstone 1990:9; Sharp & Moore 1993:130; Gill & Wright 1994:136). It is a commonplace assertion today that learning is the result of an active interaction between what learners are taught and their current ideas, beliefs, points of view and needs. This is because learners, more especially adolescents, are not passive recipients of any teaching, no matter how uninvolved they might be (Irvin 1992:28; Shapiro 1994:19). Nor are their minds blank slates able to receive instruction in a neutral way (Driver, Guesne & Tiberghien 1985:4; Galton & Harlen 1990:2). Today there is a growing shift towards a constructivist mode of thinking in the field of science education. The view that learners construct their own knowledge has gained currency as can be seen from a number of articles on this issue (Krueger 1994:31). According to this theory the ideas of individuals develop because of their life experiences, perceptions of the environment, values and beliefs (Pope & Gilbert 1983:194;

Sanders & Cramer 1992:543). These should be recognised in any attempt to transform the curricula.

At the heart of constructivism lies the notion that learning takes place, in part, through a process of conceptual challenge and change (Galton & Harlen 1990:2; Sharp & Moore 1993:130). For example, the learner is free, when presented with new information, to choose to absorb it, use it to reorganise existing knowledge, disregard existing knowledge as no longer of any value or to completely ignore it. Thus, the constructivist theory emphasises learner-based learning as an important approach to curriculum development. This is because according to this approach, the act of learning is self-initiated, has the quality of personal involvement and is evaluated by learners themselves. Thus, the truth of the knowledge obtained through this act is more likely to be personally appropriated by learners.

Consequently, school science (including biology) should relate meaningfully to learners' own ideas and experiences. Stewart (1987:23) suggests that the more meaningful school science is to learners, the more likely will learners find science interesting and enjoyable. In the same way their attitudes towards learning biology and science generally would be positive. This is unlike the past when it was expected of the learner to memorise passively and regurgitate the imposed learning matter without questioning (Pope & Gilbert 1983:195). Therefore, educators and others engaged in curriculum development and reform need to first establish the learners' beliefs, conceptions, attitudes and feelings about phenomena with which they will be confronted at school (Cobern 1996:303). This will assist them during curriculum development to provide meaningful experiences for learners.

The present study focuses on curriculum development in biology education. It is influenced both by the Progressivist and Reconstructionist views of development and it is based on the present biology curricula from grade 10 to 12. According to these views, learners are regarded as individuals with the potential to

contribute towards their own learning and towards the welfare of their society. This study considers the extent to which future curriculum planning and development in biology and science education should recognise learners as individuals who should be involved in curriculum decision-making processes. It is anticipated that their opinions and suggestions may be used as inputs during curricula development. This may in turn result in their finding biology appealing in terms of importance and relevance - developing in them more positive attitudes towards biology.

## **1.2 ANALYSIS OF THE PROBLEM**

### **1.2.1 Awareness of the problem**

The most fundamental concern of schooling and education today lies with the curriculum (Ornstein 1982:404) and curriculum development. This field has been severely neglected over the years. In South Africa, the severity of this neglect is apparent in the kind of learning that took place in schools over the years. As Clark (1995:5) suggests, very little relevance appears to manifest from the experiences offered to learners at schools. The curriculum development process in this country has always been described as highly academic (Hockey 1995:78; Fraser 1992:51). It is characterised by the élitist's status with certain control measures that are employed to prevent learners from exercising choice of content, particularly in black communities (Jansen 1988:521).

Therefore, the present study is a sequel to previous research into biology education conducted by the author. This research was done in secondary schools in the former Department of Education and Training (DET) in South Africa (Manganye 1994). The purpose of that research was to determine the factors that were significantly related to the development of negative attitudes towards biology in learners. In particular, the objectives of the aforementioned research were:

- to determine the relationship between learners' attitudes towards biology and certain factors related to the educator, the learner, the biology curriculum and the classroom environment
- to detect the relative influence of the factors related to the educator, the learner, the biology curriculum and the classroom environment
- to determine whether significant differences occurred in learners' attitudes towards biology with gender, standard, parental level of formal education and school type factors, as moderator variables

Of the three main objectives of the study above, the second (to determine the relative influence of the factors related to the educator, the learner, the biology curriculum and the classroom environment), is relevant for the present study. The results of correlational analysis showed that *learner* and *curricular* aspects correlated highly and significantly with attitude towards biology. However, when a linear regression analysis was computed, it was found that the *curriculum* alone contributed to 44% of the variance in learners' attitudes towards biology, while learner plus curricular aspects together contributed 55% of this variance. This means that 11% of the variance in learners' attitudes towards biology could be explained by characteristics inherent within them (p. 119).

This situation confirmed the need to redirect attention to the biology curriculum itself with the aim of making recommendations for future developments. This is contrary to the traditional approach where examinations were used as the only important variable to diagnose and effect changes to the curriculum. For many years in absolute use, examinations have not yet produced the thinkers who are needed to solve most of our biological and social problems. Over the past three decades under the same department, biology was taught and learned by rote. Up till now, learners were never considered when curricula were organised and developed. Furthermore, very little was done to compensate for negative attitudes in learners either. This has been so despite research findings that the development of positive attitudes by learners to science should be accorded a much more serious status in any curriculum reform (Gardner 1975:1).

When the biology content from grade 10 to 12 is reviewed, many questions become apparent, and cannot be answered. Features of syllabus discontinuity, repetition, rigidity, difficulty and sometimes irrelevance, are issues that disillusion educators and learners (Fraser 1992:57). The content does not seem to address critical and crucial issues in the lives of learners such as health, agriculture, et cetera. In other words, the knowledge derived from the present biology curriculum seems to have little practical relevance and a poor transfer potential.

### **1.2.2 Examination of the problem - an historical background**

Regard for a learner-centred curriculum dates back to the 18th century, particularly in the writing of Jean Jacques Rousseau (Tunmer 1981:32). The learner was no longer regarded as a being created or moulded by his/her environment, whose behaviour could be corrected once the environment was altered. The basic claim of this approach is that the curriculum should provide learning experiences that will enable learners to follow their own interests across traditional subject-boundaries, and be able to survive afterwards. This allows their potential to unfold. To achieve this, learners should be helped to make choices and decisions about what they would want or would not want for specific subject contexts.

However, the literature on the use of children's ideas, points of view, conceptions, beliefs, commitments and feelings in an endeavour to structure and organise educational programmes is scarce. Existing studies that emphasise the role of learners in curriculum change are piecemeal. They are mainly focused on the dynamics of educator-learner verbal interaction and, particularly on how educators' beliefs, attitudes, or expectations influence their interaction with learners. Such studies have focused more on educators than on learners. Generally, they do not pay attention to the specific activities in which learners become engaged at schools. Neither do they lay any emphasis on how learners perceive and respond to those activities (Brophy 1988:519).

Furthermore, most of these studies were influenced more by cognitive theories (Fensham 1988:133) than the affective (progressive) movements. Many of the studies are only concerned with the 'cause-effect' or 'process-product' approach in which relationships are established between measures of educator behaviour and measures of learner outcomes (Brophy 1988:519). Others were completely based on the community for the formulation of aims and objectives for curriculum development. They were thus influenced by the cultural transmission view of teaching and learning that stressed the passivity of the learners' minds, e.g. associationism, behaviourism, stimulus-response psychology, et cetera (Pope & Gilbert 1983:194). Consequently, many of their aims were the result of the aspirations and needs of the individual developers, implementers and the greater society rather than those of learners themselves. Furthermore, much of the research that was conducted in this field was aimed at earning the researcher a degree. It therefore, had very little to do with the day-to-day problems of our society.

Recently, we have started to witness a paradigm shift within Psychology and Education. This shift has resulted in a renewed interest in learners' active processing of information. Following in Dewey's tradition, progressive educators have developed programmes that encourage learners to adopt an active approach to learning (Pope & Gilbert 1983:194). Certain researchers were also keen to focus on learners' personal needs (Erickson 1979:221 & 1980:323; Posner, Strike, Hewson & Gertzog 1982:211; Albert 1978:389). Downing (1912:334) and Nettels (1931:219) have also emphasised the importance of using learners' interests in developing a course of study for science.

Ornstein (1982:407) indicated that a great concern during this era was that the curriculum had to be more relevant to the learner than to the society or the educators themselves. Shavelson (1972:225) also suggested a critical problem in the development of the curriculum and in the formulation of instruction which rested on how a body of knowledge could be structured so that the communication of this knowledge to learners was effective, and their learning

correspondingly efficient. Brophy (1988:519) indicated that an account of classroom events should also include information on how learners' perceptions, knowledge and beliefs are affected by the activities they perform in classrooms. Postman and Weingartner (in Pope & Gilbert 1983:194) stressed that unless learners perceive a problem to be a problem and what is learnt to be worth learning, they will not become active, disciplined and committed to their studies.

Accordingly, Berman and Roderick (in Pope & Gilbert 1983:195) indicated that curriculum development should recognise learners as meaning makers and experiences should consequently be planned that enable them to consider, contemplate and expand their meanings. Frey (in Fraser 1992:59-60) also stressed that no curriculum development can be undertaken without taking the learner population into account in terms of how they learn, as well as their frames of reference and interests in the subject area. Gunstone (in Fensham 1988:88-9) suggested a move or emphasis quite different from the present concern that places the conceptions of scientists in learners' minds. He indicated that instead, learners should be led by these conceptions to suggest their own curriculum content in negotiation with the educator. According to the abovementioned authors, a worthwhile curriculum based on learner-centred theory can be constructed by reference to the needs, interests and wants of individual learners.

### **1.3 THE RESEARCH PROBLEM**

From the above discussion, it appears that very little research is available that deals directly with learners' attitudes towards biology and the implications thereof for curricula development. The only literature that is available appears to look at the learner-centred curriculum from the point of view of a methodology shift from the educator to the learner. Consequently, learners' ideas, beliefs, points of view, et cetera are often used only to describe what they have in mind about given phenomena (Driver et al 1985). The role of learners in designing and shaping what they would like to be exposed to or not at school is still in its infancy in curriculum circles.

Therefore, the purpose of this research is to determine the attitudes of learners towards the content of the biology curricula in secondary schools and the implications thereof for future curricula development.

More specifically the study seeks to provide an answer to the following question:

*What are the implications of learners' attitudes towards curriculum involvement and towards specific biology content for biology curricula development?*

The main research question can be stated as:

*Is there a significant relationship between learners' views on involvement in curriculum development and their attitudes towards specific biology content?*

## **1.4 AIMS OF THE STUDY**

### **1.4.1 Specific aim/s**

The specific aims of this study are to determine the relationship between the learners' views on:

- involvement in biology curricula development and their attitudes towards specific biology content
- to outline the implications of these views/attitudes for curriculum development in biology

These will be considered when making recommendations for future curricula development in biology education in an outcomes-based education system.

### 1.4.2 General aim/s

There is general agreement that children bring to school a wealth of experiences and sometimes reservations concerning those experiences offered to them by the school (Gamble 1951:51). There is a shift of emphasis towards the description of how classroom activities are perceived by learners rather than by educators (Brophy 1988:520). These should be used as a basis for any curriculum development exercises. Unfortunately, up till now, no such experiences and perceptions have been considered in and during the design, planning and implementation of the curricula for schools and learners. Yet, this information should be fully utilised by the school, although with some modifications to accord with current school situations. In this way, learners will be helped to function on the basis of their experiences. This is important as learners are helped to acquire and maintain positive self-concepts and attitudes towards their studies, e.g. biology.

For very long now, it would appear that learners are being deprived of this opportunity to participate in matters that concern them. According to Smetherham (in Deer & Thompson 1990:27), curriculum innovations are almost exclusively directed at educators with the assumption that the learners will be passive recipients of the change process rather than active participants. In the first instance, this is usually the result of certain forces within our personal cultures (Gamble 1951:51). Secondly, researchers have emphasised the absence or lack of sound curriculum development models in South Africa. This is perhaps the case with other countries as well. The power-coercive framework of administration, highly influenced by party politics characteristic of this situation might have been responsible for this. Furthermore, greater emphasis on the needs and expectations of the society and community than those of learners could also be linked to this.

However, in as far as learners' views also affect the classroom practices of the educators, ignoring them could result in learners feeling negative about or

disinterested in any experiences prescribed for them by the school and the educators (Brophy 1988:519). Therefore, it is hoped that the results of this study will make every person involved in education, including the experts in curricula development, aware of the importance of considering the learners' experiences, needs and expectations when selecting, organising and implementing curricula to meet learners' needs. In this way the experiences and activities of what should take place at school will have been negotiated with learners. This may, in turn, result in the development of positive attitudes in learners towards their studies generally and towards biology in particular.

### **1.5 DEMARCATION OF THE FIELD OF STUDY**

Curriculum development is a complex educational enterprise. It involves many aspects that may not be covered by a study like this. Consequently, this study will concentrate primarily on learners in selected secondary schools in the Northern Province concerning their perceptions and attitudes towards certain variables related to biology. These will be used as inputs for making recommendations for the design of a biology curriculum.

A review of the literature will centre on the following very important aspects related to the research problem:

- theories on attitude development especially with regard to biology
- models of curriculum development

### **1.6 DEFINITION OF CONCEPTS**

For the purpose of clarity and to avoid ambiguity in communication, certain concepts of this study will be defined and elaborated on. Since secondary school learners are adolescents, adolescence will be defined and explained. Other concepts that will be explained are attitude, curriculum and curriculum development.

### 1.6.1 Adolescence and the adolescent

To understand adolescents' attitudes towards diverse biology content areas, it is important to give some background on this phase of development. The term "adolescence" comes from a Latin verb "adolescere" which means to grow into maturity (Rogers 1981:6; Darley, Gluckburg, Kamin & Kinchla 1981:367). It is the period of life between childhood and adulthood (Van den Aardweg & Van den Aardweg 1993:10) and as such, a bridge linking these two stages of development (Rogers 1981:10). Vrey defines adolescence as the stage of growth and development towards something, as well as the period of maturation as such (Vrey 1979:165). The adolescent is a youth at the stage between childhood and adulthood (Van den Aardweg & Van den Aardweg 1993:13). He/she is in the process of emancipation from parental care growing gradually into the adult world that is full of choices. During this period, the adolescent strives towards achieving attitudes and beliefs, as well as developing skills, needed for survival and for effective participation in society (Darley et al 1981:367).

### 1.6.2 The period of adolescence

No complete agreement exists on the exact period that marks the beginning or end of adolescence. This is because children and cultures differ widely and therefore many approaches and criteria for such a division exist (Vrey 1979:165). These approaches and criteria range from cultural, psychological, biological, sociological and chronological age perspectives. For instance, some people see adolescence as that span between the onset of puberty and the completion of bone growth, while others regard it as a stage between the confines of specific age limits.

Biologically, the child is an adolescent from the onset of puberty, that is, the period during which sexual maturity is attained. However, sociologists argue that adolescence should be seen as a *socially* rather than a *biologically* determined phase of development (Darley et al 1981:368). Different views on the

chronological age of the adolescent exist. Some people see adolescence as starting from 12 or 13 to 17 or 18 years of age. Aristotle regards it as the period between puberty and 21 years of age (Siann & Ugwuegbu 1988:211). Brown and Weiner (1979:322) maintain that in the Western culture, adolescence is seen as that period starting from eleven years of age up to the early twenties. According to Vrey, when cultural influences are considered, adolescence should be seen as starting from 12 and going up to 22 years of age (Vrey 1979:165).

Secondary school learners are often regarded as adolescents. Yet, this may not necessarily be correct in developing and under-privileged communities. Many learners in these communities, and especially in black communities, are already adolescents while at primary school. At the same time, many secondary school learners could rather be seen as youths than adolescents. Therefore, it would be fair to say that adolescence begins with puberty but its ending is culturally determined. Brown and Weiner (1979:322) indicate that it would be a temptation to assume that words such as 'childhood' and 'adolescence' have a psychological meaning because their definition is strictly based on culture.

In some societies there is no such thing as adolescence because as soon as young people reach sexual maturity, they enter adulthood. This may be accompanied by some kind of initiation or puberty rite to mark the occasion. Until fairly recently, many children in Western societies carried adult responsibilities such as working in factories at the approximate age of seven or eight (Brown & Weiner 1979:323). This situation sometimes still prevails in black communities because most children are already parents and labourers at an age when other children in Western societies are still attending school. Reasons for this state of affairs may be ascribed to poverty, parental neglect due to illiteracy as well as confused roles these children had ascribed to themselves when they were still scholars.

### **1.6.3 Developmental aspects of adolescence**

#### **1.6.3.1 Cognitive development**

The cognitive development of the adolescent needs to be considered in curriculum development. This is because each phase in the development of the child displays its own cognitive manifestations. Piaget identified four levels of cognitive development, namely sensory-motor (0-2 years), pre-operational (2-7 years), concrete operational (7-11 years) and formal operational (from 11 years) (Vrey 1979:153-155). Parallel to these, are Bruner and Vygotsky's enactive/vague syncretic, iconic/complexes and symbolic/potential stages (Fontana 1988:52-53). Children in the first two operational levels of cognitive development rely on their senses and on the concrete. As Kolodiy stated, these children can manipulate physical objects, but have difficulty dealing with hypothetical problems or with those which involve predictions of the future (Yount & Horton 1992:1060). This means that the truth of any piece of reality is based on its concrete relevance.

However, from the age of 11 or 12, the child enters Piaget's final stage of formal operations (Darley et al 1981:369). It is during this stage that children acquire several important cognitive capacities they did not have in childhood. The most basic change in the formal operational period is their ability to think about the possible and the abstract rather than the concrete. For instance, at this stage, the adolescent can consider that which has not taken place and can, at the same time, imagine all the diverse possible relationships and outcomes in a given situation. Hence adolescents can reason about contrary-to-fact situations (Darley et al 1981:370, Yount & Horton 1992:1060).

Adolescents have the ability to test systematically a set of possibilities for correctness as well as to manipulate thoughts and their systems of thought mentally. Therefore adolescents can be seen as propositional and hypothetico-deductive thinkers respectively (Darley et al 1981:370, Vrey 1979:155). It is this

ability to think abstractly which enables adolescents to explore the impossible and improbable as well as reality. However, the frequent use of abstract and deductive reasoning, when coupled with their frustration at the adult world, often leads to a great deal of questioning which results in estrangement (Fontana 1977:34). This may result in the development of negative attitudes towards any referent, including biology.

In order for the adolescent's formal operational level to be enhanced, the ability to think more abstractly should be reflected in the education system's curriculum with special reference to the biology curriculum. This will increase their freedom of thought and self-expression that may influence their biology self-concepts and attitudes positively.

However, it must be noted that not every child reaches the formal operational stage. For instance, Neimark reported that only 30 to 40 percent of adolescents and adults display formal operational thinking, while Berry and Dansen reported absence of this aspect in non-literate cultures (Darley et al 1981:370). Again, a small scale research into the cognitive development of the grade eight learners in the former Gazankulu Department of Education (Northern Province) using the Science Reasoning Tasks, revealed that only about 2% of learners in this region can handle formal operations. Too much abstraction in curricula and teaching may hence lead to conflicts which may well result in the learners swinging away from learning a specific course or subject because of the development of negative attitudes towards such a course or subject.

### **1.6.3.2      *Affective development***

Like any other transition, adolescence is marked by profound pressure exerted upon the child. This is because he/she cannot yet reconcile the two poles of childhood and adulthood. On this basis, Fontana (1977:33) commented as follows:

*The adolescent has learned to cope with the business of being a child, now he finds himself called upon to cope with the business of being an adult, and to cope with it in a complex industrial society which, because of the lateness of school leaving age, is reluctant to accord him adult status.*

Adolescence is seen by psychologists as a period during which a person is in a psychological moratorium, more especially when choices have to be made (Burns 1979(a):174). This is because these choices are often made on the basis of inadequate knowledge and experience. For instance, the choices of career, values, life-style, personal relationships and fields of study are more of a psychological problem. This is because such choices are often undertaken in the face of conflicting evidence and values within a restless and uncertain society.

Social scientists often label adolescence as a period of storm and stress. According to Hall, adolescents typically waver between contradictory and extreme states such as cruelty and sensitivity, diligence and laziness (Darley et al 1981:370). It is the period of dramatic ups and downs through which every teenager must pass in order to develop into a mature adult (Brown & Weiner 1979:372). As a period of mood swings, and of rapid shifts from enthusiasm to deep depression, adolescence is also characterised by the child's low self-confidence, anxiety and escalating aggression and sexual impulses.

In contrast to the above, the notion that adolescence is a crisis period, flowing from physiological change to psychological maturation is not supported by many researchers (Brown & Weiner 1979:372; Burns 1979(a):176). On this basis Offer was quoted by Brown and Weiner (1979:372) as saying that adolescent turmoil should be seen as only one route of passing through adolescence. Adelson (in Gage & Berliner 1988:44) also confirms this last view. According to him, adolescents are not in a state of turmoil, nor are they deeply disturbed, resistant to parental values and politically active and rebellious. In this view, adolescent turmoil should rather be regarded as culturally determined.

The validity of these conflicting views should be given serious consideration in educational settings, including the biology classroom. This is because emphasising any one of them may be an over-simplification.

### **1.6.3.3      *Social development***

Adolescence is characterised by children's craving for self-actualisation and a total emancipation from their parents. As Darley pointed out, the adolescent longs impatiently for liberation and the acquisition of an autonomous adult status. They do this by breaking their childhood bonds of emotional dependency on their parents. This is often accompanied by the rejection of their parents' opinions resulting in a certain amount of parent-child conflict (Darley et al 1981:371).

The adolescents' increased ability for abstract thought makes it possible for them to conceptualise their own thoughts. They can question their own moral opinions and religious beliefs and treat them as objects to discuss and reason about (Brown & Weiner 1979:369). At the same time, adolescents are sensitive to what others think of them. It is this personal evaluation of themselves against the real and the imaginary others that helps the development of a genuine concept of themselves. A more positive self-concept is desirable because it serves as a strategy the child can use to cope with anxiety or tension (Vrey 1979:168), thereby developing positive attitudes towards people, objects and ideas. Thus a positive self-concept may promote the development of a positive attitude towards biology.

Adolescence is also characterised by an inclination to conform. This is the tendency whereby adolescents identify themselves more with their peer group than with their parents. According to theorists, the major task during adolescence is to establish intimate relationships (Darley et al 1981:376). It is in their relationships with friends where the adolescents' views are shared. The more acceptable their views are to the group, the more positive will be their self-

concepts and attitudes. This in turn will influence readiness to participate in tasks regarded by others as difficult, for example in science.

However, this conformity to the peer group has some serious problems. The new ideas acquired by the adolescent from relationships with friends often conflict with those of parents and educators. The kind of persons exemplified by parents and friends has a very decisive influence on the behaviour of adolescents. Apart from this, the manner in which the science/biology educator handles the subject and indicates the value of this subject to learners can influence their attitudes towards biology positively or negatively.

#### **1.6.3.4      *The adolescent and identity formation***

This is the fifth of Erikson's developmental stages, namely "identity versus role confusion". This stage is characteristic of adolescence because it is more concerned with the children's discovery of themselves. During adolescence, the adolescent is preoccupied with identity formation. Self-identity according to Fontana (1988:248-249) refers to the sum total of the concepts individuals have about themselves.

Although there is some sense of self-identity in early infancy, the search for it is particularly characteristic of late adolescence (Brown & Weiner 1979:374). This is partly because of the emergence of more mature life goals, such as career choices and the adolescents' levels of intellectual functioning (Brown & Weiner 1979:374; Fontana 1988:249).

This search for identity is often accompanied by a great deal of experimentation and adoption of role models in order to establish who the adolescent actually is. By finding out more about their life-worlds, listening to what others say about them, identifying with adults, children and the subjects they learn, adolescents gradually construct pictures of the kind of persons they are (Fontana 1977:33).

Thus, adolescents can view themselves as scientists or non-scientists, capable or incapable, and so forth. However, the socio-psychological atmosphere in which the adolescents find themselves, and their physical maturity may have profound immediate and enduring effects on their personalities as well as on their overt behaviour. Failure to identify themselves according to their life-worlds, significant others, as well as school subjects, lead to what Erikson called "role confusion". According to Fontana (1988:251), role confusion implies that an individual has no clear idea of the kind of person he/she is or the role that he/she should resume in life.

Low self-esteem, insecurity, self-doubt and self-questioning are the consequence of identity confusion. The adolescent with no clear idea of the person he/she is, is prone to fall prey to the many diverse and conflicting pressures of adult life, adhering for security to a rigid and artificial picture of him/herself that leaves no room for change (Fontana 1977:33).

Therefore, schools should understand the child's search for identity and provide education that will be seen by all as relevant to their present and future needs. This encourages the development of positive attitudes (Fontana 1977:121). Shayer and Adey (1989:145) pointed out that learners are motivated as long as the aims and content of the science curriculum that they are exposed to are related to the model of how they proceed through adolescence to adulthood.

Educators should understand adolescence as a human stage of development and, by their tolerance of the adolescent, while maintaining consistent standards, help them to answer the questions that they are confronted with on their way to adulthood.

Although many adolescents might have reached a stage of formal operations, only the minority will have reached the ego identity achievement stage at which to make crucial decisions about their subject choices at school (Kelly 1987:22; Vrey 1979:177). Therefore, all educators should approach their adolescent

learners with much more circumspection and care in order to prevent the development of ill-defined tensions and conflicts characteristic of this period. These tensions have negative educational effects on learners' attitudes and performance.

#### **1.6.4 Attitudes**

An attitude is a state of mind, behaviour or conduct, regarding some matter as indicating opinion or purpose, a state of readiness, a tendency to act or react in a certain manner when confronted with stimuli and a mental set held by individuals which affects the way they act (Oppenheim 1979:105; Hayes & Orell 1989:338). Allport (in Van den Aardweg & Van den Aardweg 1993:28) defines attitude as a mental or neural state of readiness, organised through experience, which exerts a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.

Attitudes are those convictions held by a person about something, which influence such a person's behaviour. They represent states of mind, favourable or unfavourable, towards anything and everything and therefore are especially important for mental development. Attitudes influence the individual's readiness and receptiveness to learning (Rogers 1981:141; Hasan & Billeh 1975:247). As internal states of mind that influence the individual's choices of personal action, attitudes contain some elements of value and belief (Fontana 1977:104). Fontana (1988:204) maintains that attitudes may be partly conscious and partly unconscious, with the two usually in conflict with each other.

According to Gagne (1977:21), attitudes are response tendencies or states characterised by readiness to respond. They are enduring orientations which people develop towards the objects and issues they encounter in life (Fontana 1977:104). Allport, as cited by Gagne' (1977:219), defines an attitude as a mental and neural state of readiness, organised through experience, and exerting a

directive or dynamic influence upon the individual's response to all objects and situations with which he/she is related.

Newcomb, (in Wright, Taylor, Davies, Sluckin, Lee & Reason 1970:480), defined attitude as indicating an individual's organisation of psychological processes as inferred from his/her behaviour, with respect to some aspect of the world that distinguishes itself from other aspects. Attitudes represent the residue of the individual's experience with which he/she approaches any subsequent situation. This, together with contemporary influences of such a situation, determines his/her behaviour in that situation.

Attitudes can be positive, neutral or negative (Child 1986:257). According to Hart and McClaren (in Yount & Horton 1992:1059), an attitude can be considered as an enduring positive or negative feeling towards an aspect of an environment conflict, and generally as an interaction of cognitive, affective and conative domains. Therefore, attitudes, whether positive or negative, are reinforced by beliefs (cognitive) and often attract strong feelings (affective) that will lead to a particular form of behaviour (behavioural) (Oppenheim 1979:106).

While interest is closely related to attitude, Newton (1975:368) argues that the two are not identical or synonymous. For instance, interests stem from an internal satisfaction closely linked with the child's competence motive. Attitudes are more general while interests are specific to a given stimulus. Interests are directly related to what a person can do and what he has already learned. Interests are reflected in a person's tendency to seek or avoid certain kinds of activities (Avertson, Anderson, Anderson & Brophy 1980:211). Interests have a personal subjective character and as such, are related to values. However, Rogers (1981:142) maintains that interest suggests favourable attitudes towards an activity and a desire to participate. Vrey sees interest as implying a deliberate direction, and therefore is a completely voluntary attitude (Vrey 1979:232).

The development of attitudes is dependent upon the extent to which various activities or objects appeal to the individual's convictions and feelings about them. For instance, learners need to perceive the relevance of the subject in order to assimilate it in a meaningful way. If they cannot, the content of this subject is simply memorised and later forgotten, with no modification of their internal cognitive structures, or their attitudes (Yount & Horton 1992:1060-1061). This situation may cause serious and irreparable damage to the learner's feelings about and attitudes towards biology.

However, it is the possession of positive attitudes towards an aim that will enhance the endeavour towards its achievement. Therefore, educators and the school should strive to promote the development of positive attitudes in their learners towards science in general and biology in particular.

#### **1.6.5 The curriculum**

A thorough perusal of the literature reveals that the term "curriculum" is a most complex, diffuse and dynamic domain of the educational endeavour. Such a curriculum which is negotiated with learners (among others), is called a socio-constructivist curriculum (Jacobs, Gawe & Vakalisa 2000:183). One major complication concerns lack of established vocabulary (Johnson 1967:128; Macdonald & Penny 1984:163). Thus, the term is used with several meanings (Kelly 1982:7; Cremin 1971:207) that appear to bear reference to many diverse and even conflicting views of 'curriculum' (Tunmer 1981:30; Lawton 1983:1). Goodlad describes curriculum and the curriculum field as a "semantic jungle" (Childress 1977:47; Eisner 1965:155). According to Rugg (in Gamble 1951:51) "curriculum" is "an ugly, awkward, academic word, fastened upon us by technical custom, consisting of the entire programme of the school's work". Those who have attempted to define it, however, have only managed to give a rigorous statement, seeking to express in a sentence or two, the whole meaning of the word (Mathews 1983:2). Moreover, these definitions were usually a mere oversimplification of the term (Buckland 1982:168). Sometimes the meaning of

curriculum is confused with that of curriculum development, in which case the term focuses more on the practical process of how to organise than on the theoretical process of understanding (Johnson 1967:127). Curriculum 2005 in South Africa may serve as a good example of this.

Therefore, this lack of conceptual and definitional clarity of curriculum has always been a basic and most serious source of contention for curriculum planners, researchers and even implementers (Childress 1977:4). Nevertheless, although definitions may not necessarily help understanding, Lawton (1983:1) argues that it is sometimes necessary to clarify meaning, especially where words such as 'curriculum' are used in quite different ways and different contexts. A similar view was expressed by Stenhouse when he indicated that apart from clarifying meaning, definitions also suggest perspectives from which to view various words (Stenhouse 1975:1). Therefore, it is important that terms such as "curriculum" are defined in a way that will lead to conceptual clarity of some sort. However, the way in which conceptions of "curriculum" differ and sometimes conflict with one another necessitates a systematic categorisation of these meanings in order to gain a better perspective.

Three main perspectives exist on which the present and future definitions of "curriculum" could be based (Childress 1977; Tunmer 1981:31; Bayona 1995(a):13-15).

The first perspective regards curriculum as "a fixed course of study". This appears to be the original meaning of curriculum (Bayona 1995(a):13). Historically, the word "curriculum" derives from two Latin words, "currere" or "*curro*" meaning to run and "courses" which means a course or track (Carl, Volschenk, Franken, Ehlers, Kotze, Louw & Van der Merwe 1988:21). In French, the term curriculum is translated by the phrase *cours d'études* that refers to a course of studies (Lawton 1983:2). Adherents to this view regard curriculum as "a round of studies (universal and consistent in nature) to be run through, pursued and presumably learned" (Childress 1977:49; Hirst 1969:143-4). This

conception of curriculum suggests that the curriculum consists of a body of compulsory and optional subjects and subject matters that are set out for learners to cover (Bayona 1995(a):13; Tanner & Tanner 1980:6; Saylor & Alexander 1974:2; Tunmer 1981:30). It is a "deliberately selected set of courses which taken together, are assumed to produce certain differences in the learners which otherwise would not have occurred" (McDiarmid 1971:30). This selection is often done externally of the school by experts. In a society like South Africa, for example, the courses and subjects consisted of the social and cultural experiences that should be transmitted to and assimilated by learners. For this the textbook is used as an instrument, the educator as the energiser and the examination as the monitor of the learner's progress (Childress:1977). Education is provided through a *string of beads curriculum* intended to produce the all-round leader in society (Tunmer 1981:31).

This definition carries some influence of Classical Humanism (Lawton 1983:6). More central to this approach is the creation of an elite education system designed to enable man to perform justly, skilfully and magnanimously all the adult and citizenship duties. The person thus produced must be an "all-round amateur", who could respond to demands in his/her society (Tunmer 1981:31).

The second perspective is at the other end of a curriculum-definition-continuum and is an all-embracing view of "curriculum". Here curriculum is perceived as "all experiences under the auspices of the school". It is the learning that learners acquire directly and/or indirectly from the total school environment (Bayona 1995(a):14). The earliest people behind this thinking are Bobbitt and Charters (in Childress 1977:50). Both have stressed the importance of activity analysis and detailed specification of objectives in behavioural terms (Bellack 1969:288).

However, Bobbitt alone saw the curriculum as referring more to a series of experiences that children and youths must have by way of attaining certain objectives - the entire range of experiences both directed and undirected concerned with unfolding individual abilities. It is the device through which the

vast range of knowledge and values, skills and roles, which the school offers to its learners is organised, taught and eventually evaluated (Eggleston 1980:1). This view of curriculum reveals the *means-ends* relationship. Consequently, curriculum represents the sum total of the means consisting of a series of experiences by which the learner is guided in attaining certain intended outcomes (Hirst 1969:143-4; Hirst & Peters 1970:60; Childress 1977:51).

Although in agreement with Bobbit, Charters objected to the conception of the curriculum that is completely based on aims. This is because most of these aims are context-dependent and often consist of statements of ideals that are themselves isolated from activities (Childress 1977:51). To him, "curriculum" was not only concerned with ideals that govern life, but also with things that a person does and thinks about. Hence curriculum is seen more as an activity than a series of experiences. It is a key to what happens at school (Mathews 1983:1; Eisner 1965:158). Kelly (1982:10) supports this and further indicates that it will be a serious mistake to omit in our definition of curriculum the whole range of activities which educators plan and execute with deliberate reasons and intentions.

According to Tanner and Tanner (in Carl, et al 1988:21), the curriculum includes all planned and guided learning experiences, formulated through the systematic reconstruction of knowledge and experience, under the auspices of the school. In this way, curriculum is not necessarily a course of study, nor is it a listing of goals or objectives. Instead, according to this conception, curriculum encompasses all the learning experiences that learners have under the direction of the school. According to Rugg (in Childress 1977:52), curriculum is everything that the learners and educators do, with the relationship between extracurricular and intra-curricular activities being very important. According to Tunmer (1981:30), it is an activity in which people engage in a complex, observable phenomenon with many dimensions.

The third perspective consists of two main conceptions of a curriculum. The first one is based on Tyler's intended-outcome model of curriculum development. It

represents a shift away from the conception of the curriculum as referring to “content”, “activity” or “experience” towards curriculum as a structured series of “intended” or “anticipated” outcomes of a given learning situation (Childress 1977:53). According to this view curriculum is a tangible expression of educational objectives - a structured series of the intended learning outcomes. This view of a curriculum corroborates with what Johnson alluded when he said: “curriculum is not concerned with what students actually do in a learning situation, but with what they will actually learn as a result of a given learning situation” (Johnson 1967:130). As such, the curriculum has an anticipatory relationship within the learning process and it therefore deals with expectations. These are the learning outcomes to be achieved through instruction (Johnson 1967:130; Childress 1977:53). In this way, the curriculum prescribes the results of instruction rather than the means.

However, it is important to note how unthinkable it would be to talk of a curriculum as referring only to *ends* without due regard also given to the *means*. In fact, this would be a mere simplification of the psychological events. Instead, it would be far more reasonable to consider the curriculum also as referring to the *means* likely to produce the *ends*. These include the *experiences*, organised into *content* and *activities* in which both the educators and learners engage in educational settings.

Secondly, there are those within this perspective that view curriculum as a plan or a programme administered under the jurisdiction of the school (Bayona 1995(a):15). Saylor and Alexander (1974:6) defined curriculum as a plan for providing sets of learning opportunities to achieve broad goals and related specific objectives of an identifiable population served by the school. Thus, the curriculum is the scheme that is based on formal and informal need assessment. This is necessary for providing sets of learning opportunities (which include all the learning of a child at school, content and learning material of the course and its method of delivery) to achieve broad goals and related specific objectives (Welch 1969:429; Childress 1977:55; Rollnick & Perold 1995:5). On the other

hand Brameld (1970:348), regarded curriculum as a structure symbolising a moving wheel. It represents a vital, moving and complex interaction of people with things in a free wheeling setting of which *programme*, *people* and *structure* are the three major interrelated aspects of any curriculum.

From the definitions of curriculum above, it is interesting to note that the word "curriculum" is quite a complex one. There is no single definition that is final. Consequently, the most useful definition that may be adopted is one that is flexible and broad enough to embrace all the learning that goes on in a school and all the dimensions of the educational process as such (Kelly 1982:26). This is because curriculum cannot only be limited either to 'content', 'experiences', 'activities' or 'objectives' alone. Thus, the definitions by Kerr (1968:16) and Gamble (1951:51) that describe curriculum as "all the learning that is planned and guided by the school, whether it is carried out individually or in groups, inside the school" and "the sum total of the experiences which a child has, anywhere, as he lives and learns", respectively appear to have a more broader meaning. Another observation from the definitions above (except the one given by Gamble) is that learners appear to be passive recipients of curricula.

However, the author's view of curriculum in this thesis is that which looks at the curriculum in relationship to the meaning of "education". According to Peters (1973) education is "the initiation into worthwhile activities". This definition is broad enough and it also appears to have a true and all embracing flavour that allows societies and/or individuals (this time the learners) to determine their appropriate experiences according to what they deem 'worthwhile'. Therefore, if curriculum refers to *all the learning that is planned and guided by the school* or *the sum total of the experiences that children have as they live and learn*, surely these experiences need to be 'worthwhile' for education to prevail. This is because what happens in schools through the curriculum might not necessarily be educational.

Therefore, in order to avoid the confusion and bias brought to light by the many definitions given above the researcher proposes the following definition of the curriculum for this research:

*a programme of planned experiences (content and activities) that learners need to be exposed to at school in order to achieve certain intended educational outcomes*

Following this definition, therefore, the curriculum should be seen as everything planned that will help to develop learners (Curriculum 2005, February 1997:10). It entails all the materials, such as textbooks, educators and learners' guides, laboratory apparatus and other teaching and learning material with which to facilitate learning, as well as the methods to implement and evaluate the progress of education (Walker & Schaffarzick 1974:84).

However, should the selection of the experiences for learners be a unipolar exercise where educators and, more especially, the (so-called) experts outside the real school situation are charged with the task to design the curricula for schools to implement? Or should the parents, educators, education authorities and learners feature as prominently as possible in suggesting what will be in keeping with learners' expectations? For many years outside experts researched and developed curricula that were disseminated to the educators to adopt. However, the extent to which learners' attitudes towards the curriculum may be influenced by curriculum content is researched in this thesis. This has implications for the involvement of learners in curriculum development.

## **1.7 PROGRAMME OF STUDY**

This study comprises the following chapters:

Chapter one was an introductory chapter describing the research problem and defining important concepts.

In chapter two theories on attitude development towards biology as described in the literature, is explained.

In chapter three models of curriculum development and their influence on biology content are delineated.

In chapter four the research design of the study is fully explained.

The research results (analysis, presentation and discussion thereof) are presented in chapter five.

In chapter six, the conclusions and implications of the study for curricula development in science (biology) education are outlined.

## CHAPTER TWO

### THEORIES ON ATTITUDE DEVELOPMENT: VIEWS FROM RESEARCH

#### 2.1 INTRODUCTION

The main aim of this study is to determine the attitudes of secondary school learners towards involvement in curriculum development as well as towards specific biology content and the implications thereof for curriculum development. In chapter one, the problem of the study was analysed and stated. The concepts "Adolescent" and "Curriculum" were defined and extensively discussed. This was followed by the demarcation of the field of the study and the division of chapters.

In this chapter, the literature on the development of learners' attitudes towards certain variables related to biology in secondary schools will be reviewed. The variables that may influence these attitudes and their implications for curriculum development are examined. A review of the literature will be based on publications published from 1980 onwards. However, under considered and unavoidable circumstances a reference to earlier sources will be cited.

Finally, some implications of attitudes towards science (biology) for curriculum development will be stated.

#### 2.2 THE CONCEPT "ATTITUDE"

Notwithstanding the definitions of attitude presented in the first chapter, it is important that the concept be further analysed to delineate the meaning intended for this study.

- Gardner (1975:1) has identified two categories of an attitude. These are the "*scientific attitude*" and "*attitude towards science*". The former category of

attitude is related more closely to a person's state of mind. It is better described as a style of thinking and is therefore, cognitive. This cognitive thinking style is characterised by such words as open-mindedness, honesty, suspended judgement, critical thinking, et cetera. Whereas, "attitude towards science" is characterised by the existence of an attitude object, namely: Science and scientists. Therefore, statements like "I hate science" and "I like science" express attitude towards science and they belong to this category. "Attitude towards science" is both emotional and behavioural in nature and is the focus of this study.

- Koballa and Crawley (1985:223) have introduced the concepts "belief" and "behaviour" in their analysis of the meaning of attitude. Beliefs are related to behaviour because both contribute to the formation of attitudes (p. 225). However, attitudes differ from beliefs in as far as the former engenders a predisposition to respond emotionally, which the latter may not.

Attitude as belief refers to the acquired information that a person accepts as true, and it is therefore, cognitive in nature. This may have positive, negative or no evaluative implications for the study of science. For instance, that science is "too mathematical" or "messy", denotes a person's belief system. This example has some negative implications that may lead people to conclude that they should not study science.

On the other hand, attitude may influence behaviour and this is often characterised by a person's inclinations to opt for science, buy scientific magazines, attend science fairs, et cetera. However, like beliefs, behaviour may have positive, negative or no evaluative implications for the study of science. Therefore, any effort to change attitude should also deal with belief and behavioural changes. This is because the principles involved in

attitudinal change are the same as those involved in changing beliefs about science and science-related behaviours.

- Shrigley, Koballa and Simpson (1988) have related attitude to belief, value and opinion. To them beliefs and opinions are cognitively oriented although the latter are also employable in verbal expressions (p. 659). Values, on the other hand, are culturally bound. Although these concepts are thus related to attitudes, these researchers argue that they may only be used to support rather than supplant them.

Thus, the analogies of attitudes with other variables by Koballa and Crawley (1985) as well as Shrigley, Koballa and Simpson (1988) may be summarised as follows:

*Attitudes → beliefs (cognition) → affection (evaluative quality) → conation (behavioural intentions).*

- Charen (1966:55) has identified two contexts in which attitudes may be examined. One is concerned with the behaviour associated with scientific procedures as methods involved in critical reasoning (scientific attitude). The other is concerned with feelings and emotional reactions, such as interest, curiosity and stimulation that constitute a way of looking at one's environment and co-exist with the procedures of science.

Therefore, the analogies of attitude with other variables by Gardner (1975) and Charen (1966) may be summarised as follows:

*Attitudes → critical reasoning → feelings and emotional reactions (interests, curiosity and stimulation)*

- Allen (1960:66) equates attitude with motivation. He argues that a person with favourable attitudes towards an activity is one who may easily be motivated to undertake such an activity. To him attitude is emotional and behavioural.
- Goodwin and Klausmeier (1975:303) conceive of attitudes as having affective and cognitive components. They also associate attitude with behaviour.

Therefore, from the various attempts to put the concept attitude in perspective, and for the purpose of the present study, the term attitude will be linked to the person's emotional/conative/affective and behavioural manifestations. Throughout this study, attitude towards science will refer to a general and enduring positive or negative feeling about science. It will centre on concepts such as interests, curiosity, motivation and stimulation as behavioural manifestations. Consequently, attitude towards science will not be confused with the scientific attitude described above. Attitude towards science (biology) is the aspect involved in this study. However, it must be remembered that although attitudes towards science direct and allow the prediction of science-related behaviour, one's positive or negative response to an attitude questionnaire may not necessarily be predictive of science behaviours at a later stage. In this way, the relationship between attitude and behaviour becomes one of probability rather than a deterministic relationship.

### **2.3 THE SIGNIFICANCE OF ATTITUDES IN SCIENCE EDUCATION**

Schofield, (in Newton 1975:368), stressed the importance of learners' attitudes when he said:

*...we should consider much more closely than perhaps in the past pupils' perception of the science we teach them. This is because we have too often thought of the problems we face about our own perception. We have therefore, failed to project ourselves into the*

*minds of our pupils, and to imagine what school science is like to someone growing up in the ordinary society we have bequeathed to them.*

Rogers (in Gardner 1975:1) also suggested that educators should shift their emphasis from pure intellectual development and start to attend to learners' feelings of wonder and delight over something seen or done. Consequently, they must constantly ask themselves questions such as:

- Do our learners enjoy some of the things they do in science?
- Does their enjoyment of what they do reach a higher level than fun and become a feeling of doing and more thinking in science?

The answers to these questions are significant and should be kept in mind when developing curricula.

Researchers and science educators have always emphasised the essence of positive attitudes if learners are to obtain maximum benefit from their work in science. They have stressed the importance of learners appreciating the nature of science and the development of scientific curiosity. Learners' experiences in the classroom and the laboratory should provide challenge, enjoyment and satisfaction. Such attitudes are significant in the general education of learners, especially those who choose science as a vocation.

The current statements about the major goals of science education include the development of favourable attitudes towards science. This is because the attitudes that people have about something exert an influence on how they behave. According to Ponte, Matos, Guimaraies, Leal and Canavarro (1994:357) the reasons for the study of learners' attitudes are grounded in the assumption that they also have a significant influence on learners' thinking and action.

Favourable attitudes enhance achievement and so encourage learners to learn how to learn. They fulfil learners' basic psychological needs to know and to succeed, as well as their future behaviours such as interest and curiosity. For example, Borasi and Schoenfeld (in Ponte, et al 1994:348) have stressed that attitudes and learners' expectations regarding a specific discipline (e.g. mathematics or biology) should be seen as a significant factor underlying their school experience and achievement. Mager (in Myers & Fouts 1992:929), also stressed the importance of attitudes in as far as they enhance learners' achievement and their cognitive development. Furthermore, learners with positive attitudes towards a subject are likely to extend their learning in that field either formally or informally after the direct influence of the educator has ended.

As early as 1960, Allen (1960:66-7) emphasised that favourable attitudes form a sound basis for future living and, as a non-intellectual factor in the learning of any school subject, they may condition the success of the educator's efforts at motivating learners.

Haladyna, Olsen and Shaugnessy (1982) have perceived the existence of a powerful link between learners' attitudes and their perception of "self" and "abilities" to learn. Talton and Simpson (1986:366) supported the contention and further said that learners with more positive attitudes towards science have very strong "concepts" of themselves and their abilities to learn.

Goodwin and Klausmeier (1975:303) have stressed the importance of attitudes in as far as they influence the individual's degree of acceptance of objects, people, ideas or situations that ordinary concepts cannot do.

According to this exposition, attitudes towards biology are extremely important and, among others, they influence:

- choice of vocation/subjects,

- behaviour,
- achievement, and
- a perception of an ability to learn.

## **2.4 BACKGROUND TO THE STUDY OF ATTITUDES**

For proper curricula development, all the domains should be considered. However, the affective domain, as the co-determinant of learners opting for or against the study of science, enjoyment of science and commitment to science, has been severely neglected over the years. Ponte et al (1994) mentioned that a neglected aspect of the change process in education is a study of the role, views and the attitudes of the most relevant participants. These are educators and learners. Collier (in Miller 1991:217) supported this statement when he said: "One limitation of education, especially higher education, is its over emphasis on analytical, intellectual training at the expense of the affective and conative development".

For example, many curriculum evaluation programmes have been criticised for their neglect to study the effects of learners' perceptions of their learning. This also included the environments in which learning took place.

Although studied and defined, attitude towards science was not distinctly differentiated from scientific thinking (attitude) and problem-solving skills (Hasan 1985:3; Koballa & Crawley 1985:223). Consequently, the development of the goals for understanding concepts and conceptual schemes of enquiry in science education has been more emphasised than that of attitudes (Hasan 1985:3).

For many years, poor science examination results have been linked more with the cognitive than with the affective domain. For example, a series of research studies conducted by Lewis (in Ormerod & Duckworth 1975:1-2) into learners' poor performance in science, revealed that the high proportion of the variance of the

examination results gained by the 14 and 16 year old learners was loaded with the general factor of attainment.

However, after the release of the Dainton's report in 1968 and learners' "swing away from Science" (Ormerod & Duckworth 1975:2) and of the assessment results of the National Assessment of Educational Progress (NAEP) in 1978, several explanations were made about science teaching and educators (Yager & Penick 1984:143). Of the many explanations made, lessening interest in science and the dissatisfaction with science and technology among learners were suggested. Consequently, many scales were developed to measure attitude. Therefore, the follow-up analyses of the examination results of the 16-year old learners conducted by Hall in 1975 (in Ormerod & Duckworth 1975:2), showed that the attainment factor was itself also heavily loaded with non-cognitive factors. This has triggered more research interest in other factors apart from learners' cognitive abilities.

This was seen as important in explaining learners' performance and attitudes towards science. In this way, the learners' attitudes towards science, their school and the teaching that they received were emphasised. Furthermore, the researchers recognised attitudes as important when determining reasons why many learners did not enrol in science courses (Ormerod & Duckworth 1975:1).

Nonetheless, it would appear that worldwide, let alone in South Africa, very little was done in this domain. Taylor, Ramsey and Howe (in Hasan 1985:4) have supported this statement. Consequently they wrote:

*Despite the recognition that attitudes towards Science are a significant outcome of Science teaching and a relevant factor in learners' cognitive learning of Science, little has been done towards specifying and determining the conditions that affect their dynamics and influence their development.*

This apparent neglect of learners' "affect", (that is their emotions, feelings, interests and attitudes) was never changed by some small scale research done in this regard for curriculum action (Shibecci 1989:13). Apart from that, much research done on attitudes was plagued with problems including those of instrumentation (Gogolin & Swartz 1992:488; Krynowsky 1988:576; Talton & Simpson 1987:509; Koballa & Crawley 1985:223; Gauld 1982:109; Haladyna et al 1982:671; Hough & Piper 1982:35; Pell 1982:28; Simpson & Troots 1982:771). Another problem was the meaning of attitude (Gogolin & Swartz 1992:488; Krynowsky 1988:576; Hasan 1985:4; Haladyna & Shaughnessy 1983:311). The apparent failure of educators to implement the affective domain in their teaching without sacrificing content of the subject concerned also seemed to be a problem (Gauld 1982:110).

However, although fragmented, Hasan (1985:4) points out that sufficient evidence exists to support the significance of positive attitudes in education. Thus, it should be emphasised that the main task and central purpose of science education is the awakening of a sense of the joy, the excitement and the intellectual rigour that can be experienced when studying science. This is irrespective of whether the learner will become a future professional scientist or not. Therefore, the affective development of the learner should also be included in the aims of science education curricula to supplement cognitive development.

## **2.5 THE DEVELOPMENT OF ATTITUDES TOWARDS SCIENCE (BIOLOGY): VIEWS FROM RESEARCH**

A number of research studies on attitude development have been carried out in other countries (Talton & Simpson 1987:508) and also in South Africa. The aim of these studies was to investigate systematically learners' attitudes towards science as taught in schools. It was also investigated how these attitudes affected learning, to obtain a sound research base for future curricula development (Pell 1985:123).

These studies ranged from characterisation of the classroom to classroom interactions with the aim to examine the relationships of the classroom environment variables with the cognitive and affective learning outcomes. For instance, in his study of the relationship between enjoyment and achievement in school physics, Pell (1985:123) pointed out that no effective learning is likely in situations where a cognitive mismatch is accompanied by a lack of affective response from learners on the subject. Apart from this, Talton and Simpson (1987:508) stated:

*the cognitive aspects of the learning environment are better predictors of cognitive outcomes and the affective aspects are better predictors of the affective outcomes.*

The variables related to attitude development mostly researched included: attainment, motivation, study methods, personality and sex differences (Fraser 1986; Pell 1982).

Other variables related to the development of attitudes that will be discussed, include:

- the role of the educator
- the role of the learner
- the role of the curriculum
- the role of the classroom environment.

## **2.5.1 The role of the educator in attitude development**

### **2.5.1.1 General overview**

The educator plays a key role in implementing the curricula at school level. While many factors exist to account for the variance in learning outcomes and attitudes of

learners, such as curriculum materials in schools (Vitale & Romance 1992:915), those inherent within educators themselves cannot be ignored. Educators of science today are confronted by an immense variety of possible teaching methods and techniques that they may employ in their work because of changes in curricula, technology, as well as working environments that are more complex (Holdzkom & Lutz 1984:vii). They are also faced with a twofold task of instructing learners to become scientists and creating in the average citizen an interest in the scope and methods of modern science (Watson 1990:49). Although no research evidence exists to prove the actual determinants of learners' attitudes towards science, the possibility that the educator may be the most powerful factor in developing such attitudes cannot be underestimated.

Kach and Borich (in Simpson & Troots 1982:766) indicated that educator behaviour influences learners' self-esteem and attitudes towards school learning in general. It was also suggested that learning is greatly influenced by the educator, and his/her characteristics are likely to reflect in the patterns of change that occur in learners. Leach (1994:54) indicated that the learners' main contact with science is through educators and their intentions are the most valuable classroom resource. This means that the way the educator interacts with learners profoundly affects the way they perceive their ability to do science. However, Ormerod and Duckworth (1975:71) warn that, even so, the degree and nature of the educators' influence on learners' attitudes towards science should be treated with care as it may vary for different groups of learners.

According to Abell and Pizzini (1992:649), a great potential for improving the learners' learning in science lies with the classroom educator. The educator and the principal are vital factors in education improvement and without their help, change cannot occur. The educator has been regarded as the mediator of the effects of the learning environment and a main agent for attitude change (Myers & Fouts 1992:931; Talton & Simpson 1987:508). Thus the educator should be seen as the

pivot of any science education programme (Jegede 1989:235) and probably the largest single influence upon classroom interaction (Simpson & Troots 1982:768).

Educator personality and value system, attitudes, sexual orientation, cognitive and affective teaching style, interest, commitment to science and a capacity for flexibility have been reported to be strongly related not only to learner's achievement, but also to attitudes towards and interest in science (Hasan 1985:4). Furthermore, educator support, task orientation, order and organisation, educator control, enthusiasm, knowledge, praise, commitment, fairness to the learners and innovation were reported to influence learning outcomes (and most probably attitudes) either positively or negatively (Jegede & Okebukola 1992:638; Haladyna et al 1982:685; Larkins & McKinney 1982:27).

#### **2.5.1.2      *Teaching methods***

Researchers have emphasised effective teaching as the most important and influential variable in learners' science interest and attitudes. They have reiterated the important role played by the educators' behaviours, knowledge of their subject and learners, their styles of teaching and attitudes in the teaching-learning situation (Fontana 1988; Ebenezer & Zoller 1993:184). The role of teaching methods on attitude development is subsequently described.

- *Lack of effective teaching methods*

In learner-centred education systems a variety of teaching methods are recommended for use. It was also shown that lack of instructional expertise for science teaching in secondary schools has a limiting effect on improving the quality of science instruction. This also includes limiting the development of positive attitudes towards science among the learners (Vitale & Romance 1992:545). Consequently, a decline in scientific literacy and interest in science was related to

the quantity and quality of instruction that young people receive during elementary and middle school years (Simpson & Troots 1982:763). Poor science understanding may be due to lack of effective science teaching skills and strategies that focus on inquiry, hands-on-activities, processes of scientific method and applications of science and technology in society (Vitale & Romance 1992:915).

Moreover, it was indicated that carefully planned, yet supervised early exposure programmes for inexperienced educators produced measurable benefits in learners' attitudes towards the study of science and achievement in science.

- *No one single method*

The use of different instructional procedures and models in the teaching of science positively and significantly influences learners' attitudes towards science. However, the relative effectiveness of these teaching methods on the development of positive attitudes towards science in learners has been and still is a controversial issue. For instance, as early as 1984 Yager and Penick (1984:143) pointed out that no method has been singled out as *the* method for successful teaching.

Concerning biology, Dallad (in Davies 1985:258) stated that there is no *one* method of teaching the subject. However, any method that is grounded on the educators' intended objectives, is likely to positively influence their learners' learning of a given content. Hyman (in Rehage & Van Til 1976:242) classified teaching methods into three categories of presenting, exemplifying and enabling. He further pointed out that each of them has either a positive or a negative tone for a specific goal. This may also be true for attitude development.

Eichinger (1992), in an attempt to collect and analyse the perceptions of university students regarding their formal experience in junior and high schools, discovered

that these students favoured classes that offered laboratory work, educator demonstration, projects and the use of audio-visual materials.

Sinclair (1994) utilised both quantitative and qualitative methodologies to examine the effects of prediction activities on learning, motivation, attitude, classroom participation and critical thinking in the teaching of genetics concepts in high-school biology. Prediction is here used as an important process of inquiry and critical analysis based on anticipation. The quantitative measures included pre- and post-tests for genetics achievement, attitude towards science and achievement motivation while qualitative field notes were made to compare the experimental-treatment and control learners as they interacted with their educators and peers. From the results of this investigation, it was found that although the quantitative results revealed no significant differences between the two groups, the qualitative data supported that prediction activities augmented classroom participation, promoted critical analysis, and enhanced the learner's interest in the lesson.

Hacker and Carter (1987) quantified teaching processes found in social studies classrooms. This was done to find out whether sufficient variance in style might exist in natural, intact classrooms to justify the possibility of using the prescriptive instructional theory in them. From cluster analysis, the social scientist, social inquirer and the knowledge transmitter were identified. The social scientist and social inquirer styles were found to emphasise higher order activities, use of multimedia materials, making observations and interpreting and inferring from such observations. They were process-orientated and emphasised intellectual and personal development of the learner for decision-making. This style emphasised questioning and making statements that were open-ended. The knowledge-transmitter style on the other hand, was found to put more emphasis on the acquisition of facts. Educators with more teaching experience were more inclined to use the social scientist and social inquirer styles of approaches in their teaching than the less experienced educators.

However, it is important to note that the impact of different teaching methods on teaching and learning should be seen as providing important information that could help educators modify their teaching styles.

- *The influence of nature of subject v/s methods*

Contradictory views exist on which one of teaching *methods* or the *nature* of the subject is more important to facilitate or inhibit learning. In their investigation of learners' attitudes towards physics, Ahlgren and Walberg (1973:187) suggested that the popularity of physics and the learners' achievement in it were, in part, more highly influenced by its teaching than its nature. Anderson (Randhawa & Fu 1973:304) also stated that the quality of an educational experience is less closely related to the content of the subject matter learned than to the method or process of teaching. In his view about the styles of teaching and their influence on learners' interest in science, Hornsby-Smith (1973:812) also suggested teaching styles as a more important variable than the subject matter in determining learner outcomes.

Kelly (1959) investigated factors that influenced learners' preference for scientific subjects to gain information about their attitudes when they take a scientifically based curriculum. The study, using questionnaires and interviews, also compared the attitudes of these learners with those who chose to specialise in arts subjects. It was found that learners who chose to specialise in science had longstanding, stable attitudes towards science. Their choice of science and their attitudes towards science were not only influenced by the nature of the subject, but to a large extent also by the method of teaching, amongst other things.

- *The role of active learning on attitude development*

Different types of teaching methods have been investigated to determine their influence on the scholastic performance of learners. Consequently, many research

studies to investigate the influence of teaching strategies on the learners' attitudes and achievement have revealed significant relationships between the variables. In a learner-centred system of education the involvement of learners, through purposeful activity and intrinsic motivation are very important for attitude development. For example, teaching science as a problem-solving process was reported by Pestel (1988:30) to have a positive influence on learners' feelings about and attitudes towards the learning of science. In accordance, Story and Brown (1979) reported more favourable attitudes towards science among learners who were involved in activity-centred lessons, as enrichment, compared to those following a textbook approach.

Brunkhorst (1992) investigated whether the development of learners' science knowledge and its applications are related to an activity-based science classroom. The results of this study revealed that learners in classes, where educators involved them in a variety of activities spent less time on testing and encouraged them to ask questions and to share the ideas, gained more knowledge. Their attitudes towards science were significantly influenced by the learning environment. Learners in these classes indicated that their learning environments positively developed their attitudes towards science.

Lederman (1986) identified educator behaviour and classroom climate, which are related to changes in high school learners' conceptions of attitudes to the nature of science. This research has revealed that educators who were rated highly by learners outperformed their poorly rated counterparts. Their dynamic behaviour and teaching influenced the development of problem-solving skills, low anxiety, interest and willingness of their learners to be actively engaged. This was in contrast to colleagues who emphasised passive seatwork and rote memory in which case communication of the educator's knowledge of the nature of scientific knowledge became the priority.

*Active teacher modelling* in the teaching of science has also been regarded as important in enhancing learners' achievement process skills and attitudes. From their investigation into the effectiveness of systematic modelling on achievement of integrated science skills and formal reasoning ability of middle school science learners, Rubin and Norman (1992) discovered that those learners exposed to this approach demonstrated greater integrated process skills than those exposed to a cyclic or traditional methodology. However, learners who experienced cyclic or traditional methodology in integrated process skills only achieved better and had more positive attitudes towards science when taught by educators who received science process instruction. Both groups of learners whose educators participated in classes that emphasised science process skills demonstrated greater achievement and more positive attitudes than learners whose educators did not.

Avertson, Anderson, Anderson and Murphy (1980) investigated the effectiveness with which middle school English and mathematics educators taught and what their classes were like. Findings from this study revealed that seatwork, lecture demonstration, and class discussions were popular in these classes. More contact among learners, because of class discussion, made learners more active. However, this was more common in mathematics than in English classes. Learners, particularly in English classes, showed preference for educators who used active but self-paced work. Positive relationships were also found between achievement and the somewhat higher order questions asked, with a significant relationship between these questions and learners' attitudes. Learners who were called to volunteer for certain tasks showed more positive attitudes than those who were forced to. Whole class involvement correlated positively with attitudes. Acceptance of learners' ideas and contributions during lessons improved their self-confidence. These findings may also be true for biology classes.

Ebenezer and Zoller (1993) conducted research to assess the perceptions of grade 12 learners of their classroom practices and activities, and their attitudes towards

science teaching and school science. It was found that learners did not appreciate the contemporary classroom activities and practices of mainly copying notes. Instead they preferred teaching and learning in which they could take an active part because that instilled more satisfaction in them than otherwise.

- *Passive learning*

Ehud (in Adey, Bliss & Shayer 1989:285) investigated the extent to which educators insisted on inculcating skills in the domain of critical/logical/analytical thinking. This was with specific emphasis on judgement, process, cause and effect relationships, the evaluation of evidence and validity of conclusions. Their research revealed disappointing results regarding the educator: many educators were shown not to have the reasoning abilities that activity-centred science curricula seek to develop. Thus, educators tended to force learners to memorise blindly by imposing material that required abstract reasoning capacities that they themselves have not yet obtained. This led to the development of negative attitudes towards science in their learners.

Holdzkorn and Lutz (1984) investigated educators' instructional methods in the classroom to determine whether other methods existed that would be more effective than what the educators were using. Results of this investigation indicated that demonstrations, learners' reports, and projects were infrequently used. The textbook dictated the course content, mode of instruction and evaluation. Learners were rarely engaged in activities for which the answers were not prescribed by the textbook. In this way, their inquiry skills were not developed. This is because the main aim of teaching in such classes had been the preparation of learners for the next grade, with evaluation emphasising definitions and knowledge dimensions. This inhibited active learning and the development of positive attitudes towards science.

Wise and Okey (in Holdzkom & Lutz 1984:74) researched a typical or traditional classroom. They found that learners were not made aware of the instructional objectives. Most of the questions asked were posed by the educator, were primarily fact-oriented and did not reflect any preplanning by the educator. Learners had no opportunity to manipulate materials or participate in activities that interested them. The educator followed the textbook in general and was in control of it. Lecture and discussion were the teaching methods frequently used, with evaluation being summative at the end, for the purpose of reporting learners' progress only. This disappointing passive learning situation could be related to the formation of negative attitudes among learners.

Gottfried and Kyle (1992) investigated whether the educator's textbook use and his/her classroom practices in the context of textbook orientation revealed any relationships between factors indicative of the biology education desired state or actual state criteria. They also identified other factors such as philosophy, personality traits or instructional style that might enable them to align themselves better with the biology education desired state criterion. The results of this investigation revealed that the classroom environment in each category of textbook-centred, multiple-reference, and the neutral group of educators were less than desirable. Most of the educators were found to function as passive and uncritical technicians who were ready and willing to disseminate knowledge in an authoritarian fashion. It was also found that these educators lacked the philosophical and psychological basis requisite for engaging in activities that would transform classroom activities to bear relevance. These contributed to the development of negative attitudes towards biology in learners.

Pell (1982) investigated factors that influence learners' choice of physics at a GCE A-level in Britain. After cluster analysis, four types of educators were identified. They were: process-orientated science educators; planned experimental laboratory educators, the preferred teaching styles and routine educators. Results of this study

revealed that for the learning by experiment group, the attitudes of girls, more than those of boys, correlated very strongly with enjoyment of the learning by experiment. Enjoyment was also found to predict attainment in physics. Classes in which educators emphasised learner-centred/textbook style (in other words, passive learning) were poorly rated by learners in favour of a educator-centred/note-making style method. The varied teaching for understanding method was strongly associated with high match scores and positive attitudes towards the subject.

- *Computer assisted learning (CAL)*

Numerous research studies have found that computer-based instruction is beneficial to learning. The use of computers and videodisk materials has been reported to influence learners' attitudes towards learning science. Hounshell and Hill (1989) examined the impact of computer-loaded biology courses on learners' achievement and attitudes towards science. Subjects of this study were randomly assigned both to the experimental and control groups. From this research, it was found that the experimental group (using CAL) outperformed the control group in both the first and second questions investigated. They concluded that a computer-assisted biology curriculum offered promise for secondary education for achievement and the development of positive attitudes towards science.

Another study involved the use of computers. Faryniarz and Lockwood (1992) investigated the effectiveness of microcomputer simulations in stimulating environmental problem solving by tertiary students. The statistical analysis of the results showed a highly significant improvement in attitude for the experimental group using computers. Environmental problem solving was shown to improve with students' opportunities to use computer simulations.

Marverech and Rich (1985) investigated whether CAL, as a supplement to traditional mathematics instruction fostered gains for disadvantaged primary school learners

in the affective and cognitive domains. Besides mathematics achievement and attitudes, the effects of CAL on learners' self-concepts and perceptions of school life were investigated. Results of this study revealed significant differences between the CAL and traditional learning groups. At all grades, learners in the CAL group scored higher on arithmetic tests than did learners in the traditional learning group only. The experimental group learners rated themselves higher on self-concept than their counter parts. More importantly, they also expressed more positive attitudes towards their schooling than learners in the control group.

Vitale and Romance (1992) investigated whether the use of videodisc technology remedied core concept knowledge deficiencies and the development of positive attitudes towards the teaching of science of pre-service educators in physical and earth sciences. Subjects of this study were assigned both to the experimental and control groups. From this study, it was found that subjects in both groups exhibited knowledge deficiencies on core concepts in pre- and post-tests. However, after completion of the course, the experimental group exhibited a higher degree of mastery than the control group. They also had more positive attitudes towards science than subjects of the control group.

- *Methods of teaching in Outcomes-based education*

Outcomes-based education (OBE) is itself a method or approach to teaching and learning. According to Spady (1988:5) OBE is a means of organising for results based on the outcomes to be achieved. It is a way of designing instruction based on stated outcomes (Towers 1992:90).

OBE emphasises learner-centred teaching and the results that are generated by the process of teaching and learning. It is predominantly individualistic and results-driven. It focuses on the link between the intention and the result of learning (Towers 1992:90; Mkhathshwa 1997:19).

Teaching in OBE is influenced by the desire for every learner to succeed. This desire to succeed determines content that should be taught to the learners, the learning experiences to be made available to them, assessment, how long they engage in learning particular knowledge or skills, and, above all, what is valued in the educational process (Killen 1996:5). Spady and Marshall (1991:67) presented the following three premises that also have an influence on the way teaching and learning are to proceed within OBE classrooms:

- All learners can learn and succeed
- Success breeds success
- Schools control the conditions that determine whether or not learners learn.

The fact that all learners can learn and succeed has important implications for teaching methods, instructional time and learning opportunities. This coincides appropriately with mastery learning, one of OBE's roots apart from competency learning (Kramer 1999:1). Mastery learning was defined by Guskey (1985:xiii) as an instructional process that involves organising instruction, providing learners with regular feedback on their learning progress, giving guidance and direction to help learners correct their individual learning difficulties, and providing extra challenges for learners who have mastered the material.

According to Killen (1996:5), OBE has more benefits for learners if mastery learning is emphasised. One thing about mastery learning is that it promotes the idea that all learners can achieve the desired outcomes if given favourable learning conditions that include flexibility in the time provided and alternative ways of learning (Kramer 1999:2). Mastery learning also reduces learners' concerns about their ability as it builds confidence in them and encourages them to attempt challenging tasks. Therefore, mastery learning and OBE make all instruction purposeful for learners' learning. They both empower learners by making them see that their efforts will have

some effects on their learning (Killen 1996:5). According to Towers (1992:90) mastery learning is an engine that propels OBE programmes.

In mastery learning, learning is presented as structured, hierarchical, sequential units of material based on clear instructional objectives and subject matter which is divided into short, individualised, incremented units. Individualised evaluation is highly accentuated when this approach is used and individual learner progress is continuously monitored. This is usually done through frequently administered diagnostic assessments (Towers 1992:91; McNeil 1996:62-63).

The use of mastery learning has been reported and supported by research. Towers (1992:92) indicated that learners in schools that used mastery learning as an approach had improved test scores. Block and Burns (1976) conducted research to determine the effectiveness of mastery learning both as a teaching and learning approach. The results of this research indicated that learners taught through mastery learning scored significantly higher on achievement tests than non-mastery learners. Mastery taught learners also showed increased degree of learning and retention intervals of up to three months. Regarding attitudes, mastery taught learners appeared more interested in the subject matter being learned and showed greater improvement in self-concept, self-confidence and feelings about instruction.

A study by Burns (1979b) aimed at comparing the effectiveness of mastery learning and some conventional methods of instruction revealed that mastery strategies had stronger effects on learning than the conventional methods. It was also shown that mastery approaches are often successful in teaching skills, such as reading and mathematics that form the basis for later learning.

After reviewing several studies on mastery learning, Guskey and Gates (1986) concluded that a group-based application of mastery learning had positive effects on a broad range of learners' learning outcomes that include achievement,

involvement, retention and the learners' affective development – which includes attitude development.

Graves and Graves (1985) compared learner achievement outcomes in classes that used the conventional instruction, mastery learning strategies and a one-to-one tutoring approach. Results of this study indicated that although one-to-one tutoring was superior to mastery learning a combination of one-to-one tutoring and mastery learning had more positive effects than the conventional instructional methods.

The fact that success breeds success also has important consequences for the educator's teaching strategies. This premise could be linked to the competency-based learning approach and motivation. According to Towers (1992:90), competency-based education is applied to the instructional and assessment efforts aimed at defining and evaluating learners' performance. Through this process, learners are prepared for success in fulfilling their various life roles. However, it is only when they (the learners) understand the reasons for achieving certain stated and specified outcomes on the basis of their value that they will be motivated to pursue them.

McAleavy (1995) compared competency-based educator training with traditional educator training programmes. The study revealed that a competency-based training approach resulted in effective transfer of skills or knowledge to a workplace. This may also result in positive attitude development in the learners.

Teaching and learning in OBE are characterised by

- critical thinking, reasoning, reflection and action
- group work, debate, role play and experiments
- learners taking active responsibility for their learning during research, debate and experiments

- constant feedback from continuous assessment
- flexible time-frames that allow learners to work at their own pace
- learner-centredness (Oxford OBE Curriculum)

All these characteristics may result in the development of positive attitudes in learners towards their work. The implications of this are also important for biology education.

### **2.5.1.3 Educator personality**

Educator personality has often been linked with educator effectiveness and attitude development of learners. Ryans in the USA (in Fontana 1988:346) conducted a study to determine the relationship between educator effectiveness and educator personality. From the Teacher Characteristics Rating scale, Ryans found that successful educators tended to be warm, understanding, friendly, responsible, systematic, imaginative, and enthusiastic. Rosenshine and associates (in Fontana 1988:347) suggested a positive relationship between successful teaching and an uncritical approach to the learners. According to these researchers, learners of low self-esteem, who are frequently criticised by their educators, lose confidence in their abilities and will consequently underachieve and develop negative attitudes.

On the other hand, learners who are allowed to find what could best be described as their own level had less anxiety than those pressurised by educators to meet a certain standard. Successful educators are also linked with proper lesson preparation, devoted time to out-of-school activities and showed interest in their learners as individuals. Although educator qualifications could not be easily linked with the classroom environment and the learners' attitudes towards science, Myers and Fouts (1992) pointed out that the educator and the classroom atmosphere that he/she creates are highly influential on the learners' attitudes.

Important causal relationships have been reported between most of the characteristics composing the personality of the educator on the one hand, and the learners' achievement and attitudes, on the other hand. It has already been reported that the personality patterns of the educators, their needs, values and attitudes predict the climate of their classes. Rosenshine and Furst (in Fraser 1986:63) maintained that the way the learner learns is associated with clarity, variability of teaching methods and materials, enthusiasm, task-orientated behaviour, indirectness, learner opportunity to learn, educator use of structuring comments, multiple levels of questioning and discourse and educator criticism.

In their study to investigate how effective English and mathematics educators taught, Avertson et al (1980) discovered that task-orientated, competent, confident, academically effective, and learner-orientated educators were rated highly by their learners. In other words, if the educators had confidence in themselves, their behaviour is such that they, and possibly the subjects they teach, are experienced positively by their learners.

In summary, the personality patterns of educators, their needs, values and attitudes predicted the atmosphere of classrooms. Their achievements and interests in science, as well as their conceptions of themselves and the universe were seen as significant predictors of classroom atmosphere. These would in turn encourage the development of positive attitudes towards science (biology) in learners.

Jegade (1989) assessed the educator's classroom characteristics, behaviour, personality and attitudes as perceived by their learners for effective teaching. The study revealed that factors such as knowledge, organisation, planning, preparation, confidence and openness were seen by learners as important in characterising an effective science educator. These resulted in learners developing positive attitudes towards science (biology).

A study by Eichinger (1992) aimed to collect and analyse the perceptions of university students regarding their formal science experience in junior and high schools. Their results showed that students preferred educators who were friendly, enthusiastic, knowledgeable, inspirational and fun. This in turn, promoted the development of positive attitudes towards science (biology).

## **2.5.2 The role of the learner in attitude development**

### **2.5.2.1 General**

It is felt that for effective education in general, and science curriculum design in particular, the child, as a learner, should be of central concern. In South Africa, this is in accordance with the stipulations of Outcomes-Based Education (OBE) which is learner-centred. Yager and Penick (1984:143) have already emphasised the importance of placing learners in the forefront thereby giving due and serious consideration both to their affective and cognitive domains. According to Talton and Simpson (1986), the variables related to learners themselves are important in influencing the development of attitudes towards science. Therefore, most of the research conducted around learners, as role players in education, emphasises the significant relationships between some variables pertaining to themselves that influence their attitudes towards science.

Many studies on this domain have revealed significant causal relationships between learners' exposure to science (Cannon & Simpson 1985), choice of science and future specialisation (Gogolin & Swartz 1992), perceptions of science and scientists (Haladyna et al 1982; Yager & Penick 1984 and 1986), gender, grade, ability and age level (Jolly & Strawitz 1984; Cannon & Simpson 1985; Haladyna & Shaughnessy 1983), interest, enjoyment and motivation (Pell 1985; Cannon & Simpson 1985), socio-cultural background (Jegade & Okebukola 1992) and their achievement and attitudes towards science. The attitudes of learners are

significantly associated with some classroom learning, instructional and educator variables (Hasan 1985:4). Thus, the perceptions of learners of some aspects of the classroom learning environment significantly influence their attitudes towards science (biology).

### **2.5.2.2 Gender**

When gender was related to attitude development in science education, significant relationships were discovered.

- Gender, interest and attitude

Research on learners' attitudes towards school subjects in the dimensions of interest, difficulty and freedom by Duckworth and Entwistle (1974) revealed the majority of the relationships for both genders to be significantly positive with interest and negative with difficulty of the subject. However, biology was more positively rated by learners than, in order of merit, chemistry and physics, and the attitudes of girls were more positive towards it than those of boys.

Another study by Martinez (1992) to uncover gender differences in factors contributing to attitude towards science, revealed that gender-related interactions with interest value of school science can, if modified, influence learners' attitudes towards science and subsequent choices concerning science involvement. This study also revealed that boys and girls differed significantly in their self-reported intrinsic interest of the experimental procedures despite interest enhancement. It suggested that girls were generally more responsive than boys in experiments that were of more social appeal. However, although the findings of this study contradicted that of previous studies which found no significant difference between the two genders for the relationship between social scores and science options, Martinez (1992) concluded that the more interesting science experiments are, the

more likely they are to improve attitudes of learners of both genders towards science.

The relationship between interest and participation in science has been reported as very important for positive attitude development. The way learners perceive science determines whether they will opt for or against it as they proceed with schooling. In a study to analyse laboratory interactions, Kelly (1987) revealed that boys dominated laboratory space and equipment, while girls would remain onlookers and takers of notes. Because of this boys tend to know the different kinds of instruments more than girls. The fact that boys are more frequently asked to assist in carrying out some demonstrations enhances their self-esteem. This may influence their attitudes positively.

- Gender, enjoyment and attitude

Enjoyment of a subject may significantly influence attitudes towards that subject. The results of a survey of learners' enjoyment of physics were presented by Pell (1985). When gender, achievement in physics and a type A-level course were considered, it was found that boys displayed superior enjoyment of physics in both the fifth- and lower sixth-forms over girls. The study also revealed that girls who reached the sixth-form and still enjoyed physics, had recognised the nature of the subject and the part experimental work played in it. Learner involvement was closely related to enjoyment, with stronger relationships for girls. This has relevance for those content areas of biology that relate to physics.

- Gender, socio-cultural environment and attitude

Research to investigate the social implications factor of attitudes towards science in order to establish the relationship between this factor and the option for or against science by boys and girls of 13 to 14 years of age has revealed that much of the

variance in learners' attitudes was accounted for by the nature of the subject itself rather than by its social implications. However, although not statistically significant, higher correlations of social and preference scores were found in favour of girls. No significant relationship was established between social scores and science options for boys and girls. The relationship between attitudes and science options was found to be influenced by gender differences, with girls being more restrained in making science options than boys.

The scarcity of female scientists, as role models was strongly associated with low levels of self-confidence and negative attitudes that girls feel. Durndell, Siann and Glissov (1990) investigated why young females who had just entered higher education made their choices of courses and what their views were of the situation where low numbers of females were entering, for example, computing and technological areas. The results of this study indicated that while males were instrumental in their choice of courses, computing students of both sexes were attracted by extrinsic awards perceived to be associated with computing. Potential female students of computing appeared to be put off by the prospect of harassment in predominantly male groups, and by problems of unfemininity. At the same time educators were criticised for putting school girls off technological subjects.

The same may prevail in our schools and classrooms today where courses like science and mathematics are often dominated by male learners. Negative attitudes of educators and male students towards their female counterparts may, in part, be responsible for the development of negative attitudes by female learners in high schools with regard to science courses. Lack of or poor parental support may be an added explanation of this situation.

Another study by Jegede and Okebukola (1992) examined how secondary school boys and girls in Nigeria perceived the socio-cultural environment in their science classes. The study focussed on five scales of authoritarianism, goal structure,

African world-view, societal expectations and sacredness of science. Results of this investigation revealed that learners, irrespective of their gender, perceived the socio-cultural environment of their classrooms in more or less the same way. This suggested that culture was homogeneous for individuals in a homogeneous group. Boys only obtained higher mean scores on authoritarianism while the means for girls outscored those of boys in the other subscales. A highly significant gender difference in societal expectation was found to favour girls. This implied that girls were not recognised as scientists so that their self-concepts and attitude development towards science were hampered.

Lundeberg and Moch (1995) conducted research to describe the process of social interaction in women learning science through Science Interaction (SI). This was done by observing the interactions of women learning science in a collaborative structure outside the classroom. The hypothesis of this study was that programmes that involve cooperative learning, such as SI, promote achievement. Results of this study indicated that providing opportunities for women to meet in a non-threatening, relaxed environment allowed a culture to form in which learners cooperated with one another in a learning community. The learners experienced a shift of power that transferred the responsibility for learning to themselves. This resulted in the development of positive attitudes in female learners.

Leach (1994) discovered that in most cases girls see science (biology) as an impersonal discipline that deals with things rather than with people, and they are likely to reject science classes in which abstraction is overemphasised. In this way science may be irrelevant for them. However, it was suggested that emphasising the relationship between science and society could help to indicate relevance. By showing the human dimension of science, by relating its examples to learners' experiences and by integrating topics within the sciences it may cause girls to be interested in science so that positive attitudes may develop.

- **Gender, self-esteem and attitude**

Leach (1994) conducted research to determine the relationship between girls' declining self-esteem and their achievements in science and mathematics. The study also determined gender differences in science attitude, achievement and self-esteem. The results of the study revealed a strong bias by educators in favour of boys in so far as boys receive more attention from their educators than girls. A tendency by educators to give girls answers or to help them out when they struggle was also revealed. Boys are more frequently encouraged than girls (p.57-58). This situation has serious implications for girls since it may inhibit the development of positive self-concepts. This may culminate in their under-achieving and developing negative attitudes towards science (biology).

Brutsaert and Bracke (1994) conducted research to examine effects on the adaptation of girls and boys to school life as reflected by self-esteem, sense of mastery, stress, fear of failure, sense of belonging in school, study- and school commitment. The results of the study revealed that it was not only learners' gender, but also that of their educators that had an influence on their self-esteem and sense of mastery. For example, it was found that primary school boys were negatively affected by a school environment characterised by female educators, although this situation had no influence on girls.

### **2.5.2.3 Age**

Although some tendency of improved attitudes towards science (biology) with age may be obvious, research has established insignificant relationships. Instead, a significant relationship existed between age and preference for science. However, although preference was seen to depend more on learners' mental sophistication than on age, there is good reason to believe that age does contribute to some extent towards the development of attitudes towards science. In contrast, their study to

examine the perceptions of four age group learners of their science classes, educators and value of science, Yager and Penick (1986) noted a trend of learners' deteriorating attitudes with increased age for all the variables. It was also found that in each case, the nine-year-old learners in lower grades were more positive about their science classes, educators and the value of science as compared to their older counterparts in higher grade levels.

Hadden and Johnstone (1983) conducted research to determine whether learners' attitudes to science, geography and mathematics changed during their first year of secondary school education. The study also sought to determine whether the change was more marked in science compared to the other two subjects. Findings from this study revealed that learners' attitudes towards science at secondary school deteriorated. However, this deterioration did not lead to perceptions of science as completely unfavourable. On the other hand, learners' attitudes towards the importance of arithmetic and mathematics were found to have improved by the time they reached secondary school.

Another study by Tamir and Amir (1987) identified the effects of instructional strategies on the study practices of Israel's secondary school learners in biology as well as on their attitudes to biology. Results have shown that learners in Israel had positive attitudes towards biology and the study of biology. However, the study further revealed that as learners grow older their attitudes towards biology become less positive while their appreciation of cognitive features of biology increases.

Cannon and Simpson (1985) also reported that the attitudes of the learners depend on their age and grade level. The attitudes of learners were more positive at the beginning of the year than at the end of the year. This is because learners often have more motivation to achieve at the beginning of the year than towards the end of it. This finding needs further verification because it would appear that as learners are being taught, they gradually lose interest in whatever they learn!

#### **2.5.2.4 Other variables related to learners**

A lot has been done to investigate some hypotheses concerning learner backgrounds, personality and intelligence and the learning of subjects in schools. Some thirty years ago, Walberg (in Shoffner 1990) discovered that classroom climate, biographical and miscellaneous variables were significant predictors of the learning of physics and therefore, attitudes towards science. The biographical variables alone were also found to be better predictors of the non-cognitive learning outcomes than the learning environment variables.

- Home background

The home environment has been reported to have an important influence on learners' attitude development and achievement (Shoffner 1990:6). For example, learners' career goals, home backgrounds, self-concepts, and learning styles have all been related with attitudes towards science.

In a study to investigate the utility of the theory of planned behaviour for understanding and predicting the physics course enrolment intentions of secondary school science learners, Crawley and Black (1992) found that although the intentions of learners to enrol in physics were largely determined by their attitude towards physics, career goals were influenced by home background.

Fraser (1992) conducted research to describe criteria which guide the selection, modification, and validation of scales for curriculum evaluation. Results of this study revealed that the instructional treatment was significantly related to scores on the social implications of science and enjoyment of science lessons. Apart from that, learners of higher Science Environment Scales were found to express more favourable attitudes than those of lower Science Environment Scales. In other words

learners who came from homes where there was stimulation for science had more positive attitudes towards science.

Shoffner (1990) investigated the role of the home environment as far as it affects achievement in and attitude towards Computer Science of grade five to ten learners in eight public schools in eastern North Carolina. Using the univariate, bivariate and multivariate statistical analyses, it was determined that the home environment could be a better predictor of attitude towards computer learning than a predictor of learner achievement. As a result of this, the home environment could be effectively altered to cultivate positive attitudes towards computer literacy.

Simpson and Troots (1982) discovered that home commitment had a strong positive contribution in the learners' science affective measures, including attitudes.

Gogolin and Swartz (1992) conducted research which revealed the influence of home background. They investigated the attitudes towards science of non-science learners. The study was carried out to determine:

- how the attitudes towards science of non-science learners compared with those of science majors
- whether attitudes towards science changed with instruction and
- what developmental experiences were associated with attitudes towards science.

The results of this study revealed a significant difference between non-science and science majors in their pretest attitudes towards science. The science majors show a significantly lower level of anxiety than the non-science learners when confronted with science-related material. However, after taking a science course, the attitudes of both groups changed significantly, although the statistical mean scores differed in favour of the science majors. Results of the interviews with the non-science

learners showed that most of them came from home backgrounds of low science interests. This had significant implications for the development of their attitudes towards science. They had no background in science experience. Although most non-science learners gained insight into the importance of science and acquired a positive respect for it, the classroom did not foster an interest in science.

However, in contrast to the findings reported above, the following finding by Mordi (1991) is very important to note: he looked at the extent to which the learners' home characteristics, school factors, teaching and learning variables accounted for the variance in learners' attitudes towards science. The results of regression analysis showed that the learners' home background accounted for only 1% in the variance of their attitude towards science. This finding showed that the learners' homes do not contribute substantially to their attitudes towards science. Instead, it would appear that the attitudes towards science that developed in the learners were largely due to school experiences. This result may be linked to the fact that most learners came from homes that may not have fostered positive attitudes towards science. However, the father and mother's levels of secondary education were significantly related to the learners' attitudes towards science.

- Motivational variables: self-concepts and study habits

Attitude is a key ingredient of how learners confront educational challenges. Their attitudes are influenced by a host of factors. One of these factors is motivation. A study by Hasan (1985) has revealed that the learners' inner motivational variables contributed 75 percent of the variance in their attitude score. Their perception of ability in science (a positive science self-concept) enhanced the development of positive attitudes towards science.

The results of a study conducted by Hug (1970) to investigate the influence of independent study on learners' attitudes showed that learners believed that they

learned more in independent study classes and had better improved study habits than in any other classes. Therefore, an independent study programme that included programmed instruction, library usage, discussion and quiet work areas could improve the learners' attitudes towards their work and towards biology (science).

### **2.5.3 The role of curriculum on attitude development**

#### **2.5.3.1 Introduction**

The concept curriculum was defined and extensively discussed in chapter 1. In this section, information about the curriculum from research and the literature review is given. This will be presented in two distinct ways as follows:

- the curriculum as entailing teaching and any other school factors
- the curriculum as content and the attitudes of learners towards biology

#### **2.5.3.2 Curriculum as everything to which learners are exposed to at school**

Several researchers have reported a significant, positive relationship between learners' aversion for science courses and their perceptions of the nature of science and scientists.

According to some studies (but not all) the nature of the subject matter (the curriculum–content) is more influential on the development of attitudes than perhaps, teaching methods. For instance, researchers have reported no significant differences among a variety of teaching methods in relation to their influence on learner's attitudes and achievement. Instead, some methods were only seen to be more superior to others in eliciting and facilitating the development of a variety of behaviour among learners.

Talton and Simpson (1987) investigated the relationship between attitudes towards and achievement in science among grade 10 biology learners. The hypotheses tested were that the characteristics of educators, peers, and the classroom environment affect learners' affective and cognitive outcomes. Results of this study revealed that of all the classroom variables investigated the *curriculum* together with educators, other learners and friends were significantly correlated with attitudes towards biology throughout the school year. However, of all these variables, the *curriculum* showed the strongest correlation with attitudes towards science.

Manganye (1994) investigated which of the following factors (educator characteristics, learner characteristics, the biology curriculum and the classroom environment) were most important in influencing the adolescents' attitudes towards biology. Certain factors such as gender, age and grade level, parental literacy level and school type were also used as moderator variables to mediate for the influence of the factors mentioned above. Of all these factors, the *curriculum* (in terms of relevance, difficulty and importance) accounted for most of learners' attitudes towards biology.

Cannon and Simpson (1985) investigated if grade seven learners assigned to three different ability groupings demonstrated different achievement levels and attitudes towards science. The study also sought to examine where the differences occurred, the strengths of the various relationships and the extent to which one variable predicted the others. Results of this study revealed that irrelevant *curricula*, (apart from ineffective teaching methods and inhibiting classroom environments) were most responsible for decreased achievement and motivation in science, as well as the development of negative attitudes towards science.

Ben-Peretz and Silberstein (1982) conducted research to sketch a preliminary outline of a "natural" model of curriculum development based on an examination of case studies in science. This was done by examining the nature of curricular

decision-making at two levels relating to external curriculum developers and educators as curriculum users, respectively. The study revealed that curriculum developers and users differed significantly in their interpretation of curricular restraints, intentions and implementation possibilities. These differences were, therefore, regarded as contributory to a mismatched transferrance of the curriculum material to the learners. This caused them to develop estranged feelings about the material with an ultimate development of negative attitudes towards science.

### **2.5.3.3 Curriculum as content and the way it relates to learners' attitudes towards biology**

#### **(a) The relationship between content and learners' attitudes towards biology**

Very little research has been done on this aspect. The only existing literature that will be used here dates back to the seventies and will be used here as another starting point. However, it is important to indicate that the present biology content may not be relevant for the majority of learners. According to Fraser (1992:60), secondary school biology was irrelevant, out of date and content laden, with major emphasis on examinations and the recall of facts.

Tamir (1973) conducted research to procure the attitudes of students towards the practical examination as a whole, and to each of its parts separately. The subjects of the study were asked to describe their attitudes towards

- the study of biology
- examinations in biology
- practical examinations in biology
- examinations in plant identifications
- examinations in animal identifications

- oral examinations
- laboratory examinations

The results of this study indicated that the study of biology was highly regarded by learners. With regards to gender, no significant differences were found between girls and boys. However, boys were more positive towards practical examinations than girls. Girls assigned a higher rating to the importance of the subject than boys. Girls also showed a slightly more positive attitudes towards plant biology (plant identification) than boys. The opposite was true for human biology (human identification).

With regards to school type, the study also compared the attitudes of learners in city schools, agricultural schools and rural schools towards biology. It was found that learners in rural schools had the least positive attitudes towards the study of biology. Despite their superiority at the end of grade 10, rural school learners lagged behind the city school learners in grade 12. They even scored less than learners in agricultural science schools. This difference is accounted for by their motivation to learn.

Almost three decades ago Tamir (1974), conducted a study to answer the following questions:

- Is the assumption that children are not interested in the study of botany justified?
- Do we have enough literature to support it?
- To what extent does it depend on the nature of the educator or on the type of the school?

From the results, it was shown that both girls and boys had more positive attitudes towards the study of animals over plants. However, girls were more interested in the study of plants (botany) than boys.

With regards to school type, Tamir compared the attitudes of grade 10 learners in two agricultural science schools and those of grade 10 learners in a regular academic high school located in a small town in a rural area. The study wanted to establish which one of *plants*, *animals* and *man* was of most interest to learners. The result of this study indicated that all learners had the most interest in human biology and least interest in plant biology. However, learners from the agricultural high schools had more positive attitudes towards plant and animal biology than learners in the academic schools who had more positive attitudes towards human biology (man).

The third study in the same article was meant to investigate grade 10 learner preferences of leisure time activities based on plants and animals. The study revealed that the learners had a highly significant preference for animal topics on the indoor scale but not on the outdoor scale. When girls and boys were compared in this regard, the results were as follows:

- Girls showed a greater preference for plant topics both indoors and outdoors than boys.
- Boys preferred animals in most of the indoor scales than girls.
- Both girls and boys preferred the outdoor plant and animal scales more than indoor scales.

It is also important that science education should be presented and assessed in a way that allows learners to see its direct relevance. For example, what they do in class should relate directly to outside experiences. Gayford (1988) conducted a study in the UK to investigate the expectations, experiences and the attitudes of 16

year old learners studying biology or human biology. It was found that of the two types of courses, learners had more positive attitudes towards human biology. They thought that human biology offered greater opportunities than other sections of biology. They also regarded it as a course that was related to life outside school. However, those learners who followed human biology did not prefer scientific subjects. Some activities in the science class did not appeal to human biology learners while the opposite was true for the biology group. Nonetheless, both groups were found to desire a high level of relevance in their subjects.

Tamir and Gardner (1989:113-114) conducted research to identify interest patterns of grade 10 learners related to the study of biology in 14 high schools in Jerusalem. Seven different instruments were used. The findings were as follows:

- All learners demonstrated highest levels of interest in human biology.
- Interest in a specific topic was associated with its social implications, e.g. human physiology.
- Girls expressed higher levels of interest in reproduction and human physiology than boys.
- Learners of parents with science occupations were significantly more interested in and oriented towards biology.

**(b) *The learners' cognitive development and attitudes towards specific biology content***

Studies have reported the existence of a high correlation between learners' understanding of certain concepts in science, including biology and their reasoning skills. For example, Johnstone and Mahmoud (1980:541-542) discovered that *Osmosis and Water potential* were very complicated concepts both for educators and learners. Several reasons for the difficulty of these concepts have been suggested by various researchers as follows:

- The understanding of osmosis and water potential requires abstract reasoning.
- Understanding abstract concepts requires a high level of reasoning which many learners and educators have not yet achieved and thus cannot cope with, for example, the relationship between macro- micro-systems in phenomena.
- To understand these concepts, learners have to learn and use several underlying concepts such as diffusion, turgor, selective membrane, et cetera.
- Some of the prerequisite concepts require knowledge of physics and chemistry.
- The problem regarding the difference between everyday meaning and the scientific meaning of concepts is not understood.
- The tendency by both educators and learners to use teleological explanations causes problems.

In another study conducted by Johnstone and Mahmoud (1980) to isolate topics of high perceived difficulty in high school biology, the researchers used grade 12 higher ability learners, first year university students, the examiners' reports, educators and the inspectors. A list of 15 biology topics was given to the subjects of the study. They were asked to respond to these topics on a four point scale of *easy, average, difficult* or *I was never taught*. The results indicated the areas of maximum difficulty, according to merit:

- Water transport in organisms including osmosis, water potential and water balance

- Energy conversions in photosynthesis, respiration, ATP and ADP
- Genetics
- The mechanism of evolution

To corroborate these findings, the researchers sought information from examiners, educators and inspectors. From the examiners' reports it was found that the following topics were reported timeously as areas of weakness and greatest difficulty:

- Basic plant and animal anatomies
- Ecosystems
- Genetics
- Water relations in organisms
- Enzymes
- Photosynthesis and respiration
- Energy storage and conversion
- Mechanism of evolution
- 

From the educators' questionnaire it was found that the following were areas of greatest difficulty:

- Osmosis, water potential and control of water in organisms
- Chemical energy – ATP, ADP, et cetera
- Chemistry of photosynthesis and respiration
- Mechanism of evolution
- Genes

Inspectors indicated that learners and students had problems with water relationships in organisms and energy considerations in the building and breakdown of foods. These findings supported one another perfectly.

However, from the same analysis, the following could be regarded as topics of less difficulty for learners:

- Gaseous exchange between organisms and the environment
- Reproduction
- The role of the kidney
- Evidence of evolution
- The cell structure and cell division
- Chromosomes
- DNA and RNA

The results of another survey with educators to determine which content was most important and most difficult for learners are presented in Stewart (1982:81). In terms of difficulty, the following concepts, in order of merit were listed:

- Cellular respiration
- Protein synthesis
- Cell division
- Chemistry necessary for biology
- Enzyme structure and function
- Photosynthesis
- Hormonal control of reproduction
- Genetics
- Taxonomy and classification

However, the results of this study also revealed that topics like homeostasis and population genetics could be a bit less complicated for learners. According to Penxa and M'Carthy (1995:74), the difficulty of homeostasis could be ascribed to

- poor understanding of the concept by educators

- textbooks that seldom encourage learners to apply what they had learnt
- the problem of compartmentalisation of content that belonged together.

With regards to importance, the following information was revealed (according to merit):

- Photosynthesis
- Cell division
- Cellular respiration
- Mendelian genetics
- Hormonal control of human reproduction
- The chemistry that is needed for biology.

Again Stewart (1982) conducted research to examine the knowledge and problem-solving strategies used by 14 ninth grade biology learners to solve problems on three types of basic genetics problems. From the study it was found that the only hindrance to learners' development of meaningful solutions to the Mendelian genetics was their weak understanding of the relationship of meiotic division to monohybrid and dihybrid cross problems. Asked about why they had to put one letter per square on the Punnet square instead of two, it was found that learners did not understand anything about chromosomal segregation during meiosis. Also, the use of algebraic expressions instead of the Punnet square approach posed problems to learners even though they could manipulate numbers in this regard.

Shemesh and Lazarowitz (1989) determined the relationship between learners' cognitive stage and their learning outcomes. The learning outcomes referred to here are based on the content that was learnt. The study revealed a very strong link between these variables. For example, learners explained the colour after exhaling air with  $\text{CO}_2$  into a solution with a pH as a "destruction" by  $\text{CO}_2$ . This indicates that the chemistry part of biology could be difficult for learners and may cause

dissatisfaction with biology. In South Africa this topic is covered in organic compounds and nutrients. This has far reaching implications for attitudes towards biology.

De Laeter and Dekkers (1993) surveyed the enrolment trends in the biological sciences in Australian upper secondary schools. The study revealed that more learners, especially girls, enrolled in human biology. This was because the subject consisted of a significant amount of anatomy and physiology which addresses the structure and function of the human body. It also included issues of human health and human ecology which embrace aspects of environmental science. Human biology was consequently seen as easy and relevant compared to the more traditionally abstract and enquiry-based biology. This has important implications for the development of positive attitudes towards biology.

Gibson and Gibson (1993) conducted a survey of college students who were taking introductory biology courses on their attitudes and perceptions on aspects of biology that should have been covered in high school science. The 232 college undergraduates were enrolled in either introductory biology or general botany. The results of the investigation indicated that although they were familiar with the topics of their study, students had problems with the principles of *Mendelian genetics*. It could be that these principles were difficult to comprehend and that learners, therefore lacked confidence in themselves. This has implications for the development of negative attitudes towards biology. The survey also indicated a significant difference between students of different gender, with boys being more comfortable with the Mendelian principles than girls. This also has implications for curricula development.

Manganye (1994) discovered that learners had negative attitudes towards biology in terms of the subject's relevance, importance and difficulty. However, the difficulty of the subject ties up well with learners' cognitive development. Many adolescents

have not yet reached their formal or abstract reasoning stage. As a result their abilities to understand certain concepts are impaired.

**(c) *The influence of learners' misconceptions on the understanding of and attitudes towards biology***

The constructivist theory of learning indicates that the ideas of learners develop as a result of their life experiences, perceptions of the environment, and values and beliefs. Therefore, people develop their explanations of what they hear and see on the basis of their mental activity.

However, this tendency has become a problem because as learners constructed their ideas, many would formulate explanations that are plausible only to them and which may not be compatible with current scientific theories (Sanders & Cramer 1992:543). These are called misconceptions. According to Moletsane and Sanders (1995):

*Misconceptions are deeply held concepts or ideas, the meanings of which deviate from the one commonly held by the science community. They usually emanate from a student's personal experience of an event prior to or during instruction. Because they make sense to the student, they become mentally internalised. These mental constructions or students' notions often become highly resistant to change.*

This may have serious implications for the understanding of science and may lead to the development of negative attitudes in learners.

Griffiths and Grant (1985) conducted a two-fold study with grade 10 learners to identify their misconceptions in science. The learning hierarchy model relating to

*food webs* was used to identify the misconceptions. All items of the instrument that were not answered correctly were scrutinised, taking one item at a time, to arrive at a possible rationale that learners used in answering the questions. The criteria thus established were transferred on field cards and on the basis of this, misconceptions were coded numerically. This was done in order to determine the frequency of each misconception. The following misconceptions were detected with regards to the study of *food webs*:

- Almost all the subjects (95.5%) failed to understand that the effects of change in one population could be passed along several different pathways as it approached the population in question. Instead they tended to confuse the food web with a food chain.
- Some subjects believed that in a food web, a change in population will only affect another population if two populations were directly related as predator and prey.
- They also believed that the population that is located higher on a given food chain within a web is a predator of other populations located below it in the chain.
- Some thought that a change in the prey size has no effect on the predator population.
- Subjects also believed that if the size of one population in a food web is altered, all other populations in the web will be altered in the same way.

Friedler, Amir and Tamir (1987) conducted a study to identify learners' difficulties in understanding osmosis and related concepts. Five hundred and seven (507) grades

9 -12 learners in 12 schools in Israel formed the sample of that study. The results of this investigation revealed that learners:

- were unable to distinguish between diffusion and osmosis
- found it difficult to explain why the process took place
- were unable to explain why water would move from one concentration to another
- did not know when the movement of water was going to stop
- could not define "concentration" and about a third of them had difficulty in understanding the nature of solutions.

All of these are the result of learners' preconceptions and misconceptions. This has serious implications for learners' comprehension of osmosis as such and may result in the development of negative attitudes.

Another study was conducted by Sanders and Cramer (1992) to identify the problem areas in the understanding of a group of South African grade 12 learners regarding the concept of respiration, after they had been taught the topic. A two tier multiple choice diagnostic test designed to identify problems in the understanding of respiration was administered to 162 grade 12 learners in two former provinces in South Africa. The results of this study indicated that the learners held some erroneous ideas about respiration. This was in four areas where learners:

- did not understand the nature and function of respiration
- did not understand that respiration is an energy-conversion process
- considered respiration to be synonymous with breathing
- believe that plants did not breath continuously.

Sanders and Sebego (1995) investigated the ideas held by grade 11 Botswana children about sex determination in genetics. The study was conducted prior to

formal instruction on the topic with 300 learners. The results of this study indicated that learners displayed serious misconceptions around the concept of sex determination. In fact what caused the sex of the child to be male was never understood at all. The following factors were associated with the gender of the newborn baby:

- family history
- male dominance or superiority
- wish of the parents
- diet of the mother during pregnancy
- type of food eaten by parents
- number of sperm cells produced
- types of animals seen by a pregnant woman

These are misconceptions which can result in learners failing to comprehend and learn genetics effectively. Ultimately negative attitudes may result because of confusion.

**(d) *The influence of textbooks on biology content***

The role of textbooks on the understanding of biology concepts has been questioned by researchers. Although very little has been written on this aspect, the evidence that exists may be sufficient to gain a better perspective about the textbooks that we use everyday.

According to DiGisi and Willett (1995) there is a strong association between the amount of textbook reading by educators and the academic level of the learner. Problems regarding textbook use have been documented. Armbruster, Bybee and Holliday (in DiGisi & Willett 1995:124) have cited some of the problems as including:

- textbook inaccuracies and mediocre explanation of concepts
- science textbooks listing too many concepts at superficial level without dealing with them in sufficient depth
- textbook content that can be subject to political and religious controversy
- information in a textbook can become outdated.

Johnstone and Mahmoud (1980) indicated that most textbook writers used confusing terms. Another criticism of textbook use was that of the textbook driving the curriculum which results in the memorisation of facts and details rather than fostering authentic scientific behaviour.

Wagiet and McKenzie (1991) made both a qualitative and a quantitative review of certain textbooks used in the teaching of ecology in grade 10 biology. The results of this review indicated that certain textbooks did not cover much content on ecology as can be seen from the number of pages devoted to the section. Grade 10 ecology covers 25 percent of the total syllabus while the content in one textbook used by many educators covered only 20 to 21 percent of the syllabus on ecology. Another very popular textbook was analysed and was found to have the following weaknesses

- a great deal of chemistry, which is rather abstract in nature
- the inclusion of too much specialist/technical terminology which may be cumbersome for learners to comprehend
- a rather compressed form of writing which may make reading difficult
- in certain instances, more than one idea or process was contained in the sentence which made reading and understanding of such a passage too difficult
- many concepts found in one sentence making it clumsy.

All these could make the study of ecology difficult and less accessible. This may result in learners developing negative attitudes towards biology.

In 1994, Barman and Mayer examined the concepts held by high school learners regarding food chains and food webs. This was followed by an examination of 11 high school biology textbooks for their coverage of food chains and food webs. The results of this study indicated that learners did not have many difficulties with the concepts of food chains and food webs. However, from the examination of the textbooks, the following information was revealed:

- although learners were fairly exposed to the idea of energy transfer along food chains and were provided with the idea that in an ecosystem feeding relationships are most accurately described as complex food webs, terms such as carnivore, herbivore, omnivore and predator-prey relationships were not incorporated in the specific discussion of food chains and food webs in six out of eleven textbooks.
- although all eleven textbooks had a diagram of a food chain, three did not provide a diagram of a food web.

This should be seen as a serious omission and inaccuracy that may make it difficult for learners to develop a mental image of the food web. This may result in learners developing negative attitudes towards specific biology content.

Alexandre (1994) conducted research to investigate how textbooks dealt with the topic of *natural selection* in grade 12 biology and the ability of educators to explore learners' ideas related to it. Textbooks were analysed with respect to the following characteristics: the way key ideas in the model were handled, the attention paid to learners' ideas, and the type of activities used in the instruction. The study involved evaluating the factors above in a sample of 17 textbooks. The results of this study

revealed an overall image of the textbooks being consistent with respect to the different characteristics that were analysed. The textbooks showed:

- little attention to probabilistic reasoning
- a lack of activities that would involve learners in discussing their own ideas
- a lack of key ideas in the model.

From this it follows that textbooks cannot promote functional learning in the majority of learners. This is because most of them have revealed a deterministic rather than a probabilistic orientation, a lack of concern about learners' alternative ideas, and a lack of activities to challenge them, while at the same time indicating that they provide little discussion on the key ideas of evolution.

#### **2.5.4 The role of the classroom environment on attitude development**

Research on classroom environments is based on Murray's needs-press theory and Getzels and Thelèn's model of the classroom as a social system (Myers & Fouts 1992:930). The *needs-press* theory of Murray emphasises the personal needs and the environmental press as important in enhancing learning outcomes. According to this theory, learners' behaviour is a result of their person and the environment and any variance in their performance is influenced both by them and the environment in which they find themselves. However, the Getzels and Thelen model on the other hand, emphasises the interactions between personalities, needs, role expectations and classroom environments. These are seen as better predictors of learners' behaviour and learning outcomes. Therefore, many studies that followed used these theories as the basis for examining the classroom environments (Talton & Simpson 1987:508).

The literature accumulated over the past years has affirmed that an appreciable amount of learning outcome variance can be attributed to the environment in which

teaching and learning take place (Jegede & Okebukola 1992:637), and perceptions of such an environment by learners. The science classroom in particular, has been reported to create a wealth of interactions among the educators and learners, learners and learners and the curriculum affecting the learners' behaviours (Talton & Simpson 1987:507). Significant relationships were also found between learners' perceptions of their science classes and their attitudes towards science (biology).

Therefore, the classroom is seen as an important determinant of attitudes towards science. The characteristics of educators, peers, curriculum and classroom climate have been reported to be significant correlates of attitudes towards science (Talton & Simpson 1986:366; Yager & Penick 1984:143).

Changes in the outcomes of education have also been seen as a function of the environment in which learners learn. The social learning that exists in the classroom may be one factor related to attitudes towards science. Therefore, both the final performance and attitudes towards science are heavily dependent upon the classroom environment (Talton & Simpson 1987:508). In this way, the classroom should be seen as a potent variable accounting for much of the variance in attitude towards biology.

Myers and Fouts (1992) conducted research to determine the types of science classroom environments and how each environment was related to learners' attitudes towards science. The hypothesis tested was that learners' perceptions of their classroom environments affect their attitudes towards science. The results of this study showed positive attitudes were found in classrooms that exhibited high levels of involvement and affiliation, high educator support, high order and organisation, high educator use of innovative teaching strategies and low levels of control. Negative attitudes therefore, were enhanced by strictly controlled classes. Learners who did physics and chemistry exhibited more positive attitudes towards

science than those who did biology. This might be ascribed to the nature of biology as characterised by a less scientific structure.

In the same year, Myers and Fouts (1992) carried out an investigation to identify the classroom environmental variables related to the views of junior high school learners about science. The results of this study revealed a wide variety of science classroom environments, teaching philosophies and teaching expertise. The attitudes of learners towards science were found to be highest in classrooms with high levels of learner involvement, educator support, group affiliation, order and organisation, and educator innovation.

McRobbie and Fraser (1993) used the laboratory as a classroom setting to investigate the relationships between the high school learners' outcomes and the classroom environment using the Science Laboratory Environment Inventory (SLEI). It was found that the nature of the science laboratory classroom environment accounted for much variance in both cognitive and affective outcomes, which include attitudes.

Haladyna and Shaughnessy (1983) explored the relationships of the learners, the educators and the learning environment with attitudes towards science. It was found that many endogenous and exogenous learners, educators and the class variables were significantly related to attitudes towards science. The exogenous factors of gender were related to attitudes towards science in grades four and nine. Professional membership, in-service science training, professional involvement, fatalism, importance of science, educator attitudes towards science, competency teaching, educators' interest, educators' perceptions of learners' abilities, educators' certification and enthusiasm were found to be significantly related to science attitudes. On the other hand, it was also discovered that cohesiveness, enjoyable and well-organised classes and instruction, friendship, management organisation

and classroom enjoyment of classmates correlated positively with attitudes towards science.

Haladyna et al (1982) investigated the determinants of attitudes towards the subject-matter of science using a theoretical model which examined three essential features thought to influence attitudes, namely: learners, the educator and the learning environment. Among the learning environment variables, the classroom environment together with satisfaction, enjoyment of classmates, disorganisation and attentiveness emerged frequently, showing moderate correlations with attitudes towards science.

In 1984, Yager and Penick reported the results of research that they carried out on learners' perceptions, opinions and interpretations regarding their classroom, the study of science and their educators. It was revealed that educators in such classes were viewed as prescriptive. They chose topics for learners and consequently, very few learners perceived they had any input in determining the content and the way they were taught science. This contributed to the development of negative attitudes in the learners.

Talton and Simpson (1986) conducted research to investigate the relationships of self, home and the classroom environment with the learners' attitudes towards science in grades six to ten. The results showed that of the three variables, the classroom environment variables predicted the greatest amount of variance in attitudes towards science.

A study by Manganye (1994:113) also revealed the importance of the classroom on the development of attitudes towards biology. Very low correlations were shown between formality, friendship, favouritism and attitudes towards biology. A negative correlation was found between attitude towards biology and competition suggesting that the more competition is encouraged in the classroom, the more the attitudes of

learners become negative. This is in line with OBE which advocates cooperation rather than competition.

Wong and Fraser (1996) conducted a similar study, using a variety of instruments, to investigate the relationship between the perceptions of learners of their chemistry laboratory classroom environment and their attitudes towards the subject. The study revealed significant relationships between the nature of the chemistry laboratory classroom environment and the attitudinal outcomes of the learners.

Levine and Donits-Schmidt (1996) used experimental and control groups to explore the role of the classroom environment in science of grade 7 learners. The results showed that learners in the experimental group perceived their classrooms in a more positive light than did learners in the control group. The interaction effects of gender, computer ownership and instruction was found to be significant. This finding suggested that the computer-integrated classrooms have the potential to reduce differences in the perceptions of learners regarding the positive role that computers can play in science learning.

## **2.6 SUMMARY**

From this review, it is important to note that a number of factors are significantly related to attitudes towards science (biology) and may therefore, influence the development of learners' attitudes. However, the recognition of these variables during any curriculum development exercise will contribute significantly towards making the curriculum more relevant, important, interesting and less difficult for learners. Thus, learners may enjoy learning science in general and biology in particular. In order for this to happen, a participative approach, where learners have a say on what concerns them in their education may be advisable. This is in contrast to the traditional top-down, power-coercive approaches that were previously used in education in South Africa. This calls for a grassroots dimension of looking into the

curriculum. In this way, learners may no longer be seen only as extras, having no say in whatever concerns them.

In chapter three, a review of the literature will be given on curriculum development principles, approaches and models. The purpose of the review is ultimately to make recommendations for future curricula development in science (biology).

## CHAPTER THREE

### MODELS OF CURRICULUM DEVELOPMENT AND THEIR INFLUENCE ON BIOLOGY CONTENT

#### 3.1 INTRODUCTION

The aim of this study is to determine the attitudes of learners towards involvement in curriculum development and the content of biology curricula in secondary schools and the implications thereof for future curricula development. In chapter two (in addition to chapter one), a further analysis of the concept *attitude* was made. Theories on attitude development were discussed. The review of the literature was based on the influence of the following factors on attitude development:

- the educator
- the learner
- the curriculum
- the classroom environment

From the previous study by Manganye (1994) it was revealed that of all the variables listed above, *the curriculum* had the greatest influence on the attitude of learners towards biology.

In this chapter, the process *curriculum development* will be defined. This will be followed by a presentation of the theoretical perspective on the curriculum in terms of approaches and foundations, as well as the designs that are essential for its development. The relevance for learners' attitudes towards biology will constantly be indicated.

### 3.2 CURRICULUM DEVELOPMENT: A FRAMEWORK FOR BIOLOGY EDUCATION

The word “development” literally means quality improvement of that which exists thereby eliminating unsatisfactory practices (Dorfling 1992:8). According to the Oxford Complete Wordfinder *development* means a stage of growth or advancement. It is a quality improvement or advancement whose search remains a continuous activity. It is an initiative that sets out to influence the school system or any other system as a whole. However, with regards to the school, it concerns classroom practice, the school context and the materials that are used.

Carl (1995:40) regards curriculum development as an umbrella term and a continuing process in which structure and systematic planning methods figure strongly from design to evaluation. Thus, curriculum development should be seen to refer to a continuous process aimed at qualitative improvement of the curriculum thereby bringing into being more effective education. It is a continuous engagement of learners and educators at schools, often using society as a source from which to select and design content that will be taught in order to obtain certain intended outcomes. This is often done through diagnosing the problems of the curriculum using formative methods. The main purpose of doing this is to adjust the curriculum to the ever-changing conditions of our society.

However, Mathews (1983:113) has cautioned that change, experiment and innovation may not necessarily constitute “development” per se in terms of growth and progression to a better state or, therefore, for the development of positive attitudes. This is especially applicable when changes are introduced for the sake of change. Therefore, in order to achieve appropriate development and improvement, curriculum development should always be informed by the result of evaluation studies. This is because evaluation supplies information about the success or failure of, for example, a teaching-learning situation. Without the curriculum coming under

official scrutiny, the range of compulsory and optional activities formally planned for learners and the school may remain static, out-dated and worthless (Tunmer 1981:32). Yet, with development, the curriculum should not remain constant nor deteriorate (Dorfling 1992:8). Therefore, as a continuous and dynamic process, the curriculum should constantly be in the process of being revised and updated (Degenaar 1988:46).

However, it would appear that for many years, the effectiveness of the curriculum in South Africa has defied evaluation and was therefore governed by "self-evident", traditional rules (e.g the rote learning of the written word). The rise of the "Social Sciences" has aggravated the attempts to quantify human behaviour and to mimic the "cause and effect" of the Natural Sciences. It would also appear that statistical social research has also failed to provide satisfactory answers to the problems of the curriculum. Reasons could be traced to the following possible weaknesses within the system:

- lack of a comprehensive model of human behaviour
- insufficient consideration of the basic principles of curriculum development
- inappropriate statistical analyses and interpretations of the outcomes of research

In South Africa the curriculum has been static since 1948. It has never been responsive to the changing socio-economic conditions of the times. Carl (1995:24) has identified other factors that have also influenced the curriculum and curriculum theorising detrimentally throughout the decades:

- a centralised education system
- an apparent rigidity in the procedure for the revision of curricula
- many educators being uninformed about curriculum theory and practice
- a tendency towards bureaucracy

- shortage of curriculum specialists
- few or no meaningful contributions by educators to curriculum development at all levels
- educators and principals often being sceptical about curriculum research and experimentation.

Moreover, curriculum development lacked a great deal of accountability. It has been common practice in South Africa and other developing countries, for large sums of money to be spent on isolated schemes without any comprehensive plan for general development. For example, schools have been built by the state or private industry but the quality of educators and the curriculum that is being implemented have never been addressed. In this way learners get a poor quality education and the effective impact of this on the labour market is remarkable.

Yet, for the new South Africa, solutions to the longstanding “educational crisis” must be sought. This includes an establishment of a sound curriculum model for change. This and many other factors must bring about positive and lasting change in education such as the development of positive attitudes towards school subjects, including biology. Therefore, all the stumbling blocks in the way of development must be removed and a more dynamic look into curriculum development adopted that will make education more relevant and purposeful to learners.

As was shown in the first chapter, the word *curriculum* is a very wide and often controversial concept in education. This is especially true when a single, universally agreed meaning must be delineated. To this end, so far, the concept has been variously defined by different scholars. Examples of definitions of the curriculum include describing it as *a plan, experiences, a system, a field of study, or subject matter* (Ornstein & Hunkins 1993:9-10). But it is important to indicate that a definition of the curriculum as either one of the above categories may be misleading.

In the first place, it would be more reasonable to define curriculum as a combination of two or more of these categories, rather than assuming and maintaining a compartmentalised view as such. Secondly, it is important that in attempting to define the curriculum, the various perspectives that have had an influence on its conception over the years be considered as well. This is because the more precise one's definition of the curriculum becomes and the more such a person relies on a preconceived plan or document about the concept, the greater will be his/her tendency to omit, ignore and even miss out relevant factors related to teaching and learning. For example, the meaning of "curriculum" may not necessarily stick to the *planned* (prescriptive) events only as the unplanned (hidden curriculum) may also have an influence (Ornstein & Hunkins 1993:10). This suggests that there are many grey areas in education and that many human variables also exist that cannot be planned for in advance.

Nevertheless, it is felt that despite the disagreement in the definition and meaning of the curriculum, it is also important to mention from the onset that the evolution of a person's definition of a concept resides in his/her convictions or philosophy about it. Carl (1995:67), supported this statement and wrote: "A particular approach can be grounded in a person's practical involvement and for that reason it is essential that everyone has this self-knowledge". It may also arise from an analysis of what others had to say about it elsewhere. These are very important assumptions and everybody interested in curriculum development must take note of these and always keep in mind the various approaches and orientations. Ultimately curriculum developers want to develop positive attitudes in learners.

### **3.3 BACKGROUND TO CURRICULUM THEORISING: APPROACHES, FOUNDATIONS AND DESIGNS**

In this section various conceptions of the curriculum will be presented. One of these conceptions will later be used as the basis for the design of a model for curriculum

research and development in biology education. The overview starts with an exposition of the curriculum conceived of as a technocratic process. In this process the professionals or experts develop curricula that are implemented by the educators at schools. This will be followed by the exposition of a non-technocratic process where curriculum development is a result of classroom participation by both learners and educators (Bowen 1994:450). Finally an overview of curriculum development as a process that is centred on stated outcomes (as in OBE) will be made.

Beauchamp (Ornstein & Hunkins 1993:11), has pointed out that the position one assumes with regard to the content of the curriculum inevitably will be of great influence upon one's theorising. Therefore, many different conceptions of the curriculum have emerged because of the divergent philosophies that people have about education. These will be briefly discussed below to highlight their evolution and the impact that they had on education and curriculum development over the years.

### **3.3.1 Approaches and foundations for curriculum development**

It is commonplace that the way we define the curriculum by and large reflects our approach to it. An individual's approach to curriculum and curriculum development reflects that person's view of the world in terms of reality, important values and the amount of knowledge perceived as important. In this way the relationship between a definition and an approach becomes that of mutual overlap (Ornstein & Hunkins 1993:1).

As a conceptual framework to curriculum development, a curriculum approach determines the nature of the person's involvement in it (Carl 1995:73), and reflects a position that may encompass the foundations, the domains and the theoretical and practical principles on which curriculum conceptualising is based (Ornstein & Hunkins 1993:1). It plays a very crucial role in so far as it expresses a viewpoint

about the development and design of the curriculum, the role of the learner, educator, and curriculum specialist in curriculum planning, the outcomes of the curriculum, and the important issues that need to be examined. A curriculum approach also reflects our views of schools and society, so that by understanding one's curriculum approach and the prevailing curriculum approach of the school or society in which one works, it is possible to conclude whether one's view conflicts with the formal organisational view (Ornstein & Hunkins 1993:1-2). The examples of curriculum approaches are fully and extensively discussed elsewhere (Ornstein & Hunkins 1993; Bowen 1994; Carl 1995).

Foundations, on the other hand, refer to the demarcations of the field of the curriculum (Ornstein & Hunkins 1993:14). They help to set the external boundaries of the knowledge of the curriculum and define what constitutes valid sources of information from that which come from accepted theories, principles and ideals relevant to the field of the curriculum. Examples of these foundations are: philosophical, historical, psychological and social. However, only the *philosophical* and *psychological* foundations are emphasised in this study.

Although much work was done in relation to the conceptualising of the curriculum (Eisner & Vallance 1974; Beyer & Apple 1988; Apple 1990; Carl 1995; McNeil 1996) a very clear framework of analysing the different conceptions was crafted by Ornstein and Hunkins (1993). Consequently, two distinct conceptual dimensions (technocratic and non-technocratic) are discernible. These are briefly discussed below. A third dimension of curriculum development based on outcomes (OBE) is also given. Finally, the curriculum conceptual framework for this study will be delineated which will serve as the basis for the development of a model upon which future biology and science curriculum development initiatives could rest. The aim would be to develop positive attitudes towards biology in learners.

### **3.3.1.1      *The technocratic approach and curriculum development***

This approach owes its origin to the works of Bobbitt, Charters, Tyler and Taba (in Hunkins & Hammill 1994:4). It is basically a means-ends approach that is both logical and prescriptive in nature. It is based on the traditional theories and models of education and, therefore, reflects the established and formal methods of schooling shaped by the intellectual character of the period (Ornstein & Hunkins 1993:2). The word *scientism* and *scientific* techniques from business and industry found their way into educational theory (Pinar 1978:206). This approach consists of a bureaucratic model and an allegiance to *behaviourism* and *technological rationality*. The curriculum worker only honours his/her dedication by accepting the curriculum structure, as it is – the technician's mentality.

Grundy (in Bowen 1994:457) has indicated that when the power of the curriculum resides with the person outside the classroom who defines the goals of learning, then the curriculum operates from a *technical* orientation. Therefore, as a technical and scientific process, the technocratic approach deals with the principles of the theoreticians and practitioners. Greater latitude and value-judgement are thus granted to those involved in planning the curriculum than to those who implement it. Advocates of this approach contend that an educational practice is not an art but a science or the scientific approach based on the presumptions of the behaviourist reductionist process. To them it is possible to create the curriculum (by the persons outside of the classroom) before its implementation. In this way, the goals, content and instructional experiences are pre-planned and educators can only be trained to implement that which was created outside of the classroom in their absence (Ornstein & Hunkins 1993:196; Bowen 1994:457). This is typical of what has been happening in South Africa up till now.

However, a lot of criticism has been levelled against the technological approaches to curriculum development. One of the criticisms is that the approach attempts to

reduce education to a *scientific activity*, analogous to the *process of industry*. As Kelly (1989:62-63) puts it, to adopt the industrial model of education is to assume that it is legitimate to mould human beings, to modify their behaviour, according to clear-cut intentions without making any allowance for the learners' own individual wishes, desires or interests being realised. This is because, like the materials upon which the industrial worker operates, the children's minds are to be fashioned by the educators according to some preconceived ideas, supplying the blueprints. Of course, this view is usually influenced by a belief that we can define the main ingredients of a course and then proceed to teach it in a systematic way (Van Niekerk 1996:32).

According to Cornbleth (in Bowen 1994:456), the technocratic approach to curriculum development puts a constraint on human possibility. This is because of its tendency to perpetuate the status quo within and outside of the school. Thus, the curriculum and its construction become arbitrarily separated from curriculum policy-making and use. Secondly, the curriculum and its construction are to be neutral and apolitical apart from competing social values and interests. Consequently, and as Vallance and Eisner put it, people are easily diverted from thinking about the political aspects regarding the goals of education and the people involved in formulating them (Bowen 1994:455). It ignores such issues as, for example, the contextual aspects in which the curriculum will be situated. Therefore, curriculum developers are not responsible for education as it takes place in the classroom because their attention is directed more to the curriculum as a document (Bowen 1994:457).

Again, the fact that truth and values are absolute, timeless and universal; and that the world of the mind is permanent, regular and orderly, memorisation and recall are the best methods to deal with ideas within the technocratically designed curricula. In fact the minds of learners are regarded as sponges for absorbing knowledge. In this way, education becomes solely concerned with conceptual matters where abstract thinking is the only highest form of knowledge construction. This has had

the effect that more emphasis is placed on separate subjects. As a subject-centred approach, it draws heavily on defined disciplines. An educator is regarded as an authority whose knowledge and expertise are unquestionable – a master concerned with the raising of academic standards. Teaching is expository and because of this, learners must merely memorise facts. Their interests are not considered in curriculum development. This is because learners are regarded as immature and without the ability for judgement necessary to determine the best knowledge and values for themselves. Whether they dislike the subject matter is secondary.

The question of a common curriculum (core curriculum) for all, which is intellectual in content, is emphasised in this approach. A definition of education by Harris (Cremin 1971:208), as the process by which the individual is elevated into the species, is typical of a technocratic approach. To him civilisation was achievable only through the study of mathematics, geography, literature and art, grammar and history. The learner had to bear responsibility and subdue his/her likes and dislikes in order to master the set tasks through unaided labour. For all the children, the educational process was one of collecting factual knowledge to the limits of their absorptive capacities (Ornstein & Hunkins 1993:45). Therefore, a school subject was a set of facts and principles that could be mastered through effort rather than interest.

More importantly still, the process of curriculum development strives for the permanency of what has stood the test of the times and the values that have moral and spiritual good. As such, this is the static view of the curriculum and curriculum thought, in general.

The models of Tyler (four basic principles), Saylor and Alexander (planning process), Francis Hunkins (decision-making) (Ornstein & Hunkins 1993:266-279; Bornman 1997:109-110); and Wheeler and Havelock (the cyclic and need reduction

model) (Chauke 1995:v) fit well into this approach. The latter model according to Wheeler and Havelock, is a modification of Tyler's linear model.

However, it is important to indicate at the outset that the behaviourist view of human beings and the behavioural objectives' model of the curriculum have been examined and rejected (Ornstein & Hunkins:1993). These views are both philosophically and psychologically unsound and anti-humanist. The behavioural objectives view of the curriculum is that of a closed system, whereas, in democracy, the individuals need to be autonomous by means of an open-ended curriculum that allows them freedom of choice and participation. This may promote the development of positive attitudes towards subjects (including biology) in learners.

### **3.3.1.2      *The non-technocratic approach and curriculum development***

The non-technocratic approach to curriculum development is rooted in the progressive philosophy and phenomenological psychology. Both are views based on pragmatic and existential philosophies, respectively. It is a child-centred approach completely aimed at whole-child development through its emphasis on the needs, interests and freedom of learners to learn and emancipate (self-fulfilment, self-actualisation and self-realisation). Therefore, the personal interests and inclinations, values and experiences of the individuals are regarded as important curriculum content. The basic premise of this approach is that all the people learn best that which has meaning for them personally and they create their own learning through selective perception.

Problem-solving and active learner participation are the main curricular activities of the non-technocratic approach. The active involvement of the learner is regarded as important in order to obtain maximum learning outcomes (Carl 1995:52). Co-operative learning, individual learning, small group learning and social activities are emphasised as opposed to competition, educator domination, large group learning

and the cognitive instruction. Each learner has inputs to make towards curriculum development. In this way, learners share the responsibility with parents, educators and the curriculum specialists in curriculum matters. The curriculum conceived in this way is called an emancipatory curriculum (Bowen 1994:474). Thus, the whole curriculum process is bottom up. However, proper consideration for the unplanned, informal or hidden curriculum and instruction is given, as well.

The non-technical – non-scientific approach accommodates the Naturalistic model of Glatthorn, the Curriculum of Affect models of Weinstein and Fantini and the Positivistic models of Doll, Schon, Young and others (Ornstein & Hunkins 1993:273-278). However, the model according to Weinstein and Fantini is discussed in detail in section 3.8.

### **3.3.1.3      *An outcomes-based approach to curriculum development***

#### **(a)      Origin of outcomes-based education**

The origin of the outcomes-based curriculum approach to education is a controversial issue. According to Jansen (1997:1) OBE does not have any single legacy. However, a careful perusal through the literature sheds some light on this matter. McNeil (1996:60) indicates that OBE is rooted in the systematic approach known as “competency-based education” aimed at defining and evaluating learner performance.

Some trace its roots to behavioural psychology, the objectives approach, competency-based education, mastery learning as well as criterion-referenced assessment (Jansen 1997:1; Van der Horst & McDonald 1997:9-12; Towers 1992:90). According to Kramer (1999:1) OBE has its roots in *competency-based* learning and *mastery-based* learning, the former being concerned with the preparation of learners to fulfil various life roles, and the latter focusing on the need

to create favourable conditions as regards time, teaching strategies and learning success. The philosophy underlying mastery learning is that all learners can achieve the desired outcomes only when they are given favourable learning conditions (Kramer 1999:2).

From an analysis of the approaches to curriculum development presented by Ornstein and Hunkins (1993:54-61), it is evident that OBE can also be traced from the reconstructionist (internationalist view and equality of educational opportunity) philosophy and the behavioural psychology.

According to McNeil (1996:58), a systems philosophy is a technological (technocratic) framework of viewing the problems of the curriculum - this is in as much as it emphasises the specification of instructional objectives, highly controlled learning activities to achieve the objectives and criteria for performance and evaluation. Therefore, developing a systems philosophy requires stressing constant feedback to monitor the learners' behaviour. In OBE this is achieved through continuous assessment.

OBE in South Africa appears to tie very strongly with the social reconstructionist view of schooling, where schooling is regarded as a way to change and improve society (Van der Horst & McDonald 1997:6) and for the country's economic development. According to Jansen (1997:1) the most immediate origin of OBE is in the competency debates in Australia and New Zealand that have animated training and development in COSATU. This has eventually crystallised in the National Qualifications Framework (NQF).

#### **(b) The characteristics of outcomes-based education**

Outcomes based education (OBE) is the kind of education that is focused and organised around stated outcomes of significance (Spady 1994:1), and teaching and

learning are geared towards achieving these results (Killen 1996:4). OBE is concerned more with *what* and *whether* learners learn successfully than with *when* and *how* they learn something (Spady 1994:8; Kramer 1999:3). Therefore, academic success is best measured by what learners actually learn (Manno 1994:1).

As a “results”-oriented approach to education, OBE requires educators and learners to focus their attention on the *desired end results* and *content*, and less on the *processes* that guide learners towards these results (Burns & Wood 1990:48-52; Van der Horst & McDonald 1997:7; Van der Horst & McDonald 1998:18-19). However, the attainment of outcomes is more emphasised than the coverage of content (Jansen 1997:1). This means that at the end of any learning process, learners should be able to demonstrate certain abilities towards the attainment of specific outcomes. Because of this, assessment (criterion-referenced assessment) is crucial and very central to the approach (Killen 1996:1&7).

OBE is founded on three basic premises according to Spady and Marshall (1991:67). That:

- all learners can learn and succeed, but not on the same day and in the same way
- successful learning promotes even more successful learning
- schools control the conditions that directly affect successful school learning.

Implementation in OBE is guided by the following *principles*:

- clarity of focus on culminating outcomes of significance
- expanded opportunity and support for learning success
- high expectations for all to succeed
- design down from ultimate, culminating outcomes (see Spady 1988:7; Spady 1994:10).

**(c) Motives for the introduction of outcomes-based education**

Motives for the introduction of OBE are many and they vary from one country to the next. According to Spady (1994:9) OBE in America was introduced to:

- ensure that all learners are equipped with knowledge, competence and qualities needed to be successful after they exit the educational system
- structure and operate schools so that those outcomes can be achieved and maximised for all learners

Bagnall (1994:21) adds that OBE:

- provides information for judgements of effectiveness and efficiency
- encourages educational excellence, individual autonomy and liberation, individuality and plurality, creativity and innovativeness, as well a high degree of responsiveness to changed circumstances

According to Manno (1994:1) the programme came into being as a result of the learners' declining achievement despite the fact that the input focus and the resource-based strategies were in place. Its introduction was explicitly enhanced by the questions that were asked by the public regarding spending, type of education and the extent to which their children were learning.

In South Africa, OBE was introduced as a response to the appalling history of education in the country and the ongoing disparity between learning and work in our society (Kramer 1999:128). Transformational OBE was, therefore, adopted to enhance rapid social change. This is because the existing system of education appears to impede development of a new society. Its curriculum does not meet the needs of learners to develop the knowledge, skills, values and attitudes that will

enable them to participate competently in the socio-economic development of the country.

Consequently, the following have been given as reasons for introducing OBE in South Africa (Kramer 1999:129; Van der Horst & McDonald 1997; Dreyer 1998). To:

- change the attitudes of the country's people that were formed during the apartheid period
- bring about equality in terms of educational provision
- develop the learners' critical thinking skills and their problem-solving abilities
- endorse lifelong learning by reconciling education with training
- ensure sustained economic growth
- maximise accountability and improved productivity

Proponents of OBE world wide, believe that the curriculum should centre on some essentially far-reaching outcomes that all learners must attain and be able to demonstrate (McNeil 1996:60). However, these outcomes should derive from the context of future life rather than the existing curricula.

According to Spady and Marshall (1991:67, 70 & 71):

- transformational OBE gives schools a profoundly different means of structuring themselves
- it provides for improved learner outcomes
- it equips all learners with knowledge, competence, and orientations needed for success after they leave school
- transformational OBE takes nothing as a given because no existing features are untouchable in carrying out a curriculum design

Spady (1988:4) indicates that designing an educational system to achieve clearly defined exit outcomes will free people from the traditional rigidity of schools and increase the likelihood that all learners will learn.

**(d) Advantages of outcomes-based education**

Van der Horst and McDonald (1997:14-15) mentioned the following important benefits to the system that can be derived from OBE:

- Educators are compelled to plan and prepare thoroughly
- Learners know in advance what is expected of them
- Permanent failure is eliminated
- Rote learning is reduced
- Learners' ability to appreciate and deal with realistic situations is increased

Melton (1996:409) indicates that OBE is essential for setting up standards for both education and training as well to increase accountability for good quality education.

An analysis by Mkhathshwa (1997:19) of the results achieved in countries where OBE was introduced revealed the following advantages:

- Learners are more focused because they know they should apply the knowledge that they have acquired – hence more positive self-esteem results.
- Learners are motivated and educators are encouraged to plan and monitor their lessons because achievement of results depends on this.
- Learners in OBE environments score above grade level on standardised tests and behaviour.
- Because of improved assessment standards, higher quality results are achieved.

- Increased instructional and classroom management and control results from OBE.

**(e) Criticism of outcomes-based education**

The introduction of OBE has never been without criticism in certain countries, as well as in South Africa (Van der Horst & McDonald 1997:16). Much of the criticism is rooted in uncertainty, since many people are not sure what the programme entails in terms of values and cost.

The fact that OBE is rooted in the *systems approach* and the *objective's model* indicates that the programme may be organised by *technical-rational* planning. However, it should be emphasised that the objectives' model to curriculum development was heavily criticised for its mechanical behaviourist view of man and education (Ornstein & Hunkins 1993:113). The assumption of the objectives approach that reality can be defined and presented in a symbolic form, while the aims of education can be made known, stated precisely and addressed in a linear fashion (Ornstein & Hunkins 1993:273), may be highly flawed. Such assumptions have always resulted in a mismatch between the developer and the implementer (Ben Peretz & Sylberstein 1982).

Education should be seen more as a process rather than as a product. According to McKernan (1997:1), education is a social-reflexive process that must be negotiated in the classrooms (by educators and their learners) on a daily basis. This is in contrast to the means-ends approach to curriculum development also espoused in the OBE circles where "design" for learning is more emphasised (Spady 1994:75).

Because of the position illustrated above, McKernan (1997:3-4) mentions the following characteristics of OBE to justify his objection to the approach:

- OBE reduces education, teaching and learning to forms of human engineering and quasi-scientific planning procedures.
- OBE is informed by the linear, step-by-step approach to learning and thus it is more than developmental.
- Although OBE can improve the structure of the lessons, there is no empirical evidence that it can improve the quality of the curriculum compared to the "process model".
- The fact that outcomes are expressed as simple recall or learning objectives explains a drive towards centralised state assessment procedures.
- The OBE model is linear, non-reflexive and prescriptive of the limits of the field of study as if there is no more education than is encompassed in the stated outcomes.

McKernan regards this tendency to be in accordance with the behaviourist psychology that is applied to schooling and the curriculum. Furthermore, it would seem that the basic drive for the selection of outcomes is done more on the basis of the demands of society than on the individual learner. Therefore, the cultural transmission approach will be appropriate to describe curriculum development for the OBE system. More choice is left to the discretion of the adult to decide which outcomes will be appropriate for learners and, therefore, which content will be needed to achieve these outcomes.

This has serious implications for the selection of content through which these outcomes will be achieved. However, as early as 1969, Scotland (in Melton 1996:414) indicated the importance of recognising that individuals will achieve the objectives identified that they perceive as relevant, important and achievable. This has important consequences for the development of positive attitudes.

The Minnesota Family Council (1993:2) has highlighted the following characteristic features of OBE:

- That education in the eyes of OBE should be an adaptive process is evident from the fact that all learners can master the same content at the same level. This means that more attention is given to the slow learner at the expense of the gifted learner.
- That there are no honours or “low track” courses in competency-based programmes means that the level mostly to be attained will be a low one determined by the slow learner.
- Since the learner needs more time to master certain competencies, it means that there will be less opportunity for that learner to excel in areas of strength.

Towers (1992:93-95) argued that organising the curriculum around *mastery learning* is too narrow, too behaviouristic, too structured and too rigid. It punishes weak learners by giving them more work. It is too demanding of educator time, energy and competence in materials development. More time is wasted on lower-ability learners while bright learners should wait.

Bagnall (1994:31) examined the influence of outcomes-driven education on educational quality using philosophical analysis from a lifelong education perspective. From this analysis, Bagnall warns that although the outcomes-driven education is directed at enhancing excellence and individual freedom, as a practical framework, outcomes-driven education

- seriously distorts and diminishes the educational institution
- is based on an oversimplified and an essentially negative model of humanity
- is ideologically dependent on neo-classical economic theory which has been found to be wanting as a public policy framework for education

- using performance indicators and outcomes as structuring concepts, or within their own contemporary socio-political framework, may diminish educational quality rather than enhancing it.

In South Africa, the criticism of OBE can be attributed to lack of understanding of the processes and principles that are involved in programme development (Van der Horst & McDonald 1998:16). Secondly, the high level of illiteracy in curriculum development among many educators is posing many problems related to implementation. Insufficiently trained educators who are also not adequately supported may have problems in implementing the curriculum.

Ideas by some local educational activists (journalists and concerned educators) of OBE need to be reviewed in order to highlight certain limitations that are suspected to be inherent within an OBE system.

Jansen (1997) has outlined 10 basic principles why an OBE approach to curricula development may not necessarily work. According to him OBE undermines the already fragile learning environment in schools and classrooms of South Africa because of

- complicated language
- absence of evidence of the relationship between curriculum, society and economic growth
- the competency levels of educators who must implement a highly sophisticated programme
- specifying outcomes in advance is not democratic as it offers an instrumentalist view of knowledge
- the means-ends approach of OBE which violates the epistemology of the structure of certain subjects and disciplines
- the fact that OBE side steps the important issue of values in education

- the management of OBE which will multiply the administrative burdens already placed on the educators
- the fact that OBE trivialises content yet learners do not learn the outcomes in a vacuum and content is a critical vehicle for giving meaning to a particular set of outcomes
- financial consequences as everybody in the system will have to be retrained, all forms of resources updated, et cetera
- the fact that an eradication of examination as an assessment tool will impact negatively on shaping the nature of OBE-directed teaching and learning

Van der Horst and McDonald (1997) indicated that inherent within an OBE approach could be found problems such as

- stated outcomes that do not focus on academic content requisite for critical thinking and problem-solving
- a possibility of a conflict between government and the parents when prescribing outcomes that include values and attitude
- lowering of standards as more attention is given to the slow learner thereby holding back the gifted one
- more money needed for educator re-education, material development, et cetera

In his review of the OBE in South Africa, an independent education analyst (Ntleane 2000:11) indicated that

- OBE side steps the social values to address both the historical and current inequalities by stressing “Simunyeism” or “rainbowism”
- concerns for social equality are couched in vague terms because learning does not begin with the concrete, existential reality

- the base document of OBE adopts a narrow technician and instrumentalist understanding and motive of education – as a result of a market understanding of education is only seen as a reservoir of skills
- in OBE education is wrongly seen as a necessary requirement for national economic growth and individual prosperity - human capital theory
- if some of the learning outcomes are not changed or improved, OBE will only produce technically and conceptually competent yet docile citizens

However, it is important to acknowledge these as positive criticisms. This is because through them, the weaknesses of the programme could be recognised in advance and addressed (Kramer 1999:3). For example, the most recent reports on OBE are calling for the scrapping or further refining of OBE on the basis of the problems inherent within the vehicle (C2005) through which the programme must be implemented (Ntleane 2000:11; Monare 2000:1; Garson 1999:34).

### **3.3.2 Curriculum designs/orientations**

The dynamic nature of any curriculum is determined to a large extent by the quality of its design. A curriculum design simply means the actual arrangement of the parts or elements of the curriculum into a substantive entity (Ornstein & Hunkins 1993:232). It is a phase within curriculum development that relates both to the creation of a new curriculum as well as the re-planning of the existing one (Carl 1995:81). During this process various decisions are taken regarding the content that must be included, presented and evaluated (Carl 1995:85; Bornman 1997:104). However, which design a person chooses depends entirely on his/her curriculum approach and/or philosophical and psychological inclinations.

The process of decision-making is influenced by the criteria that will eventually determine what the product will look like (Bornman 1997:104). Therefore, an effective curriculum should be based on, and directed by the accountability criteria.

Various authors have presented classifications of criteria for curriculum design (Carl 1995:111; Bornman 1997:105). These are criteria directed at content selection and curriculum evaluation. However, it is content selection and not curriculum evaluation that forms the core of this study. As early as 1976, Zais selected significance, utility, interest and human development (Bornman 1997:106); while Ornstein and Hunkins (1993:281) added self-sufficiency, validity, ease of learning and feasibility as criteria for content selection.

Many other criteria for content selection as presented by various curriculum authors were synthesised by Carl (1995:111-112). Of all these criteria, the following have direct relevance to the purpose of the present study that focuses on biology education:

- The criteria must take the learners' knowledge and needs into account.
- They must offer opportunities for self-discovery.
- They must promote development of thinking skills (cognitive), affective (attitudes and values) and psychomotor skills.
- They must offer possibilities for learner input and choices.
- They must promote integration of content within a specific subject (biology) with a view to form a meaningful whole.
- They must be functional in empowering learners to develop their full potential.

According to these criteria, learner empowerment and development of, among others, the affective skills are important. These criteria also provide a platform for learner input and choice. This has particular relevance for this study and for biology education in South Africa.

In their analyses of the influence of paradigms on geography education, Söhnge and Arjun (1995:91-92) outline nine criteria that the geography curricula should satisfy

so that a paradigm shift to postmodernism may take place. (This is with reference to South Africa.) According to these authors, the geography curricula should:

- be learner-centred
- focus on personal transformation
- lead to democratic classroom dynamics
- abandon emphasis on rational knowledge
- lead to development of the learners' geography knowledge and understanding
- refrain from emphasising the relevance of taxonomies as these belong to the means-ends approach of the technocratic or positivist paradigm
- shift from the social engineering model of education
- emphasise pragmatism
- strive to establish similarities within differences

These criteria are equally relevant for curricula design in biology.

Ornstein and Hunkins (1993:242) have presented three important curriculum designs for effective curricula development. They are:

- the subject-centred
- the process-centred, and
- the learner-centred design

According to Carl's classification and interpretation, the subject-centred design or orientation is associated with knowledge transmission; the learner-centred design is associated with transformation whereas the process design is associated with the transactions that take place between educators and learners. These are briefly discussed below.

### **3.3.2.1      *Subject-centred designs***

Subject matter is the oldest and most used framework for curriculum organisation. It has always been regarded as the only convenient way to develop curricula (Ornstein 1982:404). This design is based on the assumption that knowledge and content are integral parts of the curriculum. In this way the subject-centred design is founded on the academic rationalist approach in which all concepts that are central to a culture are emphasised. This is done through the subjects that are seen to be more important than anything else. This conception has had serious implications for biology content. For example, of the five philosophies or approaches to curriculum development and teaching of biology in South Africa, as outlined by Fraser (1992:57) the first one emphasising a *content-laden syllabus* has been implemented. According to this approach, learners should be subjected to as many experiences as possible while a wide spectrum of content should be contained within the curriculum. Furthermore, learners should be assessed mainly on the recall of facts.

Within this approach, five different designs exist, namely subject, discipline, broad fields, correlation, and process designs. All of them emphasise subjects in various ways. For example, the first two are entirely based on essentialist and perennial philosophies respectively, while the third and fourth designs are based both on the essentialist and progressive philosophies respectively. The fifth one is based on progressive philosophy alone (Ornstein & Hunkins 1993:262).

### **3.3.2.2      *Process-centred designs***

The process-centred curriculum design is problem-centred because it focuses on the problem of living, both of the individual learner and the larger society. Designs of this kind are organised to reinforce cultural traditions as well as to address those community and societal needs that are currently unmet. However, although these

designs appear to place the individual in a social setting, they are not themselves learner-centred. The process-centred design is based on both the reconstructionist and progressive philosophies. Three examples of this design are the life situations, core, as well as social problems and reconstructionist designs. These designs put more emphasis on society and its problems. Therefore, society and the child are the main sources of knowledge (Ornstein & Hunkins 1993).

### **3.3.2.3      *Learner-centred designs***

Learner-centred designs are concerned with creating curricula that are valuable to learners. This is a reaction against the subject-centred design whose focus has entirely been on the subjects. While the learner-centred design considers learners whose interests and needs are emphasised, as the centre of any curriculum development programme, the subject-centred curriculum mainly focuses on the cognitive aspects of learning (Ornstein 1982:406). The learner-centred design is based on progressive philosophy. Skeggs (in Söhnge & Arjun 1996:91) said that learner-centred curricula should involve the child as a role player.

Four major sub-categories of this design are the child-centred, experience-centred, romantic (radical), and the humanist designs. The first two sub-categories are influenced by the progressive philosophy, the third one by reconstructionism and the last one is the result of both the reconstructionist and existential philosophies. One thing common about these designs is that every time the child is central as the most significant source of knowledge more than society and subjects. However, the radical and humanist designs also recognise society and psychology as sources of knowledge, but not as much as they recognise the child.

For the purpose of this study which focuses on the biology curriculum, the *learner-centred* design will receive extensive attention in subsequent sections.

Kelly (1989:97) has emphasised the importance of learners' needs, interests and growth, as concepts that are central to learner-centred education and the curriculum, as well as the concept of development itself. In this study, the *interests* of learners will be accentuated more for the purposes of content selection and classification. As early as 1971 Wilson (in Kelly 1989:100) has suggested that decisions on the content of the curriculum should be taken with reference to learners' interests. Therefore, use of learners' interests should be made not to achieve our own purposes as adults, but to help them realise their own interests more effectively, as children. This will enable them to organise their experiences in such a way as to extend and deepen those interests and gain a clearer view of their intrinsic value. (This will find expression during a delineation of a model for curriculum development in biology.)

### **3.4 THE NEED FOR A CONCEPTUAL SHIFT: TOWARDS A LEARNER-CENTRED MODEL OF CURRICULUM DEVELOPMENT IN BIOLOGY**

Dramatic changes in society have started to take place during the past three to four decades. Most of these changes are characterised by movements away from the industrial base to an information base; from single to multiple options; from hierarchies to networks; from institutional to self-help, et cetera (Spector 1993:9). However, it is important to indicate that in South Africa, such changes started with the dawn of democracy in 1994. That the 21st century needs workers who can quickly adapt and even anticipate repeated changes in their various spheres of life cannot be underestimated. Spector (1993:12) describes of the 21st century, the century in which many of today's learners will spend most of their life, as a super symbolic society. Consequently, the need to transform has become inevitable.

Several of these challenges and changes relate to the curriculum. In essence, many problems in South Africa's education are related to the curriculum. Quite a number of strategies that were employed in the past to address educational and, particularly

curriculum issues, have not been able to yield sustainable results in fostering change today. Of course, as we start the new century, we certainly need to consider retrospectively how things used to be done and the problems thus experienced in order to be better prepared for the new and inevitable challenges ahead of us. This means that our theoretical reflection on the topic of the curriculum should be done not only with the view to gain understanding, but also to improve it (Carl 1995:24). We need to revisit our verdict in order to confirm if we still really need to continue the same way in future as we did in the past or not. Must future curriculum conceptualising still be influenced by the technocratic approaches or not?

When one ponders the literature in trying to answer the question posed in the paragraph above, it becomes evident that a need for a complete conceptual shift from the past and present practices is unavoidable. In this regard Goodson (1990:299) recommended moving firmly and sharply away from, amongst others, decontextualised and disembodied modes of analysis; consistent adherence to technical, rational and what he called '*scientific management games*' - the 'objectives' game. We must move away from the simplistic view of the curriculum as prescription. This is because curriculum, as prescription, is based on the assumptions that we can dispassionately define the main ingredients of the course of study and then proceed to teach it (Goodson 1990:299). For this study, the curriculum should be viewed as a psychological construction at various levels.

According to Toffler (Spector 1993:11), the way people organise knowledge influences the way they organise themselves. If the organisation of knowledge is changing, the human organisations that transmit it must also change. Therefore, in future, learners should be seen as individuals who can think, with an ability to rearrange, add to or delete information from their personal conceptual frameworks. However, for learners to develop self-understanding and self-realisation, the curriculum needs to be built on a constructivist approach to learning. This will create opportunities for learners to make choices of whatever will concern them even at a

later stage in their lives. Thus positive attitudes towards subjects, including biology may develop.

### **3.4.1 Paradigm shifts and curriculum development**

The phrase "paradigm shift" is the most popular expression in South Africa's educational terminology today. This refers to a move from one way of looking at things to another, a move towards a new mindset, a new attitude towards things and a new way of thinking, a change to a new game with a new set of rules. The scenario in South African education has been that of a traditional curriculum, which is time constrained and driven by the calendar. It has been a paradigm of a structured and inflexible curriculum underpinned by poor quality educational materials. It is such a curriculum in which the vision developed is neither for social nor personal development. However, these shifts are very important because they drive significant changes.

In their discussion of the re-conceptualisation of the curriculum process, Hunkins and Hammill (1994) identified modernism and postmodernism as paradigms that had influenced our education systems for a long time. Each time period has been associated with specific individuals as proponents of such conceptions as well as the curriculum approach adopted that had a significant influence on the content of the various subjects, including biology. Söhnge and Arjun (1996:88) have associated the modern period with the present, whereas the postmodern period is linked to the future. Therefore, as we enter the 21<sup>st</sup> century, there is a need to shift from the modern technocratic to the future non-technocratic era where personal development will be more emphasised.

The postmodern period is influenced by the following criteria, according to Doll, Lewin, Waldrop and Goodman (in Cornbleth 1990):

- a holistic approach to conceptualising the curriculum and its creation
- flexible curricula approaches
- participation of all role players
- interesting and enriching content

Doll has presented these criteria as richness, recursion, relations and rigour (Hunkins & Hammill 1994:15).

Langgulung (1993:24) has emphasised a need for continuous reform of education systems as a step towards uplifting the quality of education. Such reform should also enable educators and curriculum planners to create plans to overcome their present weaknesses as well as to fulfil the needs of the nations, present and future. The same should be done with the individual school subjects in order to ensure their continued relevance. Ornstein and Hunkins (1993:11) have asked a number of good quality questions in trying to define the field of the curriculum. One such question, and the most relevant question for this study, asks: "To what extent is the subject a matter of student choice, professional choice and parent choice"? However, the researcher instead, prefers to phrase it differently as follows: "To what extent is subject matter (in biology) a matter of the learner's choice"? This is because the former question appears typical of a situation where learners are mere members of communities who simply go to school to be told what is appropriate for them while they are passive recipients of predetermined subject packages without any say in their content.

Cornbleth (1990:199) has condemned a tendency by curriculum developers and designers to focus their attention on curriculum documents during curriculum development. She argued that this is in effect to adopt a key element of a technocratic position. According to her, this position is counter-productive and contradictory. It is counter productive in so far as it helps to sustain technocratic approaches to the curriculum and curriculum thought which have relatively little

impact on curriculum knowledge. Our struggle to make sense of the biology curriculum stems from this position.

Grundy (in Bowen 1994:460) also indicated that in a curriculum that is informed by technical interests, the implementation of the plan is separated from its development even if the planner and implementer may be the same person. This is contrary to the approach followed with the practical curriculum where the development and implementation of a plan are linked and they are therefore, viewed as an emerging curriculum. In the emancipatory curriculum, the learning group (educator-learner and learner-educator) is responsible for the formulation and implementation of the curriculum plan that is aimed at empowerment. However, it is important to indicate that in order for the curriculum field to become vital and significant, it must nurture each moment and its internal dialectic; it must strive for synthesis and for a series of perspectives that are empirical, interpretative, critical and emancipatory (Pinar 1978).

Advocates of the humanist approach have indicated that the present school system has failed miserably by humanist standards. This is because both the educators and the schools have shown consistent determination to stress cognitive (and not affective such as attitudinal) behaviour and to control learners for the good of the adults (Ornstein 1982:408; Ornstein & Hunkins 1993). This can be linked to the current disenchantment of learners by many things that they do and are confronted with at school. However, it is felt that involving learners in curriculum development will enhance the development of positive attitudes towards those curricula, for example biology.

### **3.4.2 A paradigmatic context of the biology curriculum**

Biology is a science subject – one of the other three (agricultural science, physical science and engineering) in the Learning Area, Physical- and Natural Sciences. The

biology curriculum in South Africa has always been associated with the scientific stream only in so far as every learner leaving secondary school should have studied it. However, the scientific status of this subject was tarnished when everybody (except those that opted for the commercial stream) had to take it irrespective of aptitude and interest. Although biology is a science subject, its structure and approach differ considerably from that of physical science so that teaching it remains a matter of having the correct textbook for the examiner (Manganye 1994:12; Pell 1987:15).

However, the provision of the biology curriculum in South Africa is made in such a way that it offers differentiation. Apart from horizontal differentiation, where learners have a choice to make among the different subjects, opportunity is also given for vertical differentiation within individual subjects. Vertical differentiation is made within each subject and is currently effected by offering certain subjects on three levels of difficulty (Lower Grade, Standard Grade and Higher Grade) in grades 11 and 12. Biology is one of these subjects. This arrangement into grade levels is mainly for the purposes of learner progression from one class to the next and for admission into tertiary institutions. Thus it is the examinations that dictate the format of the approach to the subject. This is also influenced by the entrance requirements at tertiary institutions.

However, there are clear indications (particularly in biology) that the choice of grade level results in injustices regarding vertical differentiation. According to several researchers (Slabbert 1990:67; Charoux 1993:50; Manganye 1994:12) practical considerations lead to different groups of learners (those who take a subject on the higher or standard grade, respectively) to be grouped together in one class. In this way it already means that learners are subjected to didactic differentiation that is effected only by means of examinations. It is on the basis of this that Higher Grade and Standard Grade syllabi share considerable content in common. Differentiating in accordance with its difficulty becomes a serious problem for educators. This does

not seem to have any impact on the development of biology curricula. The educators and learners in high schools are therefore compelled to teach and learn in ways that will enable the learners to obtain grades acceptable to these institutions.

Fraser (1992) conducted research into the opinions of subject specialists on curriculum-development principles and the teaching of biology at secondary school level. From this study, five main approaches or philosophies to curriculum development in biology education were revealed. They are:

- The teaching of biology as a *body of knowledge* (content-laden) with emphasis on rote learning and recall of content.
- The *popularisation of the subject curricula* by addressing popular themes *relevant* and *familiar* to learners.
- *Shortening of the subject curricula* and development of the science processes within the learner.
- Emphasis on *environmental education* and the incorporation of relevant topics in biology curricula.
- Differentiation between a popular school biology course and an academic-oriented option (Fraser 1992:57).

Comments by the respondents as to the significance of each approach to biology curriculum development have been systematically presented. However, a cautious reading through them reveals important information regarding the reasons in support or against each approach. This has had important implications for the present structure and content of biology that we have today. For example, of the five identified approaches the first one (*the content-laden curriculum*) has been implemented in South African biology education up till now through the recommendations of the curriculum specialists. This is typical of the technical approach to curricula development where the power resides with a person outside

the classroom defining the goal of learning (Bowen 1994:457). Neither the educator nor the learner is involved.

Relevance of the subject according to the second approach (popularisation of biology curricula), has resulted in a number of reactions. However, an understanding of biological facts and processes through the study of organisms was regarded as fundamentally important above mere addition of themes that may not necessarily lead to long-term survival of humans (Fraser 1992:58). With regard to the differentiation of biology into a popular school subject and an academic oriented option (fifth approach) the feeling of the respondents was positive although some envisaged a few problems. However, despite this input, there is enough evidence that the biology that is being taught in our schools is 'pure' or 'academic'.

Schreuder (1991:25) expressed doubt whether the academic approach will ever lead to the realisation of those syllabus objectives which can be described as effective or successful in equipping the learner with skills and knowledge necessary to address issues that are related to his/her bio-social environment. The fact that content in this regard was selected outside the school and in the absence of the people who should have been involved (for example, educators and learners) leads to the possibility of a mismatch between the biology content that is taught and that which is needed.

The aforementioned thinking has not only influenced the choice and selection of content, but also the way that content was taught and presented in textbooks by textbook writers. The prescription of a 60% lower order and 40% higher order abilities in grade 12 biology Higher Grade, and 75% lower order and 25 higher order abilities in Standard Grade examinations is a clear indication of the influence of the first approach, according to Fraser (1992). Also, inability by learners and sometimes also their educators to deal with biology within a process-based approach bears

witness to the long-held view in biology that teaching should encourage rote learning and the recall of facts.

However, for the past decade biology examinations have shown a paradigm shift away from loading the syllabus with content, rote learning and the recall of facts towards shortening the syllabus and engaging in science processes to address the *how*, more than the *what* types of questions. These examinations have also reflected the scientific approaches to the teaching and learning of biology. This endeavour has, in most cases, left those educators who were not science students themselves perplexed and frustrated. This may have been influential in causing the high failure rate in biology that is witnessed every year (Manganye 1994).

Therefore, one can safely conclude that biology education in the South African secondary school system, according to the first approach mentioned by Fraser (1992), is still rooted in the pre-modern paradigm. The struggle by both educators and learners to cope with the subject's scientific nature is a clear indication that teaching and learning in schools only satisfy a single requirement – to pass the examinations. However, the curriculum making process, according to postmodern thinkers should be regarded as an uncertain system. Therefore, curriculum designers should assume what Bornman (1997:112) called openness to process, an eye for the unexpected, and a willingness to let individuals interact with the systems as they evolve. The *ends* should no longer be perceived as ends but as evolving *beginnings*. Moreover, curriculum designers should view things as ever changing: our understanding about the nature of individuals, the educators' views, course materials, society and the environment in which education takes place. This thinking does not only have an influence on education and the curriculum specialists, but also on biology as a science subject.

Furthermore, the tendency of over-reliance on examinations has hampered meaningful curricula development in South Africa. This has resulted in mere syllabus

revisions where, arbitrarily chosen topics or themes were either removed or added to the existing syllabi for no clear cause, for example, a discard from the grade 12 biology syllabus of a topic on genetics. Knowledge on reproduction will also not be examined in grade 12 biology. On the other hand, the grade 11 biology curriculum seems to concentrate heavily on taxonomic bias. Consequently, the content is dominated by more emphasis on, for example, pteridophytes, bryophytes, spermatophytes, amoeba, hydra, locusts, et cetera. Everything appears more academic and traditional. However, some of this content may not be relevant to learners.

It is in the light of the above facts that advancing beyond the technocratic approach to a non-technocratic approach is needed. It is assumed that such a move may offer many advantages for curriculum development. Some of the advantages would include helping learners to realise their responsibilities and improve their attitudes through the act of being allowed to exercise a choice in this regard.

In addition to factors that have been discussed so far, the following two factors (ideology and the country's stage of development) also deserve mention as they have been influencing curriculum development in South Africa in a number of substantial ways for decades. The biology curriculum is no exception.

#### **3.4.2.1 *Ideology and curriculum development***

The very strong influence of ideology in the South African education system has been substantial. Concern among people and groups makes curriculum design and development a political activity where competition for authority and control occurs over a variety of matters, such as educational standards and values (Bornman 1997:114). The strong political and rigid management inclinations such as the use of examinations as means to develop the curricula as well as emphasis on the scientific approaches are examples of the influence of ideology. These have been

at the expense of the use of softer, humanist approaches that are friendly also to learners. Yet, the curriculum should be concerned with programmes for learners. Söhnge and Arjun (1996:90) indicated that too much emphasis on the scientific approach hinders the paradigm shift that is necessary for any real change.

This has generally been the situation in South Africa for decades. Up to now, education seems to have been regulated by prescriptions from the top. The definition of the curriculum as a document dictates the terms of thinking in this regard. As Hockey (1995:78) indicated, the curriculum is politically and ideologically laden and, therefore, usually designed to serve the dominant political structures. Shaul (in Jansen 1990:196) supports this view although he argues that for political reasons, no education or curriculum is ever neutral. In this way education may be used to influence learners to maintain the status quo. This sort of curriculum is often executed through power-coercive strategies (Sibiya 1990). Within the power-coercive environments, where primary attention is given to the curricula that emphasise content and teaching methods (subject- and process-centred designs) child development gets secondary attention. This is despite the long held view that if the young are to be enabled to participate actively in the various roles of adult life, they are required to engage in activities that prepare them for these roles (Kirk 1986:48).

The cultural transmission approach to teaching and knowledge construction dominates science education even today. Its focus is mainly on cognitive development (Ornstein 1982:406), with culture and society as driving forces. This has always neglected the role of the children's experiences in constructing their own knowledge (Pope & Gilbert 1983:193). The teaching methods of this approach are such that they emphasise the role of the learner only as a passive receiver of knowledge rather than as an active participant. At the same time, the aspirations of the ruling order are emphasised in designing education. This may be another possible cause for learners to develop negative attitudes towards their subjects. For

example, Shapiro (in Fensham 1988:96) has highlighted the following two assumptions held by educators about learning in the classrooms when she said:

- "Most educators have ideas about how their pupils learn best and they strive this thinking into the instruction that they offer."
- "Many educational programmes are based on the ideas which curriculum writers hold about the nature of students and how they learn, so that they tend to believe that their way of viewing school learning is the approach for learners to learn."

In South Africa, the conception that a child is a weak and helpless individual who always needs to be taught and guided by adults was achieved through the cultural transmission approach of the Christian National Education policy (Jansen 1990:196). According to this policy, formative education was seen as a vehicle for moulding the conscience of the child in relation to the South African hierarchy of values. Consequently, the main aim of education became that at the end all children should acknowledge the authority of God and be moulded as such for future citizenship of the country. This picture clearly shows the place and position of the child in the educational map. In this way the child was regarded as an object to be manipulated.

This is why the aims of education are often mismatched with what learners can really appreciate and understand. Most of these aims are largely based on society and its politics rather than on the needs and interests of learners as consumers of such education. Driver and Bell (1986:454) maintained that the content and purposes of the science curriculum should be considered according to their relevance for learners outside the classroom. In this way learners' attitudes towards their subjects would be influenced positively for they are free from educator domination, the demands of subject matter and adult-imposed curriculum goals. According to Kirk (1986:42), the key to curriculum problems lies in creating maximum scope for learners' choices, and thus allowing them to cultivate positive attitudes through

intensive study of activities they find interesting. In this way, the whole aim of education would be to enable learners to pursue with deeper sophistication, insight and understanding, the activities that they value.

Ponte et al (1994:347) indicated that the study of the roles, views and attitudes of learners are a neglected aspect of the change process in education. This is so because much attention has been exclusively based on the process-product approach to curricula development. As Doyle (in Brophy 1988:519) puts it, much of the research conducted has focused more on educators than on learners and they have not paid much attention to the specific activities in which these learners become engaged in schools. Moreover, they have not paid any attention to how learners perceive and respond to these activities. Thus learners were considered as objects of educator activity and dominance. According to Fullan (in Mac an Ghail 1992:223) and Jansen (1988:523), the management and the educator's bureaucratic over-concern with the technical and administrative aspects of the curricular initiatives resulted in their collective failure to acknowledge the centrality of meaning to educational change. Consequently, they have also failed to acknowledge the need to build shared meanings of innovation among and between themselves and learners. Hence, the question: "What do the learners say about what they learn in most subjects at schools, including biology?" remains unresolved in South Africa.

The exclusion of learners from curriculum decision matters completely rejects consideration of their personal needs and interests. However, reasons to the contrary are many and varied. Some educators believe that the inclusion of learners would present instructional dilemmas to the educator, thereby failing the mission of schools to cultivate the mind (Jansen 1988:405). The other reason might be the stereotyped and rigid overemphasis on examinations, coupled with the teaching of content purely for this purpose. These have denied learners opportunities to participate actively in their own learning. Therefore, the importance of appreciation, understanding and usually a possible application of facts by learners have been

sacrificed. This is because of over-emphasis on rote learning and recall for examination purposes. However, examinations used as main criteria for university or college entrance are themselves, often full of inadequacies.

#### **3.4.2.2      *The stage of development in South Africa***

South Africa has not yet reached the post-industrial phase. As a result of this, South Africa is not characterised by mass consumption and the magnitude of the information revolution as experienced in other more developed countries such as the USA and Great Britain (Söhnge & Arjun 1996:90). This may be attributed to the high level of illiteracy in the country. Therefore, for the next few years, South Africa will still rely heavily on the dictates of the traditional approaches to curricula development. Many people and programmes will still be forced to put more emphasis and importance on knowledge acquisition packaged within the various disciplines and communicated in ways that will foster mastery of content (*technocratic*).

However, taking South Africa today with its envisaged learner-centred education system and the constitutional rights of every citizen (children included) into account, it will be nothing less than futile to continue to base our future curriculum decision-making on the technocratic principles and theory. Therefore, there is a serious need for approaches to the curriculum and curriculum development that are suitable for conditions of constant change and unpredictability (Hunkins and Hammill 1994:12). For this to happen, the humanist approach to curriculum design and development could be a wise option, with special reference to biology education. This is because the content selected on the basis of this approach addresses significant values and norms for learners. Consequently, learners may develop positive attitudes towards biology.

The introduction of an outcomes-based curriculum (OBE) in South Africa has this vision because it strives to cater for the dual and simultaneous purposes of

increased cognitive and affective development (McNeil 1996:3). The rationale behind OBE is the integration of the affective domain (which includes attitudes) with the cognitive domain. Advocates of this approach believe that the goal of the curriculum is to provide alternatives to choose from and to take responsibility to appreciate the choices available (McNeil 1996:14). Therefore, learners should be challenged to take responsibility for and to appreciate their choices and to feel comfortable by being guaranteed power to make such choices (Ornstein & Hunkins 1993:254). However, whether this will take shape as envisaged remains to be seen.

### **3.5 THE LEARNER-CENTRED DESIGN AND CURRICULUM DEVELOPMENT IN BIOLOGY EDUCATION**

Today the concerns of learners in any curriculum change process are being widely recognised as a significant variable for successful change (Deer & Thompson 1990:27). Recent curriculum innovation programmes emphasise the need to provide more active learning, with learners taking greater pedagogical responsibility in their preparation for active and creative citizenship in life (Ranson in Mac an Ghail 1992:222). Nevertheless, although some effort to deal with this problem was considered regarding curriculum development to address this situation in South Africa, very little has been achieved. This appears to have been the result of a lack of a sound curriculum model and mismatched educational goals. Furthermore, the existing literature in this regard focuses only on the role of learners in day-to-day classroom interactions rather than as active participants in curriculum change.

According to Flaude, Hammer and Mc an Ghail (in Mac an Ghail 1992:221-222) there are often discussions of local authority, management and educator responses to curriculum change. Because of this, learners appear as extras in the narrative of curriculum reform acted out each day within the schools (Rudduck 1983:32). The aspects such as how learners learn and their attitudes towards the learning event as a whole seem to play no role in the development of curricula.

It has been reiterated that by considering the interests of learners, educators can plan more vital educational programmes. Boomer (1982:viii) indicated that a mere understanding of what it is that human beings do when they learn, could possibly help in bringing about the principles of learning. These principles could in turn be transformed into teaching principles that will further be of significant value during curricula development.

Therefore, if the overriding outcome of education is the development of autonomy (i.e. the cultivation of those capacities for independent decision-making), then all the practices that will strengthen learners' dispositions should be encouraged (Kirk 1986:42). Schofield, as quoted by Newton (1975:368) twenty-five years ago said: "We need to look much more closely than perhaps, before or in the past, at the students' perception of the Science that we teach". Thus if the curriculum refers to life that affects the child, then, it must offer this child programmes that will be compatible with his/her aims. Therefore learners should also be allowed to choose their own curricular objectives, to pursue whichever curricular activities they wish to engage in and to assume full responsibility for their own learning. These may improve their attitudes towards subjects, such as biology.

Boomer (1982:4) speaks of a negotiated curriculum rather than one that is imposed upon learners by the educators. In this way learners are encouraged to participate, appreciate and, indeed, develop self-confidence - and therefore, positive attitudes towards their subjects. This is in contrast to the traditional practices where the relationship between educators and the learners, curriculum experts and learners, curriculum experts and educators, et cetera (Ben Peretz & Silberstein 1982) is an authoritarian and exploitative one. Because of this, learners are required to study the traditions that reflect the educators' (experts) value systems and to pursue arbitrarily selected objectives that do not command their consent. Thus, it is felt that such education, far from liberating learners, prolongs their domination by and dependence on adults. According to Kirk (1986:43), this further enslaves them to the orthodox

modes of thinking and action that may be strange to them. Consequently, the emergence of a truly autonomous person is frustrated and this may result in learners developing negative attitudes towards learning, and towards biology as a subject.

The implication of this is that as active participants in their learning, some features of the environment attract learners' attention and lead to a meaningful reaction towards them. Consequently, the experiences that appear to have more relevance and value for them are appraised more than others. This is often irrespective of the person who was responsible for their selection. Thus, knowledge becomes a product of the transactions between a person and the environment. The emphasis here is placed upon a person reaching out to make sense of the events by engaging in the construction and interpretation of personal experiences.

However, this does not necessarily mean that learners must be as autonomous and free as to be lax. Instead, the argument here is that, unlike in the past, and for any future curriculum development effort, learners should be consulted so that they too, become part of the force that tries to plan and prepare learning material (Boomer 1982:5). Shapiro (in Fensham 1988:114) also indicated (in support of the above statement) that a recognition of learners' ideas, views and interests will enable educators and curriculum makers to be aware of making explicit, building upon and enhancing the already developing directions of learners interests. This will also encourage learners to reflect on their own learning processes. Consequently, their attitudes towards their subjects, e.g. biology will improve because they will have been involved in the selection of its content.

Furthermore, absence of a learner perspective from the official curriculum decision-making process in secondary schools constitutes a major limitation in the implementation of innovations (Mac an Ghail 1992:229). This is because effective science teaching relies on the educator having some understanding of the learners' viewpoints. Therefore, educators and curriculum developers need to be aware of

current perspectives of learners in education (Pope & Gilbert 1983:193). They should exercise their powers and responsibilities in ways that will empower learners so that they too, should exercise their own powers and responsibilities (Boomer 1982:3). This will further enable them to take an even more active role in, and responsibility for their own learning (Slabbert 1990), resulting in their developing positive attitudes that are based on positive experiences.

However, Zylberstajn and Viennot (in Pope & Gilbert 1983:193) have expressed a concern that educators often pay little or no attention to learners' personal experiences in curriculum organisation. Jackson (1983:47) also warned that until the educators take the needs of their learners into consideration at school level, the latter are unlikely to be motivated. Hence, they may develop negative attitudes towards subjects such as biology.

### **3.6 CURRICULUM DEVELOPMENT IN BIOLOGY EDUCATION: THE HUMANIST APPROACH**

The humanist approach to the curriculum and curriculum development stems from the human potential movement in psychology (Ornstein 1982:407). Kelly (1989:93) has called this the developmental planning approach that is based on human development and potentiality. According to this approach, the individual is seen as an active being with legitimate control over his or her destiny and education as a process by which the degree of such control can be maximised. As the term indicates, this approach focuses more on personal and social aspects of the curriculum.

The humanist curriculum is rooted in and stimulated by the learner-centred movement of the early 1900's and the progressive child psychology of 1930 to 1950. Its basic premise according to Kelly (1989:94), is the child's growing ability to act autonomously so that the promotion of autonomy becomes a major principle of the

child's educational practice. It is characterised by its emphasis on self-concept and motivation where the former is the most important determinant of behaviour. Affective development is more accentuated than cognitive development (Ornstein 1982:407). Educators assume more of a facilitator's role, allowing learners opportunities to reflect on that which they will be involved with in their lives. In this way, the development of positive attitudes in these learners may be enhanced.

According to Ornstein and Hunkins (1993:7), leaders in the humanist approach contend that by attempting to be scientific and rational, curriculum developers miss the personal and social aspects of the curriculum and instruction. These rational developers rarely consider the need for self-reflectiveness and self-actualisation among learners. This results in overlooking the social and psychological dynamics of the classrooms and the schools.

However, like any other approach, the humanist approach is not free from criticism. The initial criticism of and a move away from the humanist curriculum have been levelled against the situation it created in education. Its opponents indicated that by emphasising the humanistic principles in curriculum development and education it allowed for a too extensive learners' choice. According to Ornstein (1982:408), the humanist's lack of attention to cognitive learning and intellectual development has led to its subjective position with regard to teaching and assessment although empirical evidence is lacking. Declining achievement scores in mathematics, science and the higher order intellectual skills have been reported as a result of the humanist approach (McNeil 1996:3). Yet, it is important that any content that is selected for the curriculum should be verified with learners in order to determine the extent to which it accords with their aspirations and interests. This is in line with this research and it is taken with special reference to biology as a school subject for the 21<sup>st</sup> century.

There is the possibility that South Africa will still have to face the intellectual challenges of the times in order to uplift the academic standards of her citizens in the areas of the various disciplines. This is the result of high illiteracy levels in the country. The affective development of learners (which includes their attitudes) at school will remain crucial in order for meaningful education to take place. The humanist approach to curriculum development offers opportunities for learners to develop positive attitudes and, thus, emancipate and self-actualise. These are very important outcomes of an effective education system that is aimed at development and growth (Kelly 1989:97).

The achievement of emancipation and self-actualisation will enable learners to understand themselves. It will also help them discover the persons they are in terms of emotional, physical and intellectual development. The opposite may be true with the behaviourist approach in which learners are shaped into a form that has been designated in advance (McNeil 1996:4). In a behaviorist approach, curriculum design takes place by outside experts in such a way that learners do not participate. Thus, learners are reduced to objects to be manipulated by adults and society for their own ends.

### **3.6.1 Characteristics of the humanist curriculum**

#### **3.6.1.1 *Purpose of the humanist curriculum***

According to the humanist approach, the major function of the curriculum is to provide learners with intrinsically rewarding experiences that should contribute to their personal liberation and development based on growth, integrity and autonomy (McNeil 1996:6). Self-actualisation is at the heart of the humanist curriculum. Learners are permitted to express, act out, to experiment and to even make choices. According to this curriculum, a person with a balanced personality is one who is able to do good things while also exemplifying a commendable character. The humanists

also believe that each learner has a "self" that is not necessarily conscious but which must be uncovered, built up and taught.

The humanist curriculum is closely associated with the *Third Force Psychology* (Ornstein & Hunkins 1993:254; McNeil 1996:7), which came about as a reaction against behaviourism in which the learner was regarded as a detached intellect, whose affective responses and higher-order personality aspects were completely ignored. As a result of this, the humanist curriculum emphasised human action more than a mere response to a stimulus. Meaning is cherished more than the methods. Thus, the focus of attention is more on the subjective than on the objective nature of human existence. This approach acknowledges the existence of a relationship between learning and feeling (Ornstein & Hunkins 1993:3).

In 1969, Paul Hirst (1969:142) emphasised the importance of the psychological influence on curriculum development when he said:

*...anyone who, today advocates curriculum changes on purely philosophical grounds without considering the psychological and sociological factors that are relevant, is simply irresponsible.*

For sound and rational curriculum planning, empirical evidence on how the children learn is indispensable.

In 1978 Joseph Schwab (1978:9-10) also said:

*A curriculum based on theory about individual personality; which thrusts society, its demands and its structure, far into the background or ignores them entirely is incomplete and doctrinaire, for the individuals in question are members of a society and must meet its demands to some minimum degree since their existence and*

*prosperity as individuals depend on the proper functioning of their society.*

In the same way, one may also say that a curriculum grounded only in a view of social need or social change must be equally incomplete and doctrinaire. This is because societies do not exist only for their own sake but also for the prosperity of their members. In this way, learners are not seen as minds or knowers but as bundles of affects, individuals, personalities and earners of a living. They are not only group inter-actors, but also possessors of private lives.

### **3.6.1.2      *Role of the educator***

In each and every type of curriculum the role of each player should be ascertained. McNeil (1996:9-10) has outlined three essentials for an educator within a humanist curriculum as follows:

- listen comprehensively to the learner's view of reality
- respect the learner
- be authentic and natural without putting on appearances

All these contribute significantly to learners' feelings of intimacy and recognition that may result in them developing positive attitudes towards learning.

Carl Rogers (in Ornstein & Hunkins 1993:253) indicated that people and, more especially learners, can enhance their self-directed learning by drawing on their own resources to improve self-understanding, learn concepts and develop attitudes. This should also enable them to guide their own behaviour. Here the educator's task is to set the educational environment and provide such activities that these personal resources are tapped.

In support of the above, McNeil (1996:11) said:

*Whether providing instruction in computer programming or chemistry, the humanist teacher creates opportunities for the learners to deal with their affective concerns - i.e., beliefs, values and vocational training or basic skills.*

In this way an educator is a facilitator whose involvement with learners is based on co-operation and negotiation.

### **3.6.1.3 Organisation**

The humanist curriculum stresses the importance of *coherence* of subject matter in terms of unity of ideas, feelings and behaviour (McNeil 1996:11). This approach strives to resolve the weaknesses of the traditional curriculum in which the logical organisation of the subject matter, as defined by the experts, fails to connect with learners' psychological organisation. Therefore, relevant integration of the subject matter in the light of learners' basic needs and lives is very important and should be regarded as the only approach to content organisation. This makes it easy to learn content where topics have been properly related and put together in an integrated fashion.

For the humanist, *sequencing* is another aspect that is very important in curriculum development. It suggests that the curriculum should include a progressive development of understanding and that each successive experience builds on the one that precedes it (Ornstein & Hunkins 1993:117).

#### **3.6.1.4 Evaluation**

The humanist curriculum emphasises *process* rather than *product*. Therefore, assessment is subjective. The objectives-approach should therefore be applied particularly to determine whether the programme has achieved anything. According to Carl Rogers (in McNeil 1996:13), learners learn more, attend school more often and they are more creative and capable of problem-solving when humanist principles are employed.

### **3.7 THE CURRICULUM DECISION-MAKING PROCESS**

The decision about what should be taught in the classroom is a decision about curriculum purposes (McNeil 1996:111). This involves all participants who are considered to be working towards a common goal of ensuring greater success in improving teaching process and learning outcomes (Bayona 1995a:23). As early as 1973 Eisner indicated that all curriculum development activities, whether they occur in schools or outside of them, are influenced by decisions that range from broad types of educational policy to the decisions about specific aspects of a particular programme (p.13). The decisions can either be long term or short-term.

#### **3.7.1 Levels of curriculum decision-making**

Curriculum decision-making occurs at various points that may include the cabinet, ministry of education and the school. In each case essential activities and processes involve:

- gathering basic information
- deciding on aims and objectives
- planning a strategy for change
- the process of curriculum development

- implementation in schools
- evaluation

However, participation in curriculum development varies from one country to another. In some countries, curriculum decision-makers are formally separated on matters that relate to policy and priorities on the one hand and design, implementation and evaluation on the other hand (Bayona 1995a:26). In South Africa, policy decisions on education and the curriculum have traditionally formed part of a broad political process that was executed by parliament (Sibiya 1990). This was often related to the government's pursuit to rationalise education and to exert its ideological influence. Participation in curriculum decision-making has always been the domain of specialists - the so-called "experts". As a result of this, curriculum development occurred outside the public domain, as an in-house and largely non-participative activity. Lack of educator-participation has the following weaknesses:

- The system of education is top-down.
- There is the possibility of continued use of education by government as a weapon for political gains.

That educators are not included in curriculum development in South Africa is fully supported by Söhnge and Arjun (1996:90) when they indicated how South Africa is still positioned regarding change and paradigmatic shifts. Learner participation is even beyond recognition at this stage!

However, in recent years there have been moves to democratise curriculum construction in other countries by involving all those with an interest in curriculum development (Van Niekerk 1996; Bayona 1995(a); Bayona, Carter & Punch 1990; Bayona & Punch 1990). With the introduction of OBE in South Africa, democratisation is also considered. This is partly so because of the commitment of

the government to a full participatory process in curriculum development (OBE March 1997). As Basson and Walker (1984:174) indicated, curriculum development should be a people-centred activity that involves deliberation and negotiation. This is an important approach to explore the underlying curriculum issues in a way that will lead to practical action.

Bayona et al (1990) has emphasised the need for curriculum decision-making to be based on broad participation. Participation should represent all the relevant features of society and culture, the learner and the learning process, as well as the content in the various disciplines. Thus, it should develop around the identified levels of curriculum decision-making and should as a result, engage the various groups. The confluent curriculum (of which OBE is an example), stresses participation. It emphasises power sharing, negotiation and a joint responsibility of all participants (Ornstein & Hunkins 1993:254).

However, it is important to indicate that participation in curriculum development in OBE circles is mainly for the selection of outcomes. This may be limiting, as many people are likely to be left out, especially illiterates and probably learners. Therefore, it is apparent that OBE is all about preparing learners for their lives after school, so that starting from that perspective leaves learners without much to contribute to their development towards the stated outcomes.

However, since the present study is based on an experiential approach to curriculum development, learner participation is more appropriate and central. This is because of what will be required of them during the selection of outcomes.

Designing and developing curricula occurs at various levels of planning. Bornman (1997:113), identified the *classroom level, school level, regional level, national level and an international level*. Carl (1995:82) classified these levels as *micro, meso and macro levels*. McNeil (1996:112) identified *the societal, institutional, instructional and*

*the personal or experiential* as the levels at which curriculum planning, including decisions about what to teach and for what purpose, occurs. The personal or experiential level is consistent with the view that learners are not passive recipients of curriculum ends and means, but they are capable of generating their own purposes and meaning from their classroom experiences. This study is grounded on the same view. However, the planning and design of curricula have essentially occurred at levels that have been quite remote from the intended learners – the experiential level.

In the past South Africa has been plagued with the tendency of absolute reliance on the visions and inputs from the curriculum development organisations, outside of the real school situation. The decisions came down to the people as confessed truths. The subject packages and their contents were pre-selected and structured in a way that the educator simply had to implement or transmit to learners who, in turn, had to memorise and regurgitate without question. Difficulty to impart would be rectified by revising and omitting difficult sections while the success of the implementation would be monitored through the use of the examinations.

Consequently, curriculum decision-making has been completely power-coercive - a tendency that will never do any justice to democracy. This has therefore resulted in many problems that we currently experience in education where learners fail to make sense out of what they learn. Poor end-of the year results across the grades, as well as failure by learners to appreciate the curriculum to which they are exposed at school may be direct results of such neglect. Curriculum development still appears to be handled only at the macro level of decision-making.

### 3.7.2 Learner participation in curriculum development

A lot has been said about curriculum development as a participatory process with educators ultimately becoming more involved. However, nothing or very little was said about the involvement of learners in curriculum development.

Keedy and MacIch (1994:120) have said:

*... students have a need for power like any adult. Discipline problems do not occur in classrooms where their needs are satisfied. In such classrooms, the teachers and students engage in a continual examination of how subjects are taught and what topics are worthy of study.*

Therefore, until educators see themselves as managers of a learning enterprise (facilitators) and learners as being responsible for the choice of the topics they should learn, learners are unlikely to increase their efforts to learn. Consequently learners' attitudes may be negative. Educators and learners should collaboratively engage in identifying courses, designing basic essential questions as course frameworks and selecting appropriate activities as course content (Keedy & MacIch 1994).

In a study to identify some of the interpretations learners make about their experiences in a college-level chemistry course for non-science majors, Bowen (1994) found that learners conceptualised knowledge, learning and teaching in a variety of ways. The second result of this study was that learners prefer a learning environment where they have a greater equality of voice with the educator regarding how the class is conceived and maintained. Thus, in order to achieve the curriculum framework that is geared towards emancipation, both participants (learners and

educators) should negotiate an agreed upon curricular reality even if it requires challenging the institutional or professional norms.

Barrow and Cook (1993) conducted research to answer the following questions:

- What was the role of the instructor in the process of developing the curriculum of the restructured Physics course?
- What were the students' perceptions of the classroom learning environment created by the new Physics course and how did that compare to what the students would have preferred?

The findings of this study suggest that learning or personal sense making, instead of grades, becomes learners' primary focus as long as they feel ownership of the curriculum. Thus, learners should play a fundamental role in mediating the curriculum that they must learn. It is hoped that their attitudes may then improve and become more positive.

### **3.8 MODELS OF CURRICULUM DEVELOPMENT**

Models are means of summarising the phenomena that are investigated. They are representations of aspects of a theory that help understanding theory building. Successful education requires thorough and careful planning. Without this, confusion and conflict are likely to characterise the curriculum activity (Ornstein & Hunkins 1993:265). Therefore, those engaged in curriculum development need to formulate this plan on the basis of what development will take place.

However, the effectiveness of these plans can be too difficult to predict as a result of the various ways in which the curriculum and curriculum development are defined. The angle from which the curriculum and curriculum development are approached poses yet another problem.

The literature that deals with curriculum matters reveals a variety of curriculum models. These models arise from the developers' methods of approach to the curriculum and, consequently reflect more accurately the work of individual participants. According to Bornman (1997:108), the approaches to a curriculum determine to a large scale the models appropriate for the process of curriculum development. However, models for curriculum development should reflect more accurately the work of the participants involved. This is because curriculum development is a participative activity, which involves deliberation and negotiation to explore the underlying curriculum issues (Basson & Walker 1984:174; Boomer 1982).

Models of curriculum development are influenced by two basic approaches, the *technical scientific or non-technocratic non-scientific* (Ornstein & Hunkins 1993:266). (These have been extensively discussed in section 3.3.)

In this section, a curriculum development model for biology education will be sketched. However, it is felt that curriculum development in biology and any other subject should be based on a combination of the non-technical-non-scientific (non-technocratic) plan model and the technical-scientific (technocratic). It will offer a balance that may see a move gradually towards a learner-centred curriculum in South Africa. This is so because South Africans still need the knowledge that is contained within the subject disciplines of the technocratic approach.

This view is in harmony with Parlett and Hamilton's illuminative model of curriculum evaluation. that accepts the validity of both the scientific (technocratic) and the humanist (non-technocratic) approaches because education is a complex and dynamic set of interactions (Ornstein & Hunkins 1993:341; Bornman 1997:125). Furthermore, it is important to indicate that biology is a natural science subject that also addresses some humanist and social issues.

Individuals who believe in a subject matter curriculum design advocate the technical-scientific model, whereas those who believe in a learner-centred curriculum design advocate the non-technical, non-scientific model (Bornman 1997:109). Therefore, it is appropriate for any curriculum developer to consider both options. This is because approaches and models overlap, supplement and may be consequences of one another.

In this study only the Curriculum of Affect model by Weintin and Fantini will be discussed in detail in this section. The premise of this model is that education should have a human focus and the objectives should address learners' concerns of both a personal and interpersonal nature (Ornstein & Hunkins 1993:275). To Weinstein and Fantini, the curriculum has a humanitarian purpose, serving as a vehicle for developing learners' self-concepts and mature images of themselves. This has implications for the development of positive attitudes towards biology. The model consists of eight stages, as follows:

### **3.8.1 Determination of the learners**

This stage is concerned with the consideration of learners' demographic and cultural information. Also, at this stage, attention is paid to their psychological and developmental levels. This is done with the ultimate aim of gaining sufficient information on the nature of learners for whom a particular curriculum is being planned. Ultimately positive attitudes towards the curriculum may develop in learners if the curriculum is appropriate for them.

### **3.8.2 Determination of the learners' concerns**

There are three major concerns, namely concern about self-image, disconnectedness, as well as concerns about control over one's life. This is a very important stage during curriculum development because it is through the knowledge

of these concerns that relevant content may be selected and prescribed. These concerns are also important for the development of positive attitudes towards biology.

### **3.8.3 Diagnosis of the reasons for the concerns**

It is only when the reasons underlying these concerns (about self-image, disconnectedness and control over one's life) are delimited, that the educators will be able to plan for the implementation of the curriculum. Not only will this diagnosis lead to implementation but also to the selection of content. This has important implications for biology education. The reasons are psychological and social and they are important for curriculum development and the development of positive attitudes towards the curriculum in learners.

### **3.8.4 Selection of organising ideas**

Particular curriculum content can be generated around certain ideas, concepts, and generalisations that may be identified and selected as unifying themes. However, the organising or unifying ideas are selected on the basis of learner concerns rather than on the demands of the academic subjects. These also have implications for the development of positive attitudes towards the subject, e.g. biology.

### **3.8.5 Selection of content**

Content is selected and organised around the following personal and social themes:

- Content gained from experience
- Content that deals with the affective domain and relates to learner's feelings, attitudes and interests
- Content that the learner has learned from the social context

The second is the most important for biology education. This is because all the content should be negotiated with learners before implementation in order to come up with those that will address the needs and interests of learners. Kruger (in Carl 1995:111) supports this idea when he said that the selection of content should not be haphazardly done as the path of learners is influenced by it. This means that the selected content will need regular evaluation so that essential content that has an appeal for learners is retained while the rest may be omitted. This filtration process depends completely on the interest that this content will have for learners. It is usually considered favourable by learners if it accords with their view that it is worthwhile, relevant and interesting. Thus, positive attitudes in learners may develop.

However, Carl (1995:110-111) emphasises the importance of a distinction that should be made between content *selection* on the one hand and its *classification* on the other. The latter is informed by learners' interests, et cetera and it is the focus of this study. Therefore, content that will have gone through the scrutiny by learners should promote the development of intellectual skills, abilities and most importantly, positive attitudes.

### **3.8.6 Determination of the learning skills based on content**

Once the content is in place, it will be important to determine the necessary skills that will enable learners to deal with it. Various abilities such as reading, doing arithmetic, writing, observation, experimenting and interpreting data are determined at this stage.

### **3.8.7 Determination of the teaching procedure**

The teaching procedures that will accord with learners' learning styles are determined. These must also impact very strongly on their affective dimensions

(which include attitudes) so that during their interactions with their educators and peers, they must be able to develop emotionally and have strengthened feelings of self-worth.

### **3.8.8 Denotation of the intellectual outcomes**

According to Weinstein and Fantini (in Ornstein & Hunkins 1993), this stage focuses on outcomes of the context. This stage may also be called an evaluation stage as usual. This stage is generally important for any curriculum construction although this study focuses on the content, its selection, classification and organisation before it is implemented. However, after implementation, it will be important to check on the extent of the influence of this curriculum on learners in terms of teaching and learning, and the outcomes of these.

It is also important that after evaluation, the model should be able to return the curriculum process to its various stages so that some necessary alterations may be done where possible. In this way the model should become cyclical rather than linear. As opposed to the pre-Tyler model that was used to develop the curricula in South Africa, the cyclic model is hoped to benefit biology education by improving its status and rationale for learners.

## **3.9 SUMMARY**

The fact that democracy is a subjective matter, and that the interaction of individuals based on co-operative principles remains crucial, make both pragmatic and existential philosophies indispensable for curricula development.

In this chapter, an overview of curricula planning, design, development and implementation was presented. Various approaches and philosophies influencing curriculum development were outlined in order to find common ground for the

conceptualisation of the model that is intended for this study. It was also highlighted why both philosophies and approaches should be given serious consideration. This is because emphasising any one of them could result in leaving out other very important information.

It was also indicated that a choice that is based on personal experiences, the scientific and process method is very important in curriculum development for democratic societies. Furthermore, critical thinking, personal choice and individual self-definition are important ingredients for a balanced personality and for the development of positive attitudes towards science and biology.

In the next chapter, a research design to test the hypotheses for the relationships between learners' views on involvement in curriculum development and their attitudes towards specific biology content, will be outlined.

## CHAPTER FOUR

### THE RESEARCH DESIGN

#### 4.1 INTRODUCTION

The purpose of this study is to determine the attitude of learners towards the content of biology curricula in secondary schools and the implications thereof for future curricula development.

The following aspects and ideas were presented in the preceding literature review:

In chapter one

- the concepts *curriculum*, *attitude* and *adolescent* were defined and discussed
- a detailed perspective of the role of learners in curricula development was given.

In chapter two

- the concept *attitude* was further elucidated.
- a concise review of the literature on the development of learners' attitudes towards certain variables related to biology in secondary schools was given.

In chapter three

- the concept of *curriculum development* was further defined and elucidated.
- approaches to curricula development and the levels of participation in it by various stakeholders were discussed.
- various models for curricula development were also presented and discussed.

In this chapter, hypotheses generated from the literature review and the research design that will be followed in the testing of the hypotheses will be outlined.

## **4.2 RESEARCH DESIGN**

### **4.2.1 General problem statement**

The present study aims to determine the relationship between learners' average attitudes towards involvement in curriculum development and specific biology content. These are important issues for future curricula development in a democratic society where learner-centred approaches are emphasised.

Thus, the main research problem for this study is presented as follows:

Is there a significant relationship between learners' views on involvement in curriculum development and their attitudes towards specific biology content?

This problem is further broken down into specific problem statements in 4.2.2 below.

### **4.2.2 Specific problem statements and hypotheses**

The term hypothesis has been extensively defined in the literature. According to Kerlinger (1986:17) a hypothesis is "a conjunctural statement of the relation between two or more variables". Gall, Borg and Gall (1996:960) have related a hypothesis to the researcher's prediction that derives from theory or from speculation, about the relation between two or more variables. Leedy (1989:6) defined a hypothesis as "a logical supposition, a reasonable guess and an indicated conjuncture". Hypotheses are tentative and intelligent guesses that are often posited for the purpose of directing one's thinking towards a solution of the problem. A

hypothesis is a tentative, reasonable and testable explanation of the occurrence of certain behaviours, phenomena or events (Gay 1992:588).

Therefore, as an educated guess or a provisional answer to a problem, a hypothesis is important and indispensable for scientific research. Hypotheses give direction in the course of investigations that may demand or entail a number of possibilities. They enable the scientists and researchers to transcend themselves so that their bias is controlled (Kerlinger 1986:18-19).

Consequently, in order to investigate the problems of this study in a logical way, the following 19 research problems and hypotheses (which derive from the literature study) are stated:

#### **4.2.2.1      *Research problem 1***

Is there a significant difference in average attitudes towards involvement in curriculum development between learners of diverse ages?

**H<sub>01</sub>**      There is no significant difference in average attitudes towards involvement in curriculum development between learners of diverse ages.

**H<sub>1</sub>**      There is a significant difference in average attitudes towards involvement in curriculum development between learners of diverse ages.

#### **4.2.2.2      *Research problem 2***

Is there a significant difference in attitudes towards involvement in curriculum development between girls and boys?

**H<sub>02</sub>** There is no significant difference in average attitudes towards involvement in curriculum development between girls and boys.

**H<sub>2</sub>** There is a significant difference in average attitudes towards involvement in curriculum development between girls and boys.

#### **4.2.2.3      *Research problem 3***

Is there a significant difference in attitudes towards involvement in curriculum development between learners from grades 10, 11 and 12?

**H<sub>03</sub>** There is no significant difference in average attitudes towards involvement in curriculum development between learners from grades 10, 11 and 12.

**H<sub>3</sub>** There is a significant difference in average attitudes towards involvement in curriculum development between learners from grades 10, 11 and 12.

#### **4.2.2.4      *Research problem 4***

Is there a significant difference in attitudes towards involvement in curriculum development between learners from diverse school types?

**H<sub>04</sub>** There is no significant difference in average attitudes towards involvement in curriculum development between learners from diverse school types.

**H<sub>4</sub>** There is a significant difference in average attitudes towards involvement in curriculum development between learners from diverse school types.

**4.2.2.5 Research problems and hypotheses for grade 10 learners****Research problem 5**

Is there a significant correlation between the average attitudes towards involvement in curriculum development and specific biology content for grade 10 learners?

**H<sub>05</sub>** There is no significant correlation between the average attitudes towards involvement in curriculum development and specific biology content for grade 10 learners.

**H<sub>5</sub>** There is a significant correlation between the average attitudes towards involvement in curriculum development and specific biology content for grade 10 learners.

**Research problem 6**

In rank order, what are the grade 10 learners' attitudes towards the diverse content areas?

**Research problem 7**

Is there a significant difference between the average attitudes towards the diverse content areas for grade 10 learners of different ages?

**H<sub>07</sub>** There is no significant difference between the average attitudes towards the diverse content areas for grade 10 learners of different ages.

**H<sub>7</sub>** There is a significant difference between the average attitudes towards the diverse content areas for grade 10 learners of different ages.

**Research problem 8**

Is there a significant difference in average attitudes towards specific biology content between learners in grade 10 of different genders?

**H<sub>08</sub>** There is no significant difference in average attitude towards the diverse content areas between learners in grade 10 of different genders.

**H<sub>8</sub>** There is a significant difference in average attitude towards the diverse content areas between learners in grade 10 of different genders.

**Research problem 9**

Is there a significant difference in average attitudes towards specific biology content for learners in grades 10 from different school types?

**H<sub>09</sub>** There is no significant difference in average attitudes towards specific biology content for learners in grades 10 from different school types.

**H<sub>9</sub>** There is a significant difference in average attitudes towards specific biology content for learners in grades 10 from different school types.

**4.2.2.6 Research problems and hypotheses for grade 11 learners**

Research problems 10 to 14 (and their associated hypotheses) repeat research problems 5 to 9, but focused on grade 11 learners.

#### **4.2.2.7      *Research problems and hypotheses for grade 12 learners***

Research problems 15 to 19 (and their associated hypotheses) repeat research problems 5 to 9, but focused on grade 12 learners.

### **4.3      THE STATISTICAL TECHNIQUES**

The statistical techniques that will be used to analyse the results are:

**correlation**; analysis of variance (**ANOVA**) followed by Bonferroni **t-tests**; **t-tests** and descriptive statistics such as the calculation of **means**.

### **4.4      THE OBJECTIVES OF THE EMPIRICAL INVESTIGATION**

From the preceding paragraphs and from the previous three chapters, it is now possible to state the objectives of this study as follows:

- 4.4.1 to determine whether there are significant differences in average attitudes towards involvement in curriculum development between learners of different ages, gender, grade and school type.
- 4.4.2 to determine whether there are significant relationships between learners' attitudes towards involvement in curriculum development and specific biology content on the basis of age, gender, grade and school type.
- 4.4.3 to determine whether significant differences occur in average attitudes towards specific biology content areas on the basis of age, gender, grade and school type.

To accomplish these objectives, the procedure below will be followed:

- Biographical data that will be correlated include gender and grade.
- The variable “views on learner involvement in the development of biology curricula” will be quantified and measured by items in a questionnaire.
- Questions based on specific biology content areas for grades 10, 11 and 12, will be constructed and learners will indicate their views by responding to each item.
- For the differences in attitudes towards specific biology content between learners who differ with regards to age, grade, gender and school type the formulated hypotheses will be subjected to testing through an analysis of variance: F-tests and t-tests.

## **4.5 PLANNING THE EMPIRICAL RESEARCH**

### **4.5.1 The research group**

Research is concerned with the collection of information about events or phenomena that can be used to arrive at certain conclusions and generalisations. Therefore, it is scientific in that it is a systematic empirical investigation guided by theory and hypotheses about anticipated relationships between variables (Kerlinger 1986:10). However, to get to this stage requires a systematic selection of a group of subjects sharing some common characteristics who will participate in such research. This may only be done with a portion of a larger group. The larger group is called a *population* while a portion thereof is a *sample*.

The research group for the present study shall comprise learners who do biology in grades ten, eleven and twelve in the Northern Province. The learners of this sample will be between twelve and twenty three years of age.

#### **4.5.1.1 Sampling**

A sample is the element of the population considered for actual inclusion in the study (De Vos, Strydom, Fouche, Poggenpoel, Shurink & Schurink 1998:191). It is a small portion of the total set of objects, events or people who together comprise the subjects of one's study. Therefore, this technique of taking any portion of the population or universe as representative of that population is regarded as probability sampling (Kerlinger 1986:110; Gay 1992:592). This means that the sample must have approximately the characteristics of the population that is involved in the research in question (Kerlinger 1986:111). Unless this is addressed, Borg and Gall (1989:179-80) indicate that sampling bias greatly weakens educational research more than any other factor.

Therefore, in order to diminish this weakness and increase the sample's representation of the entire population, many subjects representative of the population must be involved. In this study, a random sampling technique will be used. This technique has the power to reduce bias by increasing the chances of every member of the population to be selected for participation in the study (Kerlinger 1986:110).

However, since learners in grades 10, 11 and 12 will be involved in the study, a *stratified* random sampling technique will be used to select subjects. Stratified random sampling is a technique where identified subgroups in the population are represented in the sample in the same proportion that they exist in the population or in equal proportion (Gay 1992:594). It involves dividing the population into homogeneous groups, where each group contains subjects with similar characteristics.

This will increase the representativeness of the sample and as Leedy (1989:158) has indicated, its logical and statistical defensibility. Therefore, subjects will be

selected randomly from each of grade 10, 11 and 12 learners in schools in the Northern Province. The stratification is envisaged to help add to the validity of the anticipated findings of this study.

#### **4.5.1.2      *The size of the sample***

This study is a survey and therefore, involves a relatively large sample. However, since not all members of a population can be involved if that population is large, a smaller group of that population is selected. Consequently, approximately 650 learners will be selected for this study. They will come from all the schools that run from grade ten to twelve. The schools are spread throughout the Northern Province.

#### **4.5.1.3      *Sampling procedure***

In practice, the subject sample will be constituted as follows:

- A stratified random sample of about 150 learners (including learners from each grade) in private school biology classes.
- A stratified random sample of about 100 learners (including learners from each grade) in ex-model C school biology classes.
- A stratified random sample of about 400 learners (including learners from each grade) in rural school biology classes.

Random sampling will be done for each stratum by numbering each respondent (on a list) and thereafter, allocating numbers to each respondent using the table of random numbers. However, the schools will be purposefully selected (De Vos et al 1998:198).

#### **4.5.2 Permission for and execution of the empirical investigation**

In order to avoid problems of questionnaire administration in schools as discussed by Best and Kahn (1993:240), permission will be asked from the Department of Education in the Northern Province. Conditions for granting such permission will include the following:

- The researcher himself will administer the questionnaires with the aid of Science educators. Permission from and co-operation of school principals, as well as the District and Circuit Managers will be obtained.
- The administration of the questionnaires will not interfere with the various institutions' daily programmes since it should not last for more than one class period.
- All information will be treated confidentially and names of subjects and the institutions involved will not be disclosed in the thesis.
- The information obtained from the questionnaire will be presented in such a way that no injustice will be done to the institutions, learners and students, or educators and lecturers.
- Above all, the results of this study should highlight some important educational information that may in turn, lead to improvement of educational practice in South Africa, with special reference to science (biology) education.

#### **4.5.3 The questionnaire**

The present study is a survey. The word survey is too general and means superficial observation. A survey, as Gay (1992:595) has put it is *"an attempt to collect data*

*from members of a population in order to determine the current status of that population with respect to one or more variables".* In a survey, large and small populations are studied using samples chosen from them to discover the relative incidence, distribution and interrelations of variables (Kerlinger 1986:377).

A survey is descriptive in so far as it is concerned with the gathering of data. This is done either to describe the nature of existing conditions, or to identify standards against which existing conditions can be compared, or to determine the relationships that exist between specific events (Schulze 1998:3). Since the focus is on generalising the findings to the entire population, survey research is quantitative (Gall et al 1996:289).

Therefore, the present study is about the collection and recording of data to determine the relationships that exist between specific variables. In order to elicit the opinions of subjects within the sample of the population of secondary school learners, a questionnaire will be used. A questionnaire is regarded as a commonplace instrument to observe data that may lie buried in the minds, attitudes or feelings of men and women (Leedy 1989:142). According to Gall et al (1996:767) a questionnaire is "a measure that presents a set of written questions to which all individuals in a sample respond". It is a set of questions on a form that is completed by the respondents in respect of the research project (Schulze 2000:3).

Pell (1982:95) has already indicated that using a questionnaire is a more practical way of data collection from large samples of subjects. In so doing, research time is also shortened and less money is spent on the exercise (Gay 1992:253). Since the empirical investigation will involve many subjects, variables will be operationalised and the quantified data will be analysed and interpreted. From this, logical deductions will be made.

Three questionnaires will be constructed for this purpose as follows:

- One questionnaire for grade 10 learners. (See Appendix A).
- One questionnaire for grade 11 learners. (See Appendix B).
- One questionnaire for grade 12 learners. (See Appendix C).

The scope of the questionnaires will consist of **two** sections as follows:

**GRADE 10** (See Appendix A)

- Four questions (1 – 4) general information on age, gender, grade and school type.
- 30 questions (5 - 34) concerning learners' views on involvement in biology curricula development.
- 15 questions (35 – 49) concerning learners' attitudes towards some aspects of ecology.
- Nine questions (50 – 54) and (87 – 90) concerning learners' attitudes towards some aspects of cytology.
- Seven questions (55 – 61) concerning learners' attitudes towards some aspects of histology.
- Nine questions (62 – 70) concerning learners' attitudes towards some aspects of angiosperm anatomy.
- 16 questions (71 – 86) concerning learners' attitudes towards some aspects of human anatomy and physiology.

**[90 Items]**

**GRADE 11 (See Appendix B)**

- Four questions (1 – 4) general information on age, gender, grade and school type.
- 30 questions (5 – 34) concerning learners' need for involvement in curricula development and their attitudes towards biology.
- 16 questions (35 – 50) concerning learners' attitudes towards genetics.
- 15 questions (51 – 65) concerning learners' attitudes towards microbiology (for example, algae).
- 15 questions (66 - 80) concerning learners' attitudes towards some aspects of the plant kingdom.
- 15 questions (81 – 95) concerning learners' attitudes towards some aspects of the animal kingdom.
- Ten questions (96 – 105) concerning learners' attitudes towards some of human reproduction.

**[105 Items]****GRADE 12 (See Appendix C)**

- Four questions (1 – 4) general.
- 30 questions (5 – 34) concerning learners' need for involvement in curricula development.

- 16 questions (35 – 50) concerning learners' attitudes towards some aspects of biochemistry (organic compounds and nutrients).
- 16 questions (51 – 66) concerning learners' attitudes towards some aspects of metabolism (photosynthesis, nutrition and respiration).
- Ten questions (67 – 76) concerning learners' attitudes towards some aspects of angiosperm physiology (plant hormones and plant water relations).
- 16 questions (77 – 92) concerning learners' attitudes towards some aspects of homeostasis (the nervous system, the sense organs and the endocrine system and some examples of homeostasis).
- 11 questions (93 – 103) concerning learners' attitudes towards some aspects of population dynamics.

**[103 items]**

#### **4.5.3.1      *The questionnaire format***

The questionnaire to be used in this empirical investigation will be of a structured nature. Subjects will be expected to respond to predetermined statements by means of a five point Likert response mode. The scale allows for the following responses by learners:

- strongly agree
- agree
- undecided
- disagree
- strongly disagree

All the questionnaires will seek to obtain information on learners' opinions based on the following two aspects:

- views on involvement in biology curricula development
- attitudes towards biology content in grades 10 to 12

Biographical issues will be addressed first. Items pertaining to learners' views on involvement in curricula development in each grade will then be addressed. The questionnaires will be in Appendices A (for learners in grade 10), B (for learners in grade 11) and C (for learners in grade 12).

All the items in the questionnaires will be stated in the first person in order to give the respondent a feeling of identification with the items. Stating the questions in the first person also makes the statements less clumsy. As far as possible, items will be stated in the affirmative, and in certain instances, provision will be given for negative scoring.

However, to counteract any influence on the respondents' judgement, items will consist of simple statements without qualifiers. This is important because the use of qualifiers can affect the nature and quality of the findings that may, in turn, affect the validity of the recommendations that will be made.

The target populations of this study are learners in grades 10, 11 and 12. Therefore, the questionnaire will be administered to a group or groups of respondents. This method is more convenient for this study in two ways as follows:

- less time will be spent waiting the return of responses (as in the case of mailed questionnaires) and less cost will be incurred
- further instructions and clarity can be given during the process of completing the questionnaire.

#### **4.5.3.2      *Validity and reliability***

Evidence of validity and reliability is very important in educational research. This is because most of the measurements attempted in this area are obtained indirectly (Ary, Jacobs & Razavieh 1990:256). Therefore, it is important that the research instruments are able to measure what they were intended to measure. They should provide, as far as possible, the information that is required. The consistency with which these instruments yield the same result when administered several times with the same group of respondents, form the basis of accurate measurement.

##### **(a)      *Validity***

Nuttall (1987:110) has indicated that every authentic assessment is based upon a sample of behaviour in which we are interested and upon which we want to generalise to the universe of that behaviour. Therefore, such fidelity of the inference drawn from the responses to the assessment is called validity

According to Nuttall and Willmot, (in Nuttall 1987:110) validity is the extent to which a test or examination does what it was designed to do. Mulder (1988:215) conceived of validity as referring to the degree to which the test succeeds in measuring what it has set out to achieve. Therefore, validity is an overall evaluative judgement of the adequacy and appropriateness of inferences and actions taken on the basis of test scores. As such validity could be seen as an inductive summary of both the existing evidence for and the potential consequences of test interpretation and use (Messick 1980:231). It is thus the appropriateness of the interpretation made from test scores and other evaluation results, with regards to a particular use.

Validity is characterised by representativeness, soundness, usefulness and relevance of the results. According to Hudson in 1981 (in De Vos et al 1998:83) a research instrument is valid only if it measures what it is intended to measure and

yields scores whose differences reflect the true differences of the variable being measured, rather than random or constant errors. Therefore, in this study, cognisance will be taken of both the content and face validity of the questionnaire items.

- Content validity

Content validity is the extent to which inferences from a test score adequately represent the content or conceptual domain that the test is claimed to measure (Ary et al 1990:257; Gall et al 1996:756). According to Mulder (1988:217) content validity helps to determine how well the test succeeds in covering the field with which it is concerned. De Vos et al (1998:84) indicates that content validity is concerned with the representativeness or sample adequacy of the content of an instrument, i.e. the degree to which a test attempts to measure an intended content area and it is determined by expert judgement. Content validation is therefore, a judgemental process. In the present study, all questionnaires will be presented to experienced biology educators for their opinions regarding the range of questions that is asked. This will be done before the questionnaires are finalised for implementation and administering.

- Face validity

Like content validity, it is important for a questionnaire or test to be face-validated before final implementation. Face validity is concerned more with the relevance of the instrument or questionnaire in terms of what it appears to measure (Ary et al 1990:259; De Vos et al 1998:84). Face validity is also determined by means of the judgement of an expert. In this study the abovementioned biology educators judged whether the questions tested the areas for which they were formulated.

**(b) Reliability**

Reliability is the internal consistency of the measurement, i.e. if the same test was given to the same group of testees on different occasions, it should be such that the chances of getting the same score by individuals within this group are very high. Reliability of a measuring instrument is the degree of consistency with which it measures whatever it is intended to measure (Ary et al 1990:268).

As the degree of correspondence between two sets of independent score measurements for the same testees, reliability is expressed as a correlation between the two sets of scores. For the present study, the Cronbach alpha correlation coefficient of the test items will be calculated using the *split-half method* of reliability testing. This method is preferred since it requires a single administration of the test.

**4.5.3.3 Pilot study**

In order to establish clarity on the questionnaire items, a pilot study, involving a few subjects, will be conducted. Gay (1992:229) indicates that pre-testing or piloting the questionnaire will yield data concerning instrument deficiencies as well as suggestions for improvement before real implementation. In order to do this, and for the sole purpose of this research, one class each of grade 10, 11 and 12 (not included in the research) will be used. From the responses, some necessary adjustments may be made. Only then will the questionnaires be finalised and be ready for use with the whole sample.

**4.6 SUMMARY**

In chapter 4 the research design was explained. In chapter 5, the results will be given and discussed.

## CHAPTER FIVE

### RESULTS AND DISCUSSION OF RESULTS

#### 5.1 INTRODUCTION

In the previous chapter the research design was explained. The results of the empirical investigation to determine the attitudes of secondary school learners towards biology are presented, analysed and discussed in this chapter. The information about the respondents is given in section 5.2 below. Analysis is based on the hypotheses already stated in the preceding chapter.

In order to facilitate presentation, the research problems and only the null-hypotheses will be restated. Eventually, it will be determined whether the null-hypotheses were rejected or not and, therefore, if the experimental hypotheses were accepted. The analysis and discussion of the results will be done with the help of the quantitative information contained in 34 tables. The tables illustrate the relationships between the dependent variables and various independent variables as outlined in chapter 4.

The results were analysed through the use of diverse statistical techniques. The *Pearson product moment correlation* was used to establish the relationships between the variable attitude towards involvement in curriculum development and towards specific biology content areas. By means of analysis of variance (ANOVA) it could be established whether differences in the learners' attitude towards involvement in curriculum development and towards specific biology content on the basis of age, gender, grade and school type were significant. If significant differences were found, the ANOVA will be followed by Bonferroni t-tests to determine where the significant differences were.

In addition the reliability for each of the three questionnaires for views on involvement in curriculum development, was calculated: it was 0.76; 0.79 and 0.76 for grades 10, 11 and 12 respectively.

## **5.2 BIOGRAPHICAL INFORMATION**

### **5.2.1 Sample**

The whole sample of this investigation consisted of 666 female and male subjects. The sample was selected randomly from three school types in the Northern Province. This has been duly described in chapter 4.

### **5.2.2 Age groups**

The sample of this study consisted of subjects of varying ages as follows:

15 years or less = 83

16 years = 139

17 years = 136

18 years = 77

19 years and above = 227

*Missing values = 4*

### **5.2.3 Gender**

Participants in this study were randomly selected from both male and female populations and their numbers are as follows:

Girls = 370

Boys = 290

*Missing values = 0*

#### 5.2.4 Grades

The sample of this study came from the following grades:

Grade 10 = 235

Grade 11 = 222

Grade 12 = 209

*Missing values = 0*

#### 5.2.5 School type

Learners from three school types were used as subjects for this study, and they are

learners from *rural* schools = 405

learners from previous *model C* schools = 106

learners from *private* schools = 153

*Missing values = 2*

For the analysis of the results at the University of South Africa, use was made of SAS (Statistical Analysis Software). Extensive use was also made of SPSS (Statistical Package of the Social Sciences).

### 5.3 ANALYSIS OF THE RESULTS

#### 5.3.1 Research problems focusing on involvement in curriculum development in learners of different ages

##### 5.3.1.1 *Research problem 1*

Is there a significant difference in average attitude towards involvement in curriculum development between learners of diverse ages?

##### *Null-hypothesis 1*

There is no significant difference in average attitude towards involvement in curriculum development between learners of diverse ages.

**TABLE 1**

*Average attitudes towards involvement in curriculum and standard deviations of diverse age groups*

Age group	N	Mean	Standard deviation
15 years or less	83	3,3281	0,4772
16 years	139	3,2945	0,4909
17 years	136	3,3115	0,5868
18 years	77	3,1992	0,3796
19 years and above	227	3,1544	0,3232

*Missing values: 4*

In order to get a clearer picture about the information in table 1, and to ascertain whether there are significant differences between the means, the F-test was calculated. The results are depicted in table 2.

**TABLE 2**

*F-value of significance of differences between average attitude towards involvement in curriculum development between learners of diverse ages*

	Sum of squares	df	Mean square	F	Significance
Between groups	3.536	4	0,884	4,368	0,002

According to the table above, the null-hypothesis may be rejected at the 1%-level significance. This means there is a significant difference in attitude towards involvement in curriculum development between learners of diverse ages.

To determine which age group was more eager to be involved in curriculum development, the Bonferroni t-tests were implemented. The significant differences were revealed as follows:

**TABLE 3**

*Mean difference and significance of difference in attitude towards involvement in curriculum development between learners of diverse ages*

Age (I)	Age (J)	Mean difference (I-J)	Significance
15 years or less	19 years and above	0,1736	0,027

16 years	19 years and above	0,1401	0,040
17 years	19 years and above	0,1571	0,013

According to the table above as well as table 1, learners who are 19 years and older are significantly (on the 5%-level of significance) less eager to get involved in curriculum development than younger learners of 15 years or less, 16 years and 17 years. However, the 15 years or younger group is most eager to be involved in curriculum development as illustrated by the highest mean (3,3281) of all age groups.

### 5.3.1.2 *Research problem 2*

Is there a significant difference in attitude towards involvement in curriculum development between girls and boys?

#### *Null-hypothesis 2*

There is no significant difference in attitude towards involvement in curriculum development between girls and boys.

**TABLE 4**

*T-values and significance of difference in mean attitude towards involvement in curriculum development between girls and boys*

Gender	N	Mean	Standard deviation	t-value	Significance
Girls	370	3,2698	0,4623		
Boys	290	3,2136	0,4440	0,001	0,972

According to the above table, the null-hypothesis may not be rejected. Thus there is no significant difference between girls and boys with regard to their attitude towards involvement in curriculum development although girls were a little more positive to be involved compared to boys (3,2698 > 3,2136).

### **5.3.1.3      *Research problem 3***

Is there a significant difference in average attitude towards involvement in curriculum development between learners from grades 10, 11 and 12?

#### *Null-hypothesis 3*

There is no significant difference in average attitude towards involvement in curriculum development between learners from grades 10, 11 and 12.

**TABLE 5**

*Average attitude towards involvement in curriculum development and standard deviations of diverse grades*

<b>Grade</b>	<b>N</b>	<b>Mean</b>	<b>Standard deviation</b>
Grade 10	235	3,2282	0,4507
Grade 11	222	3,2990	0,4686
Grade 12	209	3,2042	0,4387

**TABLE 6**

*F-value and significance of difference in average attitude towards involvement in curriculum development*

	Sum of squares	df	Mean square	F	Significance
Between groups	1.062	2	0,531	2,587	0,076

According to the table above, the null-hypothesis may not be rejected. Thus there is no significant difference in average attitude towards involvement between learners from grades 10, 11 and 12. However, learners in grade 11 seem to be most positive and eager to be involved in curriculum development as illustrated by the highest mean of 3,2990.

#### **5.3.1.4      *Research problem 4***

Is there a significant difference in average attitude towards involvement in curriculum development between learners from diverse school types?

*Null-hypothesis 4*

There is no significant difference in average attitude towards involvement in curriculum development between learners from diverse school types.

**TABLE 7**

*Average attitude towards involvement in curriculum development and standard deviations of learners from diverse school types*

School type	N	Mean	Standard deviation
Rural	405	3,1632	0,3733
Previous model C	106	3,4208	0,4577
Private	153	3,3327	0,5816

*Missing values = 2*

**TABLE 8**

*F-value and significance of difference in average attitude towards involvement in curriculum development between learners from diverse school types*

	Sum of squares	df	Mean square	F	Significance
Between groups	7.160	2	3,580	18,243	0,000

According to table 8, the null-hypothesis may be rejected on the 1%-level of significance. Thus there is a significant difference in average attitude towards involvement in curriculum development between learners from different types of schools.

To determine exactly where the significant differences were, Bonferroni tests were performed. The results are depicted in the following table.

**TABLE 9**

*Mean difference and significance of difference in average attitude towards involvement in curriculum development of diverse school types*

<b>School type (I)</b>	<b>School type (J)</b>	<b>Mean difference (I-J)</b>	<b>Significance</b>
Previously model C	Rural	0,2576	0,000
Private	Rural	0,1695	0,000

According to tables 7 and 9, learners from the previously model C schools and private schools are more eager to be involved in curriculum development than learners from rural schools: (3,4208 and 3,3327 are significantly greater than 3,1632).

### **5.3.2 Research problems focusing on specific biology content for grade 10 learners**

#### **5.3.2.1 Research problem 5**

Is there a significant correlation between learners' attitudes towards involvement in curriculum development and specific biology content for grade 10 learners?

#### *Null-hypothesis 5*

There is no significant correlation between learners' attitudes towards involvement in curriculum development and their attitudes towards specific biology content for grade 10 learners.

TABLE 10

*Pearson's correlation between attitudes towards involvement in curriculum development and specific biology content for grade 10 learners*

Content	Correlation with attitudes towards involvement in curriculum development	Significance
Ecology	0,045	P > 0,05
Cytology	0,064	P > 0,05
Histology	0,078	P > 0,05
Angiosperm physiology	-0,128	P = 0,05
Human anatomy and physiology	0,240	P < 0,01

According to the table above, the null-hypothesis can be rejected at the 1%-level of significance for the correlation between *attitudes towards involvement in curriculum development* and *human anatomy and physiology* (but not for ecology, cytology, histology and angiosperm physiology) for grade 10 learners. The more positive the attitudes towards human anatomy and physiology, the more eager the grade 10 learners are to be involved in curriculum development. However, it should be noted that the correlation (0,240) is low.

### 5.3.2.2 *Research problem 6*

In rank order, what are the grade 10 learners' attitudes towards the diverse content areas?

In order to answer this question, the means and standard deviations were calculated. The results are in table 11.

**TABLE 11**

*Means and standard deviations of attitudes towards diverse biology content for grade 10 learners*

<b>Content</b>	<b>Ecology</b>	<b>Cytology</b>	<b>Histology</b>	<b>Angiosperm physiology</b>	<b>Human anatomy and physiology</b>
<b>Mean</b>	3,2738	3,3621	3,4414	3,1745	3,4731
<b>Standard deviation</b>	0,5944	0,7981	0,6998	0,7456	0,6898

According to table 11, the rank order of attitudes towards the diverse content areas from most positive to least positive is as follows:

- (1) human anatomy and physiology
- (2) histology
- (3) cytology
- (4) ecology
- (5) angiosperm physiology

This means that learners in grade 10 like to learn about human anatomy and physiology more than angiosperm physiology. In this way, the study of angiosperms, ecology, cytology and histology may influence learners' attitudes negatively.

### **5.3.2.3      *Research problem 7***

Is there a significant difference between the average attitude towards the diverse content areas for grade 10 learners of different ages?

*Null-hypothesis 7*

There is no significant difference in average attitude towards the diverse content areas for grade 10 learners of different ages.

In order to test this hypothesis, analysis of variance was calculated. The results appear in table 12.

**TABLE 12**

*F-value and significance of difference of attitude towards the diverse biology content areas for grade 10 learners*

<b>Content</b>	<b>df</b>	<b>F-value</b>	<b>Significance</b>
Ecology	4	0,875	$p > 0,05$
Cytology	4	0,793	$p > 0,05$
Histology	4	1,766	$p > 0,05$
Angiosperm physiology	4	1,126	$p > 0,05$
Human anatomy and physiology	4	9,820	$p < 0,01$

According to table 12, the null-hypothesis may be rejected at the 1%-level of significance for anatomy. This indicates that the diverse age groups differ significantly in their average attitudes towards human anatomy and physiology.

The following table illustrates the average attitudes towards human anatomy and physiology for the different age groups:

**TABLE 13**

*Average attitudes towards human anatomy and physiology for the different age groups*

<b>Age group</b>	<b>N</b>	<b>Mean</b>
15 years or less	70	3,7797
16 years	80	3,5468
17 years	24	3,2382
18 years	18	3,0780
19 years or above	42	3,1252

According to table 13, the rank order of the age groups from most positive to least positive towards human anatomy and physiology is:

- (1) 15 years or less
- (2) 16 years
- (3) 17 years
- (4) 19 years or above
- (5) 18 years

However, to determine which means differ significantly after a significant *f-ratio* was found in the ANOVA (Hinkle, Wiersma & Jurs 1988: 367), post hoc multiple comparison tests were subsequently computed for human anatomy and physiology to determine where the significant differences lie.

Significant differences were consequently found between the following age groups:

**TABLE 14**

*Significant differences between learners of different age groups*

<b>Age group</b>	<b>Other age groups with whom there are significant differences</b>	<b>Significance</b>
15 years or less	17 years 18 years 19+ years	p < 0,01 p < 0,01 p < 0,01
16 years	19+ years	p < 0,01

Tables 13 and 14 demonstrate that the 15 years or less age group is significantly more positive towards human anatomy and physiology than the 17 years and older learners. The 16 year-old group is also significantly more positive towards human anatomy and physiology than the 19 years and older learners.

#### **5.3.2.4      *Research problem 8***

Is there a significant difference between the average attitude towards the diverse content areas for grade 10 learners of different genders?

#### *Null-hypothesis 8*

There is no significant difference between the average attitude towards the diverse content areas for grade 10 learners of different genders.

To test this hypothesis, an independent samples t-test was executed. The results are in table 15.

TABLE 15

*T-value, means and significance of differences between grade 10 boys and girls' attitudes towards diverse biology content areas*

Content area	Gender	N	Mean	t-value	Significance
Ecology	Girls	137	3,2748	0,003	p > 0,05
	Boys	97	3,2746		
Cytology	Girls	136	3,4207	1,334	p > 0,05
	Boys	97	3,2791		
Histology	Girls	136	3,4665	0,614	p > 0,05
	Boys	97	3,4092		
Angiosperm physiology	Girls	136	3,1816	0,142	p > 0,05
	Boys	97	3,1675		
Human anatomy and physiology	Girls	136	3,5398	1,694	p < 0,05
	Boys	97	3,3851		

According to table 15, grade 10 girls are significantly more positive (at the 5%-level of significance) towards human anatomy and physiology than grade 10 boys. In this regard the null-hypothesis may be rejected.

However, even if the differences in attitudes towards the diverse content areas are not significant for girls and boys, girls appear to be more positive than boys towards the diverse content areas since their mean attitudes are higher in all instances.

### 5.3.2.5 *Research problem 9*

Is there a significant difference between the average attitude towards the diverse biology content areas for grade 10 learners of different school types?

*Null-hypothesis 9*

There is no significant difference between the average attitudes towards the diverse biology content areas for grade 10 learners of different school types.

To test this hypothesis, analysis of variance (ANOVA) was executed. The results are in table 16.

**TABLE 16**

*F-values and significant differences of average attitudes towards the diverse biology content areas for grade 10 learners of different school types*

Content area	df	F-value	Significance
Ecology	2	2,348	p > 0,05
Cytology	2	3,213	p < 0,05
Histology	2	2,893	p > 0,05
Angiosperm physiology	2	7,082	p < 0,01
Human anatomy and physiology	2	12,385	p < 0,01

According to table 16, the null-hypothesis may be rejected at the 5%-level of significance for cytology and on the 1%-level of significance for angiosperm physiology and human anatomy and physiology. Therefore, learners from diverse school types differ significantly with regard to their attitudes towards *cytology*, *angiosperm physiology* and *human anatomy and physiology*.

The following table illustrates the average attitudes towards *cytology*, *angiosperm physiology* and *human anatomy and physiology* of learners from diverse school types.

**TABLE 17**

*Average attitudes towards cytology, angiosperm physiology and human anatomy and physiology*

School type		Angiosperm physiology	Human anatomy and physiology	Cytology
Rural	Mean N	3,3368 131	3,3379 131	3,4566 131
Model C	Mean N	2,9666 47	3,8938 47	3,3593 47
Private	Mean N	2,9851 55	3,4419 55	3,3140 55

Since the null-hypothesis was rejected, Bonferroni post hoc tests were consequently executed for human anatomy and physiology to determine where the significant differences lie. Significant differences were found between the following school types as illustrated in table 18.

**TABLE 18**

*Significance of differences between school types for cytology, angiosperm physiology and human anatomy and physiology*

Content area	School types that differ significantly	Significance
Cytology	Rural and private	$p < 0,05$
Angiosperms	Rural schools with model C Rural schools with private	$p < 0,01$ $p < 0,01$
Human anatomy	Rural schools with model C Private schools with model C	$p < 0,01$ $p < 0,01$

According to tables 17 and 18:

- Learners from rural schools are significantly (on the 5% level of significance) *more* positive towards cytology than learners from private schools.
- Learners from rural schools are significantly (on the 1%-level of significance) *more* positive towards angiosperms than learners from private schools and model C schools.
- Learners from model C schools are significantly (on the 1%-level of significance) *more* positive towards human anatomy than learners from rural schools, but learners from model C schools are significantly *less* positive towards human anatomy than learners from private schools.

For the abovementioned, the null-hypothesis was rejected.

### **5.3.3 Research problems focusing on specific biology content for grade 11 learners**

#### **5.3.3.1 Research problem 10**

Is there a significant correlation between the average attitudes towards involvement in curriculum development and their attitudes towards specific biology content for grade 11 learners?

#### *Null-hypothesis 10*

There is no significant correlation between the average attitudes towards involvement in curriculum development and their attitudes towards specific biology content for grade 11 learners.

TABLE 19

*Pearson's correlation between attitudes towards involvement in curriculum development and specific biology content for grade 11 learners*

Content	Correlation with attitudes towards involvement in curriculum development	Significance
Genetics	-0,160	$p < 0,05$
Microbiology	-0,088	$p > 0,05$
Plant biology	0,085	$p > 0,05$
Animal biology	-0,086	$p > 0,05$
Human reproduction	-0,085	$P > 0,05$

The null-hypothesis may be rejected at the 5%-level of significance for the correlation between attitude towards involvement in curriculum development and genetics. The correlation is significant although it is low and negative (-0,16). This implies that the more negative learners feel about genetics as such, the more eager they are to be involved in the planning of the curriculum.

However, there is no significant correlation between attitude towards involvement in curriculum development and attitude towards *microbiology*, *plant biology*, *animal biology* and *human reproduction*. Therefore, the null-hypothesis may not be rejected in this regard.

### **5.3.3.2 Research problem 11**

In rank order, what are the attitudes of grade 11 learners towards the diverse content areas?

**TABLE 20**

*Means and standard deviations of attitudes towards diverse biology content areas for grade 11 learners*

<b>Content</b>	<b>Genetics</b>	<b>Micro-biology</b>	<b>Plant biology</b>	<b>Animal biology</b>	<b>Human reproduction</b>
Mean	3,1453	2,9926	3,0964	3,1171	3,1903
Standard deviation	0,3827	0,4112	0,4293	0,4382	0,4800

According to the table above, the rank order of attitude towards the diverse content areas are from most to least positive as follows:

- (1) human reproduction
- (2) genetics
- (3) animal biology
- (4) plant biology
- (5) microbiology

### **5.3.3.3      *Research problem 12***

Is there a significant difference between the average attitude towards the diverse content areas for grade 11 learners of different ages?

*Null-hypothesis 12*

There is no significant difference between the average attitude towards the diverse content areas for grade 11 learners of different ages.

**TABLE 21**

*F-value and significance of differences between average attitude towards the diverse biology content areas for grade 11 learners of different ages*

<b>Content</b>	<b>df</b>	<b>F-value</b>	<b>Significance</b>
Genetics	4	4,370	p < 0,01
Microbiology	4	2,321	p > 0,05
Plant biology	4	0,325	p > 0,05
Animal biology	4	2,154	p > 0,05
Human reproduction	4	6,271	p < 0,01

According to the table 21, the null-hypothesis may be rejected on the 1%-level of significance for genetics and human reproduction. The following table illustrates the average attitudes towards *genetics* and *human reproduction* of the diverse age groups:

**TABLE 22**

*Average attitude towards genetics and human reproduction of diverse age groups in grade 11*

<b>Age</b>		<b>Genetics</b>	<b>Human reproduction</b>
15 years or less	Mean N	3,0852 11	3,0091 11

16 years	Mean N	3,1646 54	3,0831 54
17 years	Mean N	3,0109 72	3,0750 72
18 years	Mean N	3,2819 32	3,4517 32
19+ years	Mean N	3,2380 53	3,3389 52

Post hoc tests were subsequently executed for *genetics* and *human reproduction* to determine where the significant difference lies. The significant differences were found between the following age groups as illustrated by table 23.

**TABLE 23**

*Significance of differences for diverse age groups in grade 11 for genetics and human reproduction*

Content area	Ages that differ significantly	Significance
Genetics	Age 17 with 18 years Age 17 with 19+ years	p < 0,01 p < 0,01
Human reproduction	Age 16 with 18 years Age 16 with 19+ years Age 17 with 18 years Age 17 with 19+ years	p < 0,01 p < 0,05 p < 0,01 p < 0,05

Tables 22 and 23 demonstrate that:

- Learners of 17 years are significantly *less* positive towards genetics than learners of 18 years and older; and
- learners of 16 years are significantly *less* positive towards human reproduction than learners of 18 years and older; and

- learners of 17 are also significantly *less* positive towards human reproduction than learners of 18 years.

It therefore appears that the older the learners become, the more interested they become in genetics and human reproduction.

#### 5.3.3.4 *Research problem 13*

Is there a significant difference between attitude towards the diverse content areas for grade 11 learners of different genders?

*Null-hypothesis 13*

There is no significant difference between attitude towards the diverse content areas for grade 11 learners of different genders.

To test this hypothesis a t-test was executed. The results are as follows:

**TABLE 24**

*T-values, means and significance of differences between attitudes towards diverse biology content areas for grade 11 learners of different gender*

Content	Gender	N	Mean	t-value	Significance
Genetics	Girl	126	3,1317	-0,621	p > 0,05
	Boy	93	3,1643		
Micro-organisms	Girl	126	3,0006	0,347	p > 0,05
	Boy	93	2,9809		
Plant biology	Girl	126	3,0918	-0,205	p > 0,05
	Boy	93	3,1040		
Animal biology	Girl	126	3,1403	0,842	p > 0,05
	Boy	93	3,0895		
Human reproduction	Girl	126	3,1815	-0,406	p > 0,05
	Boy	93	3,2084		

According to the above table, the null-hypothesis may not be rejected. Thus there are no significant differences between grade 11 girls and boys with regard to their average attitudes towards the diverse content areas.

### 5.3.3.5 *Research problem 14*

Is there a significant difference between the average attitude towards the diverse content areas for grade 11 learners of different school types?

#### *Null-hypothesis 14*

There is no significant difference between the average attitude towards the diverse content areas for grade 11 learners of different schools.

An analysis of variance led to the following results:

**TABLE 25**

*F-values and significance of differences between the average attitude towards the diverse biology content areas for grade 11 learners of different school types*

Content area	df	F-value	Significance
Genetics	4	6,198	$p < 0,01$
Microbiology	4	0,652	$p > 0,05$
Plant kingdom	4	2,557	$p < 0,05$
Animal kingdom	4	1,294	$p > 0,05$
Human reproduction	4	9,458	$p < 0,01$

Table 25 indicates that the null-hypothesis may be rejected at the 1%-level of significance for genetics and human reproduction, and on the 5%-level of significance for the plant biology. This illustrates that there are significant differences between learners from the different school types with regard to these topics.

However, the null-hypothesis may not be rejected for animal biology and microbiology, respectively. This means that grade 11 learners from the different school types do not differ significantly with regard to these topics.

Table 26 illustrates the average attitudes towards *genetics*, *plant biology* and *human reproduction* for grade 11 learners of different school types.

**TABLE 26**

*Average attitudes towards genetics, plant biology and human reproduction for grade 11 learners of different school types*

School type		Genetics	Human reproduction	Plant biology
Rural	Mean N	3,2568 118	3,3615 117	3,1725 118
Model C	Mean N	2,9853 59	2,9682 59	3,0537 59
Private	Mean N	3,0701 42	3,0296 42	2,9479 42

Post hoc tests were subsequently performed for genetics, plant biology and human reproduction to determine where the significant differences lie. Significant differences were consequently found between learners of the following school types as illustrated by table 27.

**TABLE 27**

*Significance of differences of attitudes between learners of diverse school types for genetics, plant biology and human reproduction*

<b>Content area</b>	<b>School types that differ significantly</b>	<b>Significance</b>
Genetics	Rural schools with ex-model C schools Rural schools with private schools	p < 0,01 p < 0,01
Plant biology	Rural schools with private schools	p < 0,01
Human reproduction	Rural schools with ex-model C schools Rural schools with private schools	p < 0,01 p < 0,01

Tables 26 and 27 demonstrate that:

- rural school learners are significantly more positive (at the 1%-level of significance) towards genetics than private and model C school learners
- rural school learners are significantly more positive (at the 1%-level of significance) towards plant biology than private school learners
- rural school learners are significantly more positive (at the 1%-level of significance) towards human reproduction than private and model C school learners

In all these instances, the null-hypothesis may be rejected.

### **5.3.4 Research problems focusing on specific biology content for grade 12 learners**

#### **5.3.4.1 Research problem 15**

Is there a significant correlation between the attitudes towards involvement in curriculum development and attitudes towards specific biology content of grade 12 learners?

*Null-hypothesis 15*

There is no significant correlation between the attitudes towards involvement in curriculum development and attitudes towards specific biology content of grade 12 learners.

**TABLE 28**

*Pearson's correlation between attitude towards involvement in curriculum development and specific biology content for grade 12 learners*

<b>Content</b>	<b>Correlation with attitude towards involvement in curriculum development</b>	<b>Significance</b>
Organic compounds and nutrients	-0,058	p > 0,05
Metabolism	0,109	p > 0,05
Plant and water relations	0,113	p > 0,05
Homeostasis	0,102	p > 0,05
Population dynamics	0,206	p < 0,01

According to table 28, the null-hypothesis may be rejected at the 1%-level of significance for the correlation between attitude towards *involvement in curriculum development* and *population dynamics*. The correlation is also low and positive. This implies that the more positive learners are towards population dynamics, the more eager they are to be involved in curriculum development, and vice versa.

However, there is no significant correlation between attitude towards involvement in curriculum development and *organic compounds and nutrients, metabolism, plant water relations* as well as *homeostasis* and related topics.

This means that for learners to want to participate in decision-making concerning what they should learn is linked to the possibility of interest that they attach to a specific content area. Learners are probably demotivated by content that was not interesting at all but which had to be learnt only for the purpose of passing the examinations.

#### **5.3.4.2      *Research problem 16***

In rank order, what are the attitudes of grade 12 learners towards diverse biology content areas?

**TABLE 29**

*Means and standard deviations of attitude towards diverse biology content for grade 12 learners*

<b>Content</b>	<b>Organic compounds and nutrients</b>	<b>Metabolism</b>	<b>Plant and water relations</b>	<b>Homeostasis</b>	<b>Population dynamics</b>
<b>Mean</b>	3,3968	3,4187	3,3115	3,4456	3,2069
<b>Standard deviation</b>	0,5981	0,5763	0,5976	0,6602	0,4934

According to the table, the rank order of attitude towards the diverse content areas is from most positive to least positive as follows:

- (1) homeostasis
- (2) metabolism
- (3) organic compounds and nutrients
- (4) angiosperm physiology (plant water relations) and
- (5) population dynamics

#### 5.3.4.3 *Research problem 17*

Is there a significant difference between the average attitudes towards the diverse content areas for grade 12 learners of different ages?

#### *Null-hypothesis 17*

There is no significant difference between the average attitudes towards the diverse content areas for grade 12 learners of different ages

**TABLE 30**

*F-value and significance of difference between attitudes towards diverse biology content areas for grade 12 learners of different ages*

Content	df	F-value	Significance
Organic compounds and nutrients	4	3,175	p < 0,05
Metabolism	4	2,097	p > 0,05
Angiosperm physiology	4	4,413	p < 0,01
Homeostasis	4	4,264	p < 0,01
Population dynamics	4	0,954	p > 0,05

Table 30 indicates that the null-hypothesis may be rejected at the 1%-level of significance for *angiosperm physiology and for homeostasis*, and at the 5%-level of significance for *organic compounds and nutrients*, but not for *metabolism and population dynamics*. This means that diverse age groups in grade 12 differ significantly in their attitudes towards *angiosperm physiology, homeostasis and organic compounds and nutrients*.

Table 31 illustrates the average attitudes towards these content areas where there are significant differences.

**TABLE 31**

*Average attitudes towards organic compounds and nutrients, plant water relations and homeostasis together with related topics for diverse age groups in grade 12*

Age		Organic compounds	Plant water relations	Homeostasis
15 years or less	Mean N	2,6813 4	2,9722 4	3,0000 4
16 years	Mean N	3,8750 4	3,7500 4	3,6688 4
17 years	Mean N	3,5205 40	3,4950 40	3,7570 40
18 years	Mean N	3,5181 27	3,5650 27	3,5835 27

19+ years	Mean N	3,3412 132	3,2004 132	3,3357 132
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Bonferroni post hoc tests were consequently performed for the aforementioned content areas. Significant differences were therefore found between the following age groups as illustrated by table 32:

**TABLE 32**

*Significance of differences for diverse age groups in grade 12 for organic compounds and nutrients, angiosperm physiology and homeostasis and related topics*

Content area	Ages that differ significantly	Significance
Organic compounds and nutrients	15 with 16 years	$p < 0,05$
Angiosperm physiology	18 with 19+ years	$p < 0,05$
Homeostasis	17 with 19+ years	$p < 0,01$

Tables 31 and 32 indicate that for grade 12:

- 16 year old learners are significantly more positive towards *organic compounds and nutrients* than 15 year old learners

- 18 year old learners are significantly more positive towards *angiosperm physiology* than the 19 years and older learners
- 17 year old learners are significantly more positive towards *homeostasis* and related topics than the 19 years and older learners.

#### 5.3.4.4 *Research problem 18*

Is there a significant difference between the average attitudes towards the diverse content areas of grade 12 learners of different genders?

##### *Null-hypothesis 18*

There is no significant difference between the average attitude towards the diverse content areas for grade 12 learners of different genders.

To test this hypothesis a t-test was performed. The results appear in table 33.

**TABLE 33**

*T-values, means and significance of differences between grade 12 girls and boys' attitudes towards diverse biology content areas*

Content area	Gender	N	Mean	t-value	Significance
Organic compounds and nutrients	Girl	107	3,4547	1,498	p > 0,05
	Boy	99	3,3297		
Metabolism	Girl	107	3,4490	0,677	p > 0,05
	Boy	99	3,3944		

Angiosperm physiology	Girl Boy	107 99	3,3057 3,3130	-0,087	p > 0,05
Homeostasis	Girl Boy	107 99	3,4328 3,4722	-0,428	p > 0,05
Population dynamics	Girl Boy	107 99	3,1870 3,2383	-0,745	p > 0,05

According to table 33, the null-hypothesis may not be rejected. Thus there are no significant differences in attitudes towards diverse content areas between grade 12 girls and boys.

#### **5.3.4.5      *Research problem 19***

Is there a significant difference between average attitudes towards the diverse content areas for grade 12 learners of different school types?

Null-hypothesis 19

There is no significant difference between the average attitudes towards diverse content areas for grade 12 learners of different school types.

**NB:** Grade 12 learners came from rural and private schools. No grade 12 learners from ex-model C schools could be included in the study because during data collection, all learners had already started with their final matriculation examinations.

To test this hypothesis, a t-test was performed. The results are depicted in table 34.

**TABLE 34**

*T-values, means and significance of differences between grade 12 rural and private school learners' attitudes towards diverse biology content areas*

<b>Content Area</b>	<b>School type</b>	<b>N</b>	<b>Mean</b>	<b>t-value</b>	<b>Significance</b>
Organic compounds and nutrients	rural	157	3,4104	0,003	p > 0,05
	private	51	3,3551		
Metabolism	rural	157	3,4526	1,334	p > 0,05
	private	51	3,3142		
Angiosperms physiology	rural	157	3,3001	0,614	p > 0,05
	private	51	3,3466		
Homeostasis	rural	157	3,3487	1,142	p > 0,05
	private	51	3,3746		
Population dynamics	rural	157	3,2233	1,694	p > 0,05
	private	51	3,1565		

According to table 34, the null-hypothesis may not be rejected. Thus there are no significant differences between grade 12 learners from rural and from private schools with regard to their average attitudes towards the diverse content areas. This means that learners from both school types regard the specific biology topics similarly.

#### **5.4 SUMMARY**

In this chapter, important relationships were established between grade 10, 11 and 12 learners' attitudes towards involvement in curriculum development and the specific biology content areas of that grade. From the results as outlined above, important conclusions and implications for future curriculum development in biology may be made. These are outlined in the next chapter.

## CHAPTER SIX

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 INTRODUCTION

The purpose of this research was to determine relationships between the attitudes of learners towards involvement in curriculum development and the specific content of biology curricula in senior secondary schools and their implications for curricula development. The assumption of the research is that learners should play an active role and be involved in curriculum development. In this way the content and learning experiences that are selected may be relevant and could result in the development of positive attitudes towards their fields of studies – in this research, biology.

The main question asked, therefore, was

*Is there a significant relationship between learners' views on involvement in curriculum development and their attitudes towards specific biology content?*

More specifically, the study was conducted:

- to determine the relationship between learners' views on involvement in curricula development and their attitudes towards specific biology content areas in grades 10, 11 and 12
- to outline the implications of these views/attitudes for curricula development in science (biology) education

In this chapter, conclusions from the literature review and from the results of the empirical study will be given. Thereafter, an analytical integration of these conclusions will be made to illuminate some common findings and some possible discrepancies. The implications of this study for curriculum development, its

limitations and the recommendations for future research, will conclude this chapter.

## **6.2 CONCLUSIONS FROM THE LITERATURE REVIEW**

### **6.2.1 General**

An extensive review of the literature on attitude development with implications for learner involvement and the nature of the curriculum was done in chapters 1, 2 and 3.

The studies that were reviewed in chapter 2 ranged from those that tried to establish the nature of the relationships between attitude towards science (biology) and a number of variables including the following:

- The educator
- The learner
- The environment
- The curriculum

Other studies (reviewed in chapter 3) concentrated on curriculum development in education. This study will emphasise the significance of learner participation in decision-making during curriculum development. Including learners in curriculum decision-making could enhance their attitudes towards their courses (for example, biology).

Literature on research to establish whether learners were ready and willing to be involved in curriculum development matters is very scarce or nonexistent for some contexts such as the Northern Province. It is also true that very little was done to determine the perceptions of learners about specific content areas in biology in the Northern Province.

With regard to content, it was indicated that more appealing knowledge encouraged learners to participate actively in their own learning. For example, the more school science was meaningful to learners, the more they would find science interesting, enjoyable and would be ready to be involved in any activity, including curriculum development.

Boomer (in section 3.5) emphasised the importance of the negotiated curriculum rather than one that is imposed upon learners by curriculum developers. Other studies also concluded that learners developed negative attitudes as a result of the imposition of material that required abstract reasoning capacities that they had not yet obtained. According to Holdzkom and Lutz (in section 2.5.1.2), learners developed negative attitudes as a result of textbooks that dictated the course content, mode of instruction and evaluation.

In another study by Barrow (in section 3.7.2) it was shown that learning for personal sense making instead of grades would become the learners' primary focus as long as they feel ownership of the curriculum. This means that learners have a need to be involved and any content that has been scrutinised by them should promote the development of the intellectual skills and attitudinal skills that they need for better understanding. Hence the exclusion of learners from curriculum decision matters completely rejects consideration for their personal needs and interests.

Kelly (in section 3.3.2.3) has indicated that learner centred curricula emphasise satisfying the needs, interests and growth of learners. Consequently, decisions on content should be taken with reference to learners.

Bowen (in sections 3.3. and 3.3.1.2) also indicated that both the learner and the educator should be involved in formulating the curriculum plan that is aimed at empowerment. They should collaboratively engage in identifying courses, designing basic essential questions, course frameworks and selecting appropriate activities as well as course content.

Accordingly Keedy and MacIach (in section 3.7.2) indicated that learners needed to be engaged in a continual discourse of how the subjects are taught and more especially what topics or content are worthy to study.

Thus it has been shown in the literature review that learners can contribute but this calls for their involvement. Once they are involved, their attitudes may improve. For example, Sinclair (in section 2.5.1.2) has discovered that learners' interests in genetics improved with their participation.

This study aims to fill a void in South African curriculum development where learners, up till now, have not been consulted in curriculum development. In establishing the relationship between learners' wish to be involved in curriculum development and their attitudes towards specific content in biology, recommendations for curriculum development can be made. The basis of the argument is that learners' attitude about participation in curriculum development is probably influenced by each specific content area in biology.

In addition to the conclusion that learners should be involved in curriculum development, the following conclusions are made from the literature review.

## **6.2.2 Conclusions with regard to the specific research problems**

### **6.2.2.1 *Influence of age***

Previous research has established insignificant and sometimes poor relationships between attitudes towards science and age (par. 2.5.2.3). Nevertheless, from the literature review, the following conclusion can be made:

Generally, younger learners are more positive towards science (biology) than older learners.

### **6.2.2.2      *Influence of gender***

A review of the literature based on the role of gender in attitude development was given in section 2.5.2.2.

From this review, it can be asserted that

- although girls and boys were reported not to differ significantly in their attitudes towards science, girls had more positive attitudes towards biology than boys
- the attitudes of both girls and boys are positive with interest in the content and negative with content of the subject for which they have no interest
- boys, more than girls, are eager to be involved with practical laboratory work on a day-to-day basis
- girls' more than boys' willingness to be involved was linked with enjoyment
- the nature of the subject matter in terms of social relevance accounted for more of the variance in attitudes towards science in girls than in boys
- girls' (but not boys') interests in experimental procedures increased with experiments that had social appeal to them
- boys preferred subjects such as physics more than girls
- girls are likely to be more positive towards *plant biology* than *animal biology* as compared to boys who may be more positive towards *animal biology* than *plant biology*
- girls expressed higher levels of interest in *human reproduction* and *human physiology* than boys

### **6.2.2.3      *Influence of grade***

Some studies have reported no significant differences between attitudes towards science (biology) and grade or age. However, from the review of the literature on this aspect, it can be concluded that according to most literature (in section

2.5.2.3) the attitudes and interests of learners waned as they progressed through the different grades.

On the other hand some studies reported that the attitudes of learners were more influenced by educator characteristics, characteristics inherent in learners and curricular aspects than by age or grade.

#### **6.2.2.4      *Influence of school type***

When school type was used as a moderator variable, the following conclusions from the literature review in section 2.5.3.3 can be drawn:

- Tamir (discussed in section 2.5.3.3) has indicated that learners from rural schools have the least positive attitudes towards biology when compared to learners from city and agricultural science schools. Learners from city schools had the most positive attitudes towards biology.
- Tamir (see section 2.5.3.3) also discovered that learners from agricultural high schools are more positive towards *plant biology* and *animal biology*, while learners from the academic schools are more positive towards human biology. However, learners from both academic and agricultural schools have the most positive attitudes towards *human biology* and the least towards *plant biology*.

School type (city schools, private schools and rural schools) generally differ regarding the home background of the learners or the kind of teaching that takes place there, since private schools tend to cater for more affluent families and rural schools tend to have learners from poorer income families. As such they have less resources and the parents of the children are often illiterate. Thus home background and teaching methods will also be considered when conclusions are made regarding the influence of school type.

Studies have revealed significant relationships between the learning environment and attitudes towards science (biology). For example, home background factors have been significantly linked with learners' attitudes towards learning. For example, the father's levels of education have been found to influence their children's attitudes towards biology. The higher the parent's level of education, the more positive were their children's attitudes towards biology.

Other studies confirmed that home background factors contributed significantly in determining learners' attitudes. Learners who came from homes where there was stimulation for science had more positive attitudes towards science (biology). The attitudes of parents towards their children's education also influenced the development of certain attitudes in these children. The more positive parents' attitudes towards their children's education were, the more positive were their children's attitudes and vice versa. However, Shoffner (1990) indicated that the home background could be altered to cultivate positive attitudes in learners. Hence parental involvement remains central in the education of their children.

However, Mordi (as discussed in section 2.5.2.4) discovered a very small and insignificant contribution by home background to attitudes towards science, in which case the school experiences could be more influential.

The literature that was accumulated recently has affirmed that an appreciable amount of the learning outcome variance can be attributed to the environment in which teaching and learning take place (Jegade & Okebukola in section 2.5.1.1). As a result of this the classroom environment has been referred to as an important determinant of attitudes towards science, and more especially towards biology. This environment includes the teaching methods used as well as other classroom environment variables. For example, if teaching strategies that encourage learners to be active are adopted by an educator in the classroom, it will motivate learners to learn and be interested in learning. This is because learners prefer teaching and learning environments where they play an active part (as described in section 2.5.1.2).

Accordingly, recent curriculum innovation programmes have emphasised the need to provide more active learning, with learners taking a greater pedagogical responsibility in their active and creative citizenship in life (see section 3.5). Newton (in section 3.5) shared this sentiment when he also emphasised that learners should be allowed to choose curricular objectives, to pursue whichever curricular activities they wished to engage in and to assume full responsibility for their learning. This is because active learning is linked with positive attitude development (also see section 2.5.1.2).

Bowen (in section 3.3.1.2) also indicated that learners preferred learning environments where they had a greater equality of voice with their educators in negotiating and agreeing on curricular realities.

The main conclusion is that the attitudes of learners towards science have been shown to be most positive in classrooms with the highest levels of learner involvement. For example, Holdzkom and Lutz (section 2.5.1.2) indicated that learners developed negative attitudes as a result of their being denied the necessary opportunities to manipulate materials and the activities that interest them.

The abovementioned have important implications for involvement in curricula development. The more positive learners are about the content of the subject/s that they learn, the more eager they are to be involved in curricula development and the more positive their attitudes will become.

Therefore, it can be concluded that the type of school that learners attend may have an influence on their attitudes.

### **6.2.3 Conclusions with regard to curriculum content**

According to section 2.5.3, some studies have revealed a significant link between the curriculum and the attitudes of learners towards science (biology). The nature

of science in terms of relevance, difficulty and importance was found to account for much of the variance in learners' attitudes towards biology. For example, irrelevant curricula would result in decreased achievement and motivation as well as the development of negative attitudes in learners and vice versa. Also, curriculum content that was hard to interpret would cause the development of negative attitudes in learners. This has important implications for involvement of learners in curriculum development.

With regard to the specific content of biology, certain courses and course content were strongly linked with learners' attitudes towards the subject in terms of relevance, importance and difficulty. Factors such as gender and school type may also influence learners' attitudes towards specific biology content (as already indicated).

However, from the review of the literature in section 2.5.3.3, the following conclusions can be made regarding biology content:

#### **6.2.3.1      *Relevancy***

- Learners believe that the study of *human biology* is more important than the study of pure biology in terms of relevance and the opportunities that it creates for them. Human biology is believed to be more related to real life than general biology.
- Learners of different gender feel differently about *animal biology* and *plant biology*.

#### **6.2.3.2      *Biological concepts and learners' cognitive structures***

- Difficult concepts and topics that require a lot of abstract reasoning may not be understood by many and thus promote the formation of negative attitudes towards biology.

- In most cases learners will have problems in understanding concepts that require a prerequisite knowledge of physics or chemistry; for example, osmosis.

#### **6.2.3.3      *The influence of erroneous ideas in understanding biology***

- The study of some biological concepts may cause misconceptions in learners. Concepts such as the *food chain and food webs* together with the relationships within the entire ecological network and *osmosis* may be too vague and intricate for learners and this can inhibit their understanding and so cause the development of negative attitudes towards biology.
- The process of respiration may be too confusing with regard to:
  - the nature and function of the process
  - the purpose of the process
  - its relationship with breathing
  - the actual time for respiration in plants

#### **6.2.3.4      *The role of the textbook in the curriculum***

Enough evidence was revealed in the literature (discussed in section 2.5.3.3 [d]) about the role of textbooks in science education. The way in which many textbooks are written may be a cause of some of the problems that learners experience regarding biology, and science in general. For example, much of learners' negative attitudes towards biology could be attributed to textbooks that may not be well written. Some textbooks do not cover all the content necessary for the understanding of basic biology concepts. Others emphasise a great deal of chemistry and difficult terminology. In addition some textbooks reveal the following weaknesses: confusion of ideas; tautology; omissions, amongst others.

Many textbooks fail to promote functional learning in the majority of learners because of their lack of concern about learners' alternative ideas and activities that would challenge them.

### **6.3 CONCLUSIONS FROM THE EMPIRICAL RESEARCH**

The results of the statistical analysis are presented in chapter 5. From these results, the following conclusions may be made:

#### **6.3.1 Research problems focusing on attitude towards involvement in curriculum development**

##### **6.3.1.1 *Research problem 1***

Null-hypothesis: There is no significant difference in average attitude towards involvement in curriculum development between learners of diverse ages.

The empirical research results on this variable as presented in section 5.3.1.1 have indicated that the null-hypothesis may be rejected on the 1%-level of significance. There are significant differences in attitudes towards involvement in curriculum development as follows:

- Learners who are 15 years of age or younger are most positive towards involvement in curriculum development in comparison with learners who are 16, 17, 18 and 19 years of age.
- Learners who are 17 years of age are second most positive towards involvement in curriculum development in comparison with learners who are 16, 18 and 19 years.
- Learners who are 19 years and older are the least positive towards involvement in curriculum development.

**6.3.1.2      *Research problem 2***

Null-hypothesis:    There is no significant difference in attitude towards involvement in curriculum development between girls and boys.

From section 5.3.1.2, it is clear that the null-hypothesis may not be rejected. Thus there is no significant difference in attitude towards involvement in curriculum development between girls and boys. However, there is a trend for girls to be more positive towards involvement in curriculum development than boys.

**6.3.1.3      *Research problem 3***

Null-hypothesis:    There is no significant difference in average attitude towards involvement in curriculum development between learners from grades 10, 11 and 12.

From tables 5 and 6 (in section 5.3.1.3) it is clear that the null-hypothesis may not be rejected. There is no significant difference in attitudes towards involvement in curriculum development for learners in the different grades. However, the means and standard deviations for learners suggest the following trend: learners in grade 11 have the most positive attitudes towards involvement in curriculum development. Learners in grade 12 have the least positive attitude towards involvement in curriculum development.

**6.3.1.4      *Research problem 4***

Null-hypothesis:    There is no significant difference in average attitude towards involvement in curriculum development between learners from diverse school types.

The null-hypothesis may be rejected. According to tables 7 and 8 ( in section 5.3.1.4), learners of the different school types differ significantly in their attitudes towards involvement in curriculum development. Learners from ex model C schools are most eager to be involved in curriculum development. Learners from rural schools are least interested to get involved in curriculum development. This may be because of a lack of confidence in these learners who come from disadvantaged backgrounds.

### **6.3.2 Research problems focusing on attitude towards content for grade 10 learners**

#### **6.3.2.1 Research problem 5**

Null-hypothesis: There is no significant correlation between learners' attitudes towards involvement in curriculum development and their attitudes towards specific biology content for grade 10 learners.

The null-hypothesis is rejected. Table 10 in section 5.3.2.1 indicates a low positive and significant correlation between the attitudes of grade 10 learners towards *curriculum involvement* and *human anatomy and physiology*. This means that the more they enjoy this content area, the more positive they feel to be involved in curriculum development.

#### **6.3.2.2 Research problem 6**

According to table 10 in section 5.3.2.2, learners in grade 10 prefer, in order of merit,

- human anatomy and physiology
- histology
- cytology



### **6.3.2.5      *Research problem 9***

Null-hypothesis:      There is no significant difference between the average attitudes towards the diverse biology content areas for grade 10 learners of different schools.

According to section 5.3.2.5 the null-hypothesis may be rejected:

- Learners from rural schools are significantly *more* positive towards cytology than learners from private schools.
- Learners from rural schools are *more* positive towards angiosperms than learners from private schools and model C schools.
- Learners from model C schools are significantly *more* positive towards anatomy than learners from rural schools, but learners from model C schools are *less* positive towards human anatomy than learners from private schools.

The differences in attitudes towards anatomy in particular may be due to cultural differences: most of the learners in rural schools were from poor and often illiterate black families where cultural taboos on this topic still prevail.

### **6.3.3      *Research problems focusing on attitude towards content for grade 11 learners***

#### **6.3.3.1      *Research problem 10***

Null-hypothesis:      There is no significant correlation between the average attitudes towards involvement in curriculum development and their attitudes towards specific biology content for grade 11 learners.

According to tables 19 and 20 in section 5.3.3.1, the null-hypothesis may be rejected. A significantly but very low, negative correlation exists between grade 11 learners' attitudes towards involvement in curriculum development and genetics. This implies that the more negative they are towards genetics, the more positive to be involved in curriculum development. One reason for this may be that aspects of this topic are experienced as difficult and learners may want to be involved to make recommendations regarding what is included and what not.

### **6.3.3.2      *Research problem 11***

When rank order analysis was done, grade 11 learners preferred the following biology content in order of merit:

- human reproduction
- genetics
- zoology
- botany
- microbiology as indicated in section 5.3.3.2

### **6.3.3.3      *Research problem 12***

Null-hypothesis:      There is no significant difference between the average attitude towards the diverse content areas for grade 11 learners of different ages.

Tables 22 and 23 in section 5.3.3.3 indicate that the null-hypothesis may be rejected.

- learners of 17 years are significantly *less* positive towards genetics than learners of 18 years and older
- learners of 16 years are significantly *less* positive towards human reproduction than learners of 18 years and older; and

- learners of 17 years are significantly *less* positive towards human reproduction than learners of 18 years and older.

It therefore appears that the older the learners become, the more interested they become in genetics and human reproduction.

#### **6.3.3.4      *Research problem 13***

Null-hypothesis:      There is no significant difference between attitude towards the diverse content areas for grade 11 learners of different genders.

Table 24 in section 5.3.3.4 indicates that the null-hypothesis may not be rejected. The attitudes of grade 11 learners do not differ significantly for the specific biology content areas.

However, it would appear that the following may be *trends*:

- grade 11 boys prefer the study of *human reproduction, plant biology* and *genetics* more than girls
- grade 11 girls prefer the study of *microbiology* and *animal biology* more than boys.

#### **6.3.3.5      *Research problem 14***

Null-hypothesis:      There is no significant difference between the average attitude towards the diverse content areas for grade 11 learners of different schools.

According to section 5.3.3.5 the null-hypothesis may be rejected for genetics, human reproduction and plant biology as follows:

- rural school learners are significantly more positive towards genetics than private and model C school learners
- rural school learners are significantly more positive towards plant biology than private school learners
- rural school learners are significantly more positive towards human reproduction than private and model C school learners.

The abovementioned results are difficult to explain. These may be examples of where halo effects come into play. Or there may be an excellent and dedicated educator for one specific grade at some schools. These are all variables that can influence the results.

#### **6.3.4 Research problems focusing on attitude towards content for grade 12 learners**

##### **6.3.4.1 Research problems 15 & 16**

Null-hypothesis 15: There is no significant correlation between the attitudes towards involvement in curriculum development and attitudes towards specific biology content of grade 12 learners.

Table 28 in section 5.3.4.1 indicates that the null-hypothesis may be rejected. A low, positive but significant correlation exists between attitudes towards involvement in curriculum development and population dynamics. This implies that the more positive the learners are towards population dynamics, the more eager to be involved in curriculum development.

Although very low and insignificant, the correlation between learners' attitudes towards curriculum development and *organic compounds and nutrients* is a negative one.

Generally, the attitudes of grade 12 learners towards the diverse content areas are, in order of merit:

- homeostasis
- metabolism
- organic compounds
- plant water relations
- population dynamics

#### **6.3.4.2      *Research problem 17***

**Null-hypothesis:**      There is no significant difference between the average attitude towards the diverse content areas for grade 12 learners of different ages

According to section 5.3.4.2 the null-hypothesis may be rejected. The differences in attitudes towards *plant water relations*, *homeostasis* and *organic compounds and nutrients* were significant for learners of diverse ages. For grade 12:

- 16 year old learners are significantly more positive towards *organic compounds and nutrients* than 15 year old learners
- 18 year old learners are significantly more positive towards *angiosperm physiology* (plant water relations) than the 19 years and older learners
- 17 year old learners are significantly more positive towards *homeostasis* and related topics than the 19 years and older learners

#### **6.3.4.3      *Research problem 18***

**Null-hypothesis:**      There is no significant difference between the average attitude towards the diverse content areas for grade 12 learners of different genders.

The results in section 4.3.4.3 show that the null-hypotheses may not be rejected. However, even if the attitudes of grade 12 learners of different genders towards diverse content areas do not differ significantly, the following *trends* are observed:

- boys preferred *population dynamics, homeostasis and angiosperm physiology* more than girls
- girls prefer organic compounds and nutrients and metabolism more than boys

#### **6.3.4.4 Research problem 19**

**Null-hypothesis:** There is no significant difference between the average attitudes towards diverse content areas for grade 12 learners of different schools.

With regard to school type and according to table 34 in section 4.3.4.4, the null-hypothesis may not be rejected. This means that the grade 12 learners from private and rural school types do not differ significantly in their attitudes towards the specific biology content.

However, although the differences between these means are too small to be significant, the following is observed as *trends* only:

- learners from rural schools prefer *organic compounds and nutrients, metabolism and homeostasis, population dynamics* more than learners from private schools
- the attitudes of learners from private schools are more positive towards *angiosperm physiology* (plant water relations) than those of learners from rural schools.

## **6.4 FINAL CONCLUSIONS FROM THE LITERATURE STUDY AND THE EMPIRICAL RESEARCH**

### **6.4.1 Introduction**

Research problems 1-4 focus on learners' attitudes towards involvement in curriculum development. The other research problems, problems 5-19 refer to learners' attitudes towards specific biology content areas for the three grade levels.

### **6.4.2 Final conclusions with regard to learners' attitudes towards involvement in curriculum development**

#### **6.4.2.1 *Research problem 1: influence of age***

The literature generally revealed a decrease in attitudes towards science (biology) with an increase in age. Since attitudes were generally positively related with willingness to be involved in curriculum development, it is assumed that willingness to be involved also decreases with age.

From the empirical results, it was indicated that younger learners had more positive attitudes towards and they were more willing to be involved in curriculum development than older learners.

Therefore, it can finally be concluded that younger, rather than older, senior secondary school learners in the Northern Province are eager and willing to be involved in curriculum development.

#### **6.4.2.2 *Research problem 2: influence of gender***

Previous research based on this variable has revealed significant differences between learners' attitudes towards biology between the two genders. Amongst

others, it was found that girls had more positive attitudes towards biology than boys but that the latter were more ready to be involved, particularly in classroom activities (and possibly curriculum development) than girls. Girls' willingness to be involved was often related to the social relevance of the subject content.

From the empirical results, it was found that in the Northern province, girls more than boys, were positive with regard to being involved in curriculum development - however this was discovered as a trend only.

Therefore, it may be hypothesised that girls in the senior secondary schools in the Northern Province may be more positive than boys towards being involved in curriculum development in biology.

#### **6.4.2.3      *Research problem 3: influence of grade***

Previous research has revealed significant differences in attitudes towards biology among learners of various grades. Generally, the attitudes of learners towards science (biology) decrease as learners progress from lower grades to higher grades. In accordance, one would expect the willingness to be involved in curriculum development, to decrease also.

However, from the results of the empirical study, no significant difference in average attitudes towards involvement in curriculum development was found between learners from grades 10, 11 and 12. However, there was a trend for grade 11 learners becoming more positive than grade 12 learners. Therefore, it may be hypothesised that learners in lower grades in the senior secondary schools in the Northern Province have more positive attitudes towards involvement in curriculum development than learners in higher grades.

#### **6.4.2.4 Research problem 4: influence of school type**

Some studies found no significant differences between attitude towards science in learners from diverse school types - let alone involvement in curriculum development. Others found significant differences in the attitudes of learners from different school types towards biology in general or some specific biology content, in particular. For example, learners in rural schools are less positive towards biology than those in city and special schools. This would probably influence their willingness to be involved in curriculum development.

The results of the present study revealed a significant difference in average attitude towards involvement in curriculum development between learners from different school types. Learners from rural schools had the least positive attitudes and those from the ex model C schools had the most positive attitudes towards involvement in curriculum development.

Therefore, it can be concluded that learners from senior secondary rural schools in the Northern Province are generally less eager to be involved in curriculum development than learners from special (private) and urban (ex model C) schools. This may be because they are from disadvantaged schools and do not feel they have the power to make such decisions.

#### **6.4.3 Final conclusions with regard to research problems focusing on biology content for grade 10 learners**

##### **6.4.3.1 Research problems 5 & 6**

Specific biology content in grade 10 may influence attitudes towards biology. This is especially true for *human anatomy and physiology* and possibly *plant biology*.

In general, the following conclusions can be made based on previous research and the results of the empirical results. Learners in grade 10 biology:

- prefer the study of *human anatomy and physiology* to the other topics for grade 10
- are least interested in studying *angiosperm physiology* of all the biology topics.

#### **6.4.3.2      *Research problem 7***

When age was considered, a final conclusion is that:

age influences preferences for particular learning content in biology. For example, younger learners in grade 10 in the Northern Province prefer the study of *human anatomy and physiology* more than older learners in grade 10. It may be because older learners have already obtained this knowledge.

#### **6.4.3.3      *Research problem 8***

Gender also influences preferences in school curricula in biology. It was found that grade 10 girls in the Northern Province are significantly more positive than grade 10 boys towards human anatomy and physiology. This is in accordance with findings in literature and may be attributed to the nurturing role of the female in society or to their more advanced physical development in grade 10.

#### **6.4.3.4      *Research problem 9***

Generally, from the review of the literature and the results of the empirical study, it is clear that learners' attitudes towards involvement in curriculum development and the specific biology content differ significantly from one school type to another. The following conclusions are made for grade 10 learners in the Northern Province:

- grade 10 learners from rural schools are more positive towards the study of *cytology, angiosperm physiology* than learners from other school types

- learners from ex model C schools are more positive towards studying *human anatomy* than learners from rural schools, and
- learners from private schools are more positive towards studying *human anatomy and physiology* than ex model C school learners.

#### **6.4.4 Final conclusions with regard to research problems focusing on biology content for grade 11 learners**

##### **6.4.4.1 Research problem 10 & 11**

Specific biology content in grade 11 may influence attitudes towards biology.

From the literature review and the results of the present study generally, the following content seem to be least preferred by grade 11 learners in the Northern Province: *microbiology and plant biology*. In contrast they prefer *human reproduction and genetics*.

Although they prefer genetics, there is a negative correlation between attitude towards this content area and involvement in curriculum development. They may experience aspects of it as difficult and want to be involved to eliminate these topics.

##### **6.4.4.2 Research problem 12**

Age influences preferences in curriculum content. Regarding grade 11 learners in the Northern Province: older learners prefer *genetics* and *human reproduction* more than younger learners. Genetics is a difficult topic for many learners and may be too difficult to understand for the younger learners.

#### **6.4.4.3      *Research problem 13***

Gender may influence attitudes of learners towards specific biology content areas although significant differences were not found for learners in the Northern Province.

Despite this, the following are stated as hypotheses:

- boys are more positive than girls towards the study of genetics, human reproduction and plant biology;
- girls are more positive towards *micro-biology* and *animal biology* than boys.

The abovementioned may be influenced by the fact that the boys' preferences may correlate with career options that they may want to follow, such as medicine and perhaps Agricultural Science.

#### **6.4.4.4      *Research problem 14***

School type influences content preferences. The following conclusions can be made:

- learners in all school types differ significantly with regard to their attitudes towards *human reproduction*, *plant biology* and *genetics*
- rural school learners are most positive towards *genetics*, *human reproduction* and *plant biology*.

However, the possible influence of the halo effect needs to be kept in mind.

#### **6.4.5 Final conclusions with regard to research problems focusing on biology content for grade 12 learners**

##### **6.4.5.1      *Research problem 15 &16***

Significant relationships between learners' attitudes towards involvement in curriculum development and specific biology content in grade 12 were established by the research.

In general, the following topics are listed from most important to least important for grade 12 learners in the Northern Province:

- homeostasis
- metabolism
- organic compounds and nutrients
- plant water relations
- population dynamics

Thus learners most dislike the study of *population dynamics* followed by *angiosperm physiology (plant water relations)*.

##### **6.4.5.2      *Research problem 17***

Age influences content preferences. Older learners in grade 12 in the Northern Province appear to be less comfortable with homeostasis and angiosperm physiology than younger learners. This may be because these learners of 19 years and older are those who have previously failed and are thus struggling with learning. Learners of 16 years are more positive towards organic compounds than those that are younger. In this instance it may be that the younger group is too young for such an abstract topic. The way in which this topic is taught may be a source of serious contention among learners.

#### **6.4.5.3      *Research problem 18***

Although there is a trend for girls in grade 12 in the Northern Province to prefer organic compounds and metabolism more than boys, the differences are not significant. This means that the attitudes of girls and boys towards specific biology content may be similar.

#### **6.4.5.4      *Research problem 19***

With regard to school type, no significant difference in attitude towards specific content was established for grade 12 learners in private and rural schools in the Northern Province. This means that learners from the two school types had similar attitudes towards various topics in biology. There was, however, a trend for learners from rural schools to be more positive than learners from private schools. This may be the influence of a halo effect among rural school learners.

### **6.5      DISCUSSION AND CONCLUSIONS**

A review of the literature and of the results of this study on the attitudes of secondary school learners towards involvement in curriculum development and specific biology content has revealed important information that indicates the need to involve learners in curriculum development.

The major conclusions from both reviews indicate that in a number of cases significant relationships and differences exist between the variables in question. In other examples, certain trends were discovered. These are very important as they indicate how diverse learners and their interests are.

#### **6.5.1      Involvement in curriculum development**

The results of previous research and of the present study confirm the need for learners to be involved in curriculum development. This aspect is new in

education. All along learners were regarded as having nothing to contribute towards the curriculum they are involved on a daily basis. This has created a situation where learners saw themselves only as extras in education whose role was to receive instruction passively.

However, the following factors have been associated with learners' willingness to be actively involved:

- (a) Subject content must be appealing to learners, interesting and enjoyable, simple, relevant, important and more practical to learners.
- (b) The relationship between the educators/curriculum developers and learners should be based on negotiation rather than imposition.
- (c) Learning should be a tool for personal development and empowerment rather than for grades.
- (d) The methods of instruction should be in terms of how much a learner is allowed the freedom to be involved and to contribute.
- (e) The conditions of the learning environments may also include the home as the primary educational milieu.

Apart from the abovementioned, the following need to be kept in mind by curriculum developers:

- No significant differences were found with regard to attitude towards curriculum development for gender. This means that girls and boys have similar attitudes towards involvement in curriculum development although there was a trend for *girls*, more than *boys*, to be willing to be involved, particularly on issues that appear to be of social relevance.

- With regard to grade, it was shown that the attitudes of learners towards involvement in curriculum development decreased as they progressed through different grades. Therefore, learners who are young and also in lower classes, are more eager to be involved than learners in higher classes.
- With regard to age, younger learners, especially girls, are more positive towards involvement in curriculum development than older learners. This may be due to the fact that young learners who, by virtue of their age, are entering or are in the middle of adolescence may be co-operative or enthusiastic enough to want to discover things on their own. Older learners may be too preoccupied with passing matric and preparing for their adult lives.
- Learners in diverse school types differ with regard to attitude towards involvement in curriculum development: learners from rural schools are most negative while ex model C school learners are most positive towards involvement in curriculum development. The differences in learners' attitudes for the various school types may be attributed to: different parental levels of education and diverse attitudes towards the education of their children.

### **6.5.2 Curriculum content**

Research has revealed the important influence of curriculum content. Compared to other subjects, biology has been portrayed as the science subject preferred by the majority of learners. This could be because a lot of the content is interesting, understandable and relevant.

However, certain content areas or some aspects thereof in biology have been associated with the development of negative attitudes towards the subject. In

addition, the following are influential for the development of negative attitudes in learners:

- misconceptions in biology education
- a too great emphasis on textbook
- low level of cognitive development leading to misunderstanding of science (biology)
- content which is irrelevant.

**6.5.2.1      *Research problems focusing on involvement in curriculum development and specific biology content of grade 10 learners in the Northern Province***

There is a significant correlation between grade 10 learners' attitudes towards involvement in curriculum development and their attitudes towards *human anatomy and physiology*. These learners prefer this topic to all the others, especially the learners of 15 years or less as well as the girls. Learners from previously model C schools are also more positive towards the study of anatomy than learners from rural schools, but less positive than learners from private schools. Other differences between grade 10 learners from diverse school types also exist, indicating how diverse grade 10 learners are.

**6.5.2.2      *Research problems focusing on involvement in curriculum development and specific biology content of grade 11 learners in the Northern Province***

From the analysis of the results based on this variable, a significant correlation was found between learners' attitudes towards involvement in curriculum development and towards *genetics*. However, the relationship is low and negative. This means that grade 11 learners may not be comfortable with the study of all aspects of genetics. Genetics has been portrayed as a difficult topic. The difficulty of the topic could be caused by the mode of instruction,

misconceptions that learners may hold about it, learners' levels of cognitive development and the textbooks that are used. Other authors indicated that the difficulty of the topic could be the result of structures taught about it which are microscopic while the genetic concepts may be too abstract.

However, grade 11 learners nonetheless rated *human reproduction* and genetics as their most favourite topics. Regarding genetics, 18 year and older learners are more positive towards this study than younger learners. Regarding human reproduction, 16 and 17 year old learners are less positive towards this study than those who are 18 years and older.

Results also indicate that learners may not be comfortable with the study of microbiology and plant biology. The topics could be too difficult and learners may not see the importance of studying them, either. This situation may be attributed to the load of terminology contained in these topics, which may be abstract and therefore, too difficult because learners have not yet achieved the abstract reasoning capacity to cope with micro-systems.

Moreover, a closer look into the grade 11 biology syllabus reveals that this syllabus mainly concentrates on a taxonomic bias, the situation which, has been associated with difficulty. For example, the syllabus may lay too much emphasis on the study of *pteridophytes, bryophytes, spermatophytes, amoeba, hydra, locusts, lizards, et cetera*. The syllabus also appears to be heavily loaded with content so that for the educators to sort out content of significance to learners such as *genetics, protein synthesis, et cetera* may not be easy.

**6.5.2.3      *Research problems focusing on involvement in curriculum development and specific biology content of grade 12 learners in the Northern Province***

The results have revealed a low but positive relationship between grade 12 learners' attitudes towards involvement in curriculum development and *population dynamics*, but not for the other topics in grade 12 biology.

However, the results of the rank order analysis revealed that learners most preferred *homeostasis* and least preferred *population dynamics*. This could be attributed to their evaluation of the relevance of these topics.

Age influenced content preferences of grade 12 learners in the Northern Province. For example, the results of this study indicate that *organic compounds and nutrients* may be a simple topic, particularly for younger learners (of 15 years) in grade 12. The way in which the topic was taught could have positively influenced learners' attitudes towards it. For younger learners, experiments on *food tests* and related issues could be a very exciting thing. However, previous research indicated that the *chemistry* necessary for this aspect of biology could be too difficult for the majority of learners although at the same time also important.

Younger learners (of 17 years) in grade 12 appear to prefer *homeostasis* more than older learners. This topic may be difficult while it is also important. Learners of 17 years could have reached the cognitive capacity that enables them to handle highly abstract issues better than younger learners. They are therefore able to understand how homeostasis relates to their own bodies and lives so that they may feel positive towards its study. However, learners of 19 years and older are old for their grade and may be struggling to complete their school years. These learners may then be negative towards the study of homeostasis.

Similarly, the results of the present study also indicate that 18 year old learners in grade 12 express more positive attitudes towards the study of *plant water relations* than those of 19 years and more. Thus, it can be concluded that topics such as osmosis, plasmolysis and transpiration may be difficult topics for the oldest learners who are anxious to complete their school years.

Absence of significant differences in attitudes towards involvement in curriculum development and specific biology content with regard to gender and school type, indicate that these learners may feel similar towards these topics. However, the fact that there is a trend for girls to be more positive towards *organic compounds and nutrients* and *metabolism*, while boys preferred *population dynamics*, *homeostasis* and *angiosperm physiology* may be described as the function of both feminine and masculine inclinations of learners. Both metabolic processes and organic compounds and nutrients appear to go together as having something to do with nutrition, which may have more appeal to girls than to boys. On the other hand, the study of population dynamics, homeostasis and angiosperm physiology includes the manipulation of numbers and shapes in the form of graphical representations and thus may have more appeal for boys.

## **6.6 IMPLICATIONS AND RECOMMENDATIONS FOR FUTURE CURRICULA DEVELOPMENT**

The present biology syllabi are burdened with too many facts and terminology. However, according to Papenfus (1995:60), the biology that is taught to learners at schools may be fragments that are selected from the academic disciplines. The basis for the selection of such content is probably three-fold as follows:

- the developers of the biology curriculum are concerned with requirements that will keep the academic status of biology on par with that of physics and chemistry
- the universities demand that the nature and structure of the academic discipline should be reflected in the school biology syllabus

- the developers of biology curricula want learners to be appropriately prepared to further their studies at universities and technikons.

However, given as they are, the reasons for developing the biology curricula could be invalid. For example, very few matriculants enrol for further studies in biological sciences at universities and technikons. Furthermore, biology may not be a requirement for admission of candidates to any of the biological sciences. Instead, mathematics and physical science are prerequisites. Therefore, it is clear that a mismatch exists between the biology syllabi and the purpose for which they are designed. It can further be argued that the present biology syllabi may have had other concerns or reasons for their development apart from those mentioned above.

Therefore the biology curricula may not be relevant for our secondary school learners. Therefore, Papenfus (1995:62) has suggested the use of a combination of models that will give attention to bio-ethics, bio-technology, bio-social issues, human ecology and natural history. This should include the curriculum of an affective, learner-centred model as proposed by this study. Gathering information about learners preferences with regard to subject content before attempting to develop a curriculum for them is a very important stage in curriculum development. In the present study this was achieved by means of a questionnaire in which learners had to indicate their preferences. The reasons for these preferences were probably due to difficulty, interest and perceived relevance of the content. In this way it was determined which content learners appreciate. It is recommended that future curriculum development should be based on this model.

Treating learners as people with the power to contribute towards curriculum development will yield significant results in designing the biology curriculum that will not only empower learners, but also enhance the development of positive attitudes towards biology.

There is a lot of diversity among biology learners, as illustrated by the responses of the learners of the Northern Province. This confirms the need to involve learners in curriculum development.

#### **6.6.1 Implications of and recommendations for learner involvement in curriculum development**

The literature has emphasised increased learner participation also in roles of decision-making. If outcomes are identified first, (as in OBE) content can be selected by involving learners to achieve these outcomes. As a way of empowerment for personal development and emancipation, greater learner participation in curriculum development may result in learners' attitudes becoming more positive towards learning and education generally.

The finding that *younger* more than *older learners*, particularly *girls* in *lower grades* who are at *ex model C* schools are most eager to be involved in curriculum development also has important implications for the science (biology) educator. *Older male* learners in *higher grades* at *rural* schools are less eager to be involved in curriculum development. For these learners the educator may need to apply *co-operative* strategies in teaching and learning. In this way learners may be motivated to become involved in curriculum development. This involvement is necessary to ensure relevant curricula that are useful to learners.

Therefore, by increasing the educator's awareness of the diversity among learners and the role that learners should play in curriculum development, a substantial improvement in learners' attitudes towards science in general and more especially towards biology may be obtained. It is also necessary that the before mentioned should be part of educator pre-service and in-service training. Educators should be trained in how to involve learners of all ages, genders and school types in curriculum development.

## **6.6.2 Implications of and recommendations regarding learners' attitudes towards specific biology content**

The identification of topics of interest, relevance and difficulty for learners in biology clearly has implications for teaching and curriculum development. The difficulty of biology topics as perceived by learners may be a major factor in their willingness to learn it. This is despite how easy the educator may see the topic to be because it is the learner who must indicate whether the topic is easy or difficult.

Data were collected using learners in grades 10-12. The findings and implications are systematically given below.

### **6.6.2.1 *Implications regarding learners' attitudes towards specific biology content in grade 10***

The identification of *human anatomy and physiology* as the topic grade 10 learners most enjoy and *angiosperm physiology* as a topic these learners least enjoy has implications for teaching and curriculum development. Consequently, it would be appropriate to retain *human anatomy and physiology* in the grade 10 biology syllabus. It is possible that the topic may be simple for learners to understand, particularly *younger* learners. It seems also that learners are able to identify themselves better with the study of *human anatomy and physiology* than *angiosperm physiology* and, as such, the topic may be interesting and relevant for the majority of learners in this grade.

### **6.6.2.2 *Implications regarding learners' attitudes towards specific biology content in grade 11***

The analysis of the results based on the preferences for diverse topics in grade 11 indicates that they prefer the study of *human reproduction* and thereafter *genetics*. They least prefer the study of *micro-organisms*. Even though aspects

of genetics are very difficult to understand, learners still see this topic as interesting and relevant. However, based on the degree of difficulty of the topic in relation to the age of learners in grade 11, it may also be worthwhile to consider continuing the study of genetics in grade 12. In this regard, learners need to be consulted.

### **6.6.2.3      *Implications regarding learners' attitudes towards specific biology content in grade 12***

The results of the rank order analysis indicate that the attitudes of learners towards biology were most positive with *homeostasis and metabolism* and least positive with *population dynamics*.

Population dynamics may be a complicated concept for the majority of learners in grade 12. *Homeostasis* has been isolated as the least difficult and most important topic by previous authors. However, although *metabolism* (photosynthesis, nutrition, digestion and respiration) are topics of difficulty, learners have probably rated them high because of their importance and relevance.

The abovementioned have important implications for teaching and curriculum development in science (biology) education. It needs to be kept in mind that, for example, rural learners were more positive towards population dynamics than private school learners. Thus learners need to be involved in curriculum development - what is relevant to some may not be relevant to others.

## **6.7      LIMITATIONS OF THE STUDY**

This study has attempted to address an educational issue that has been seriously neglected in science (biology) educational practice and research in South Africa. A research project focusing on the involvement of learners in curriculum development should be seen as a positive contribution towards educational research since very little has been done in this regard in South Africa.

However, it is important to indicate that despite the findings presented above, the study had certain limitations. The following will serve as examples.

### **6.7.1 Sampling**

The population of this study consisted of grade 10-12 learners across the various school types that exist in the Northern Province. However, results of this study in respect of learners, especially for grade 12, (where ex model C learners were excluded because they were writing their matric examinations) may not easily be generalised to the whole population of learners in the Northern Province. Secondly, not all learners from different cultural groups took part in this study. Thus, the sample of the present study may be described as more homogeneous than the population of learners in the Northern Province.

### **6.7.2 Data collection**

The collection of data took place at the time when grade 12 learners had to sit for the final examinations. Consequently, grade 12 learners from ex model C schools did not take part because of the matriculation examinations that were underway during that time. However, this timing was intentional as much data was based on grades 10-12 syllabi. Therefore, in order to give sincere responses, care had to be taken that all learners had sufficiently covered their respective syllabi.

Moreover, data collection was only done quantitatively (by means of questionnaires). To enhance this with qualitative data by means of observations and interviews, would have been worthwhile. This is true in particular because it seems as if the halo effect may have played a role so that some learners may have portrayed their attitudes towards topics more positively than what they really are.

## 6.8 RECOMMENDATIONS FOR FUTURE RESEARCH

- A contradiction between the results of the present study and findings from previous research regarding girls' attitudes towards the study of plants or animals, warrants further investigation.
- On the basis of the limitations of this study as discussed in section 6.8, it may be unwarranted to conclude that the results as reported can be generalised towards the whole Northern Province or towards all South African learners. The sample was not representative in terms of school type for grade 12 learners. Thus, a replication of this study with a more representative sample would be advisable.
- Learners from other provinces in South Africa also need to be included. Therefore, replicating this study with a sample drawn from across the country would be advisable.
- Other research methods which include qualitative data collection techniques, should also be used in similar research endeavours.
- Research should be done on the various methods of involving learners in curriculum development - and, ultimately, what the effects of these are.
- Research should also be done on the implications of learner involvement in curriculum development on external examinations at the end of grade 12.
- Finally, if learners are involved in curriculum development, research should be conducted to reveal information on the short-term and long-term effects of this involvement. This would reveal important information for future involvement of learners in curriculum development.

## **6.9 CONCLUSION**

This research has demonstrated that there is considerable diversity in interest among biology learners, especially if age, grade, gender or type of school is considered. This diversity needs to be considered in curriculum development. The only way to do this is to involve learners in curriculum development. This can be accommodated within OBE.

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**Grade 10**

Hi, my dear learner

Welcome to the biology game of words and statements.

This is not a TEST but a questionnaire for which you already have all the correct answers.

Kindly read the directions for the whole questionnaire very quickly as laid out below and stick to them throughout.

Remember your responses are strictly confidential.

**PART A: DIRECTIONS FOR THE REST OF THE QUESTIONNAIRE**

A The aim of this questionnaire is to gather information about your feelings as a biology learner. The questionnaire contains statements that probe how you have felt in your biology class since the beginning of the year. Therefore, there are no RIGHT or WRONG answers. Your opinion is all that is wanted.

B Think about how well each statement describes the way you feel about your **role as a biology learner** and the way the **various topics in biology** appeal to you in terms of relevance, difficulty and importance.

C Answer each question by writing down the appropriate number in the square on the right. The numbers have the following meaning:

- 5 Strongly agree
- 4 Agree

- 3 Not sure
- 2 Disagree
- 1 Strongly disagree

D Provide your response to each statement truthfully.

E Indicate your answer by means of a **dash** using a HB pencil on the number of the correct answer, next to the question number.

For example: 1. [ 1 ] [ 2 ] [ 3 ] [ 4 ] or [ 5 ]

F Start from PART 2 and do not write anything above the red lines.

G Begin your questionnaire by giving the following personal information:

- 1. Age: (in years)
- 2. Gender:     Girl = 1  
                  Boy = 2
- 3. Grade:     10 = 1  
                  11 = 2  
                  12 = 3
- 4. School type: Rural = 1  
                  Model C = 2  
                  Private = 3

H Please do not write your name.

I Thank you for your co-operation.

**PART B: LEARNERS' VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT**

5. I wish I could be part of deciding what we should learn in biology.
6. I feel that as a learner I have nothing to contribute towards the selection of biology topics.
7. Many biology topics would not have been in the syllabus if we as learners were involved in their selection.
8. It is unnecessary to alter the biology topics in the syllabus because of the influence of learners.
9. I feel I must be involved in everything that concerns biology.
10. It is unnecessary to consult me when decisions are taken regarding the content that I learn.
11. Learners should make suggestions about the selection of biology syllabus topics.
12. Some biology content is irrelevant to me because I was not consulted when the topics were selected.
13. Biology will continue to be boring as long as we as learners are not consulted.
14. I wish I could be allowed to contribute towards selecting content for biology.
15. Experts make only good decisions on biology content.
16. I am unwilling to participate in curriculum matters in biology.
17. It is unimportant to involve learners in the selection of biology topics.
18. I want to give my opinion about the biology that I learn.
19. Involving learners in the choice of biology topics will make the study of biology worse.
20. Experts select too many biology topics.
21. Experts select topics that makes studying biology satisfying.
22. Experts choose irrelevant content.
23. I like teachers who involve us in making choices about the topics in biology.

24. It would be a good thing if we as learners were encouraged to express our feelings about what we learn in biology.
25. I wish I had an opportunity to take part in the selection of biology topics.
26. I do not care who is responsible for the selection of the content in biology.
27. Biology would be more interesting if we as learners, were allowed to select content.
28. Experts select biology topics that will help me understand my environment.
29. I can think of topics that should be included in biology but are omitted.
30. Learners are unable to make important choices of biology content.
31. The biology that we learn will remain irrelevant until learners are also involved in the selection of topics.
32. It would be boring if learners were included in content selection for biology.
33. Only experts can prescribe which content we should learn in biology.
34. Learners know too little biology to be consulted about the selection of topics.

**PART C: LEARNERS' ATTITUDES TOWARDS VARIOUS BIOLOGY CONTENT**

35. I find all topics in grade ten biology interesting.
36. I would like to follow a career in biology.
37. I do not like lessons that are based on ecology.
38. The study of ecology has helped me understand my environment better.
39. Some terms in grade ten biology are difficult to understand.
40. I see more value in studying ecosystems.
41. I think that ecology should be studied in grade twelve and not grade ten.
42. It is interesting to learn about the biotic and abiotic factors.
43. Learning about symbiosis is boring.
44. I do not see a reason why I should study ecosystems.
45. Learning about relationships within ecosystems is interesting.
46. The study of trophic levels in ecology is very important.

47. Learning about the recycling of nutrients is very important and relevant.
48. I do not like nature conservation.
49. Topics like pollution of air, water and land are important for grade ten learners.
50. I do not see the relevance of cell study in grade ten.
51. I can pass any examination based on the study of cells.
52. I find learning about plastids (chloroplasts, leucoplasts and chromoplasts) enjoyable.
53. I feel that knowledge of the process of mitosis is relevant in grade ten.
54. I think that the study of cells is relevant in grade ten.
55. The study of plant and animal tissues is really difficult.
56. Maybe learners in grades eleven and twelve can enjoy the study of tissues.
57. Learners in grade ten should have knowledge about tissues.
58. I do not like to learn anything more about connective tissues.
59. It is only the study of neurons that makes feel positive about biology.
60. I prefer lessons that are based on meristematic tissues.
61. I feel that the study of xylem and phloem is very important.
62. I enjoy learning about plant roots.
63. The study of roots is relevant in grade ten.
64. It is not easy to distinguish between monocotyledonous and dicotyledonous plant stems.
65. I think it is necessary to learn about the cross sections of the stems.
66. I do not understand why I should learn about roots in grade ten.
67. I think that the study of the internal structures of roots and stems should be done in grade eleven or twelve.
68. I understand why I should learn about the internal structure of the leaves.
69. The study of flowers in grade ten is boring.
70. It is necessary to learn about the different parts of the plants.
71. I hate to learn about the epithelial tissues.
72. The study of various tissues makes me like biology.

73. I do not think the study of animal tissues will make me understand biology.
74. The biology that deals with animal tissues is very difficult.
75. I often enjoy lessons based on human muscles.
76. The study of human muscles should be done in lower grades.
77. I want to learn more about the nervous system.
78. I find the study of the human skeletal system very interesting.
79. Learning about the different types of bones in the human skeleton is boring.
80. I feel that the study of the different types of bones in the human skeleton should take place in grades eleven and twelve.
81. I do not like to learn about various joints in the human skeleton.
82. It is interesting to learn about how the various body muscles work.
83. The study of the human heart and how it functions is irrelevant in grade ten.
84. It was not necessary for me to learn about the blood circulatory system in grade ten.
85. The study of blood vessels is very difficult.
86. I think that the lymphatic system is difficult for grade ten learners.
87. The process of cell division is important in life.
88. I enjoy the study of cell division.
89. I feel that I should learn everything about cell division in grade ten.
90. Cell division is a difficult process.

**SUMMARY OF THE QUESTIONNAIRE INDICATING EACH VARIABLE:****GRADE 10****GENERAL (04)**

1; 2; 3; 4

**VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT (30)**

<b>POSITIVE ( + )</b>	<b>NEGATIVE ( - )</b>
5; 7; 9; 11; 12; 13; 14; 18; 20; 22; 23; 24; 25; 27; 29; 31.	6; 8; 10; 15; 16; 17; 19; 21; 26; 28; 30; 32; 33; 34.

**ECOLOGY (15)**

35; 36; 38; 40; 42; 45; 46; 47; 49	37; 39; 41; 43; 44; 48
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**CYTOLOGY (9)**

51; 52; 53; 54; 87; 88; 89	50; 90
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**HISTOLOGY (7)**

57; 59; 60; 61	55; 56; 58
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**ANGIOSPERM PHYSIOLOGY (9)**

62; 63; 65; 67; 68; 70	64; 66; 69
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**HUMAN ANATOMY AND PHYSIOLOGY (16)**

72; 75; 77; 78; 82;	71; 73; 74; 76; 79; 80; 81; 83; 84; 85; 86
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**TOTAL ITEMS: 90**

**Grade 11**

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- B Think about how well each statement describes the way you feel about your **role as a biology learner** and the way the **various topics in biology** appeal to you in terms of relevance, difficulty and importance.
- C Answer each question by writing down the appropriate number in the square on the right. The numbers have the following meaning:

5 Strongly agree

- 4 Agree
- 3 Not sure
- 2 Disagree
- 1 Strongly disagree

D Provide your response to each statement truthfully.

E Indicate your answer by means of a **dash** using a HB pencil on the number of the correct answer, next to the question number.

For example: 1. [ 1 ] [ 2 ] [ 3 ] [ 4 ] or [ 5 ]

F Start from PART 2 and do not write anything above the red lines.

G Begin your questionnaire by giving the following personal information:

- 1. Age: (in years)
- 2. Gender:     Girl = 1  
                  Boy = 2
- 3. Grade:     10 = 1  
                  11 = 2  
                  12 = 3
- 4. School type: Rural = 1  
                          Model C = 2  
                          Private = 3

H Please do not write your name.

I Thank you for your co-operation.

**PART B: LEARNERS' VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT**

5. I wish I could be part of deciding what we should learn in biology.
6. I feel that as a learner I have nothing to contribute towards the selection of biology topics.
7. Many biology topics would not have been in the syllabus if we as learners were involved in their selection.
8. It is unnecessary to alter the biology topics in the syllabus because of the influence of learners.
9. I feel I must be involved in everything that concerns biology.
10. It is unnecessary to consult me when decisions are taken regarding the content that I learn.
11. Learners should make suggestions about the selection of biology syllabus topics.
12. Some biology content is irrelevant to me because I was not consulted when the topics were selected.
13. Biology will continue to be boring as long as we as learners are not consulted.
14. I wish I could be allowed to contribute towards selecting content for biology.
15. Experts make only good decisions on biology content.
16. I am unwilling to participate in curriculum matters in biology.
17. It is unimportant to involve learners in the selection of biology topics.
18. I want to give my opinion about the biology that I learn.
19. Involving learners in the choice of biology topics will make the study of biology worse.
20. Experts select too many biology topics.
21. Experts select topics that makes studying biology satisfying.
22. Experts choose irrelevant content.
23. I like teachers who involve us in making choices about the topics in biology.

24. It would be a good thing if we as learners were encouraged to express our feelings about what we learn in biology.
25. I wish I had an opportunity to take part in the selection of biology topics.
26. I do not care who is responsible for the selection of the content in biology.
27. Biology would be more interesting if we as learners, were allowed to select content.
28. Experts select biology topics that will help me understand my environment.
29. I can think of topics that should be included in biology but are omitted.
30. Learners are unable to make important choices of biology content.
31. The biology that we learn will remain irrelevant until learners are also involved in the selection of topics.
32. It would be boring if learners were included in content selection for biology.
33. Only experts can prescribe which content we should learn in biology.
34. Learners know too little biology to be consulted about the selection of topics.

**PART C: LEARNERS' ATTITUDES TOWARDS THE VARIOUS BIOLOGY CONTENT**

35. I enjoy learning about cell division.
36. Genetics is an interesting topic in biology.
37. Knowledge of mitosis is important.
38. Knowledge of meiosis is irrelevant for grade 11 learners.
39. Understanding genetics is meaningless for grade 11 learners.
40. Some aspects such as mutations make genetics unnecessarily difficult.
41. Predicting generations in grade 11 genetics is irrelevant.
42. Protein synthesis should be excluded from grade 11 biology.
43. Genetics is an important part of grade 11 biology.
44. The study of genetics makes biology difficult.
45. I think that genetics is an important section in grade 11 biology.
46. Grade 11 learners can understand genetics.

47. I find the process of DNA replication interesting.
48. I feel that learning about heredity is relevant for learners in grade 11.
49. I dislike learning about human sex determination in biology.
50. Sex determination in Mendelian genetics is too difficult for grade 11 learners.
51. Learning about small organisms such as chlamydomonas is enjoyable.
52. It is important to learn about fungi.
53. The study of viruses is irrelevant.
54. I understand why I should learn about algae in grade 11.
55. Learning about spirogyra is irrelevant.
56. I hate to learn about very small organisms.
57. I find learning about very small plants boring.
58. The study of very small organisms is irrelevant in grade 11.
59. Learning about viruses in grade 11 is enjoyable.
60. I think that learning about bacteria is unimportant.
61. Learning about rhizopus is boring.
62. Reproduction as it occurs in small animals and plants is meaningless for a grade 11 learner.
63. The study of bacteria is important.
64. Knowledge obtained from the study of hydra is useless.
65. It is important for grade 11 learners to know how amoeba reproduces.
66. Learning about the life cycles of plants is important.
67. I like to study about nutrition in plants.
68. Learners in grade 11 should have a clear understanding of reproduction in plants.
69. Studying pines may help me in future job opportunities.
70. I enjoy learning about pollination in plants.
71. Learning about flowers in grade 11 is meaningless.
72. It is boring to learn about flowers.
73. The study of flowers is relevant for grade 11 learners.
74. The Biology that deals with plant reproduction is unimportant.

75. I feel that the study of plants is irrelevant to me.
76. Learning about ferns is irrelevant for learners in grade 11.
77. It will be boring to continue learning about moss in grade 11.
78. Knowledge of respiration in plants is uninteresting.
79. The process of reproduction. in plants are meaningless.
80. Photosynthesis is an important process to understand.
81. It is important that learners in grade 11 learn about the tapeworm.
82. Grade 11 learners should learn about earth worms.
83. I understand my environment better because of my knowledge of snails.
84. Studying crabs is irrelevant.
85. It is relevant for grade 11 learners to learn about locusts.
86. Learning about crabs is boring.
87. There should be no Greek or Latin words in animal biology.
88. It is important that grade 11 learners to learn about frogs.
89. In future, the department of education should avoid topics that are based on the study of lizards.
90. It is irrelevant to learn about locusts.
91. Learning about nutrition as it takes place in the various animals is boring.
92. Learning about blood circulation in animals is boring.
93. I enjoy learning about the process of homeostasis in warm and cold-blooded animals.
94. Learning about respiration in animals is boring.
95. There are better topics on animals for grade 11 biology than we have now.
96. I enjoy the study of human reproduction.
97. I hate lessons that are based on human reproduction.
98. I feel that the study of human fertilisation is unimportant in grade 11.
99. Learning about reproduction in humans is meaningless.
100. Human reproduction should be excluded from biology.
101. I enjoy studying about the formation of sperm and egg cells.
102. I fail to understand why I should learn about the menstrual cycle.

103. The study of human reproduction makes me understand my body.
104. Learning about the structures of the male and female reproductive organs is relevant.
105. Knowledge of the role of hormones in reproduction is irrelevant.

**SUMMARY OF THE QUESTIONNAIRE INDICATING EACH VARIABLE:****GRADE 11****GENERAL (04)**

1; 2; 3; 4

**VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT (30)**

<b>POSITIVE ( + )</b>	<b>NEGATIVE ( - )</b>
5; 7; 9; 11; 12; 13; 14; 18; 20; 22; 23; 24; 25; 27; 29; 31.	6; 8; 10; 15; 16; 17; 19; 21; 26; 28; 30; 32; 33; 34.

**GENETICS (16)**

35; 36; 37; 43; 45; 46; 47; 48	38; 39; 40; 41; 42; 44; 49; 50
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**MICRO-BIOLOGY (15)**

51; 52; 54; 59; 63; 65	53; 55; 56; 57; 58; 60; 61; 62; 64
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**PLANT BIOLOGY (15)**

66; 67; 68; 69; 70; 73; 80	71; 72; 74; 75; 76; 77; 78; 79
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**ANIMAL BIOLOGY (15)**

81; 82; 83; 85; 88; 93	84; 86; 87; 89; 90; 91; 92; 94; 95
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**HUMAN REPRODUCTION (10)**

96; 101; 103; 104	97; 98; 99; 100; 102; 105
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**TOTAL ITEMS: 105**

**Grade 12**

Hi, my dear learner

Welcome to the biology game of words and statements.

This is not a TEST but a questionnaire for which you already have all the correct answers.

Kindly read the directions for the whole questionnaire very quickly as laid out below and stick to them throughout.

Remember your responses are strictly confidential.

**PART A: DIRECTIONS FOR THE REST OF THE QUESTIONNAIRE**

- A The aim of this questionnaire is to gather information about your feelings as a biology learner. The questionnaire contains statements that probe how you have felt in your biology class since the beginning of the year. Therefore, there are no RIGHT or WRONG answers. Your opinion is all that is wanted.
- B Think about how well each statement describes the way you feel about your **role as a biology learner** and the way the **various topics in biology** appeal to you in terms of relevance, difficulty and importance.
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H Please do not write your name.

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**PART B: LEARNERS' VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT**

5. I wish I could be part of deciding what we should learn in biology.
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7. Many biology topics would not have been in the syllabus if we as learners were involved in their selection.
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10. It is unnecessary to consult me when decisions are taken regarding the content that I learn.
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16. I am unwilling to participate in curriculum matters in biology.
17. It is unimportant to involve learners in the selection of biology topics.
18. I want to give my opinion about the biology that I learn.
19. Involving learners in the choice of biology topics will make the study of biology worse.
20. Experts select too many biology topics.
21. Experts select topics that makes studying biology satisfying.
22. Experts choose irrelevant content.
23. I like teachers who involve us in making choices about the topics in biology.

24. It would be a good thing if we as learners were encouraged to express our feelings about what we learn in biology.
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26. I do not care who is responsible for the selection of the content in biology.
27. Biology would be more interesting if we as learners, were allowed to select content.
28. Experts select biology topics that will help me understand my environment.
29. I can think of topics that should be included in biology but are omitted.
30. Learners are unable to make important choices of biology content.
31. The biology that we learn will remain irrelevant until learners are also involved in the selection of topics.
32. It would be boring if learners were included in content selection for biology.
33. Only experts can prescribe which content we should learn in biology.
34. Learners know too little biology to be consulted about the selection of topics.

**PART C: LEARNERS ATTITUDES TOWARDS THE VARIOUS BIOLOGY CONTENT**

35. I enjoy learning about organic compounds and nutrients in biology.
36. Nutrients should be removed from the grade 12 biology syllabus.
37. The study of micro- and macro-nutrients makes biology too difficult.
38. Learning about the structural characteristics of lipids, carbohydrates and proteins is unnecessary in grade 12.
39. It is relevant to learn about vitamins in grade 12 biology.
40. It is boring to learn about vitamins.
41. Studying enzymes is meaningless.
42. I enjoy studying co-enzymes
43. It is important to learn about the structural formulae of carbohydrases and other nutrients.
44. It is relevant to learn chemical formulae in biology.

45. It is important to learn about proteins in grade 12.
46. Studying lipids is meaningless.
47. I feel it is unimportant for grade 12 learners to learn about carbohydrases.
48. Studying the characteristics of enzymes is irrelevant.
49. Enzymes should be excluded from grade 12 biology.
50. It is important that learners in grade 12 learn about vitamins.
51. I find the learning about the process of photosynthesis interesting.
52. Photosynthesis is relevant to grade 12 learners.
53. There is a direct link between what I learn in photosynthesis and what I come across everyday after school.
54. Studying respiration is important in grade 12.
55. Learning about the process of glycolysis is relevant.
56. The study of respiration is important in grade 12.
57. Learning about the Krebs cycle is meaningless.
58. Terminal oxidative phosphorylation makes my study of biology enjoyable.
59. Glycolysis should be excluded from the biology curriculum.
60. Learning about alcoholic fermentation is relevant.
61. It is unnecessary that the digestive system be studied in grade 12.
62. I think learning about the structure of the respiratory system is important.
63. Studying exactly how fat is absorbed in the small intestine is boring.
64. It is unimportant that gaseous exchange be studied by learners in grade 12.
65. The mechanisms of inhalation and exhalation are relevant for us in grade 12.
66. Studying metabolism is meaningless.
67. Osmosis is an interesting topic in biology.
68. I enjoy learning about topics such as plasmolysis.
69. The experiments based on the relationships between plants and water are interesting.
70. Knowledge of how water moves up the stem is unnecessary.
71. It is unnecessary to have knowledge of the process of transpiration in grade 12.

72. Knowledge of the factors that influence transpiration is relevant in grade 12.
73. Gestation is an important topic in grade 12.
74. Plant hormones should be studied in grade 12.
75. Experiments to illustrate phototropism are useless.
76. Lessons on transpiration are boring.
77. It is a waste of time learning about the structures of excretory system.
78. Learning about the nervous system is meaningless.
79. The nervous system is irrelevant to a grade 12 learner.
80. I dislike learning about the human brain.
81. Only learners who want to become medical doctors should study the human brain.
82. The negative feedback mechanism as brought about by the nervous system is interesting.
83. Studying the endocrine system should be removed from the grade 12 syllabus.
84. I dislike studying the various glands.
85. It is quite interesting to learn about how insulin brings about the normal blood sugar level in humans.
86. I enjoy learning about the various sense organs.
87. I understand how the cerebellum brings about balance in humans.
88. I feel it is necessary to learn about co-ordination for homeostasis in grade 12.
89. It is irrelevant to learn about temperature regulation as it occurs in man.
90. The study of poikilothermic (cold-blooded) organisms is unnecessary.
91. The process to regulate the level of sugar in the blood should be excluded from biology.
92. I feel that learning about homeostasis in grade 12 biology is important.
93. Population dynamics is a relevant topic in biology.
94. The study of population dynamics is important.
95. The use of graphs in population dynamics is unnecessary.
96. I think that population dynamics is meaningless for grade 12 learners.

97. Studying population dynamics is boring.
98. Learning about population regulation is relevant.
99. Studying population dynamics is irrelevant in grade 12.
100. Some important topics like human population should be included in grade 12.
101. Population dynamics should be reserved for those learners who wish to get employment in nature conservation.
102. Graphs make the study of population dynamics easier.
103. Learning about survival strategies is relevant and important to me.

**SUMMARY OF THE QUESTIONNAIRE INDICATING EACH VARIABLE:  
GRADE 12**

**GENERAL (04)**

1; 2; 3; 4
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**VIEWS ON INVOLVEMENT IN CURRICULUM DEVELOPMENT (30)**

POSITIVE (+)	NEGATIVE (-)
5; 7; 9; 11; 12; 13; 14; 18; 20; 22; 23; 24; 25; 27; 29; 31.	6; 8; 10; 15; 16; 17; 19; 21; 26; 28; 30; 32; 33; 34.

**ORGANIC COMPOUNDS AND NUTRIENTS (16)**

35; 39; 42; 43; 44; 45; 50	36; 37; 38; 40; 41; 46; 47; 48; 49
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**METABOLISM (16)**

51; 52; 53; 55; 56; 58; 60; 62; 65	54; 57; 59; 61; 63; 64; 66
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**PLANT WATER RELATIONS (10)**

67; 68; 69; 72; 73; 74	70; 71; 75; 76
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**HOMEOSTASIS AND RELATED TOPICS (16)**

82; 85; 86; 87; 88; 92	77; 78; 79; 80; 81; 83; 84; 89; 90; 91
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**POPULATION DYNAMICS (11)**

93; 94; 98; 102; 103	95; 96; 97; 99; 100; 101
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**TOTAL ITEMS: 103**